OAKLAND COUNTY
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Oakland County Campus Energy Assessment

2025

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Renewable Opportunities

Steam Plant Decommissioning Report

Final Electrification Implementation Plan

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Oakland County Energy Plan

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Final Initial Study Findings Memo

In 2021, Oakland County (“the County”) set a goal to achieve net-zero carbon emissions by 2050 with an interim benchmark of 50% carbon emission reduction by 2035. To support achieving these goals, AECOM is conducting an energy study of 36 County owned and operated facilities in the main campus area managed by Facilities Management. In April 2025, AECOM conducted audits to better understand the operations and energy usage of these facilities. The findings from that site visit and Deliverable 1: Current Load and Capacity Reports are summarized in this memorandum. See Deliverable 1 for more detailed findings on each building.

Executive Summary

Purpose

The purpose of the Energy Plan is to identify and quantify opportunities that can provide energy, cost, and emissions savings and then compile those opportunities into a cost-effective and actionable approach to project implementation. Before identifying those opportunities, AECOM must first establish a baseline and better understand the existing building operations and conditions. Projects regarding electrification of buildings, decommissioning of the steam plant, and development of on-stie renewable energy will all rely on a strong foundation of understanding the electrical headroom and existing gas-fired equipment in the existing building and campus infrastructure. This memorandum summarizes the findings from the Load and Capacity Reports to establish that baseline understanding.

Site Visit

Over the course of approximately two weeks from April 7, 2025, to April 22, 2025, mechanical, electrical, and energy engineers reviewed 36 buildings on the Oakland County Campus. Engineers inventoried existing electrical, mechanical, and natural gas systems and conditions at each facility with particular attention to gas-fired HVAC equipment and non-LED lighting. Engineers collected information relevant to the electrification planning process supported by a pre-site visit utility analysis and drawing review. Engineers completed an energy audit of the facilities using thermal imaging, equipment inventory, and building controls review to develop opportunities for energy conservation measures (ECMs) in each building. The site visit also served to collect information on how the building is used such as required setpoints and operational hours so that recommendations do not contradict operational needs.

Key Takeaways

The following are the key takeaways from the site assessment. The composition, condition, and age of building equipment and infrastructure will help to inform upcoming recommendations for ECMs and decarbonization projects. The prioritization of projects can be informed by equipment’s condition and end of life.

- Facilities with the highest EUIs were Children's Village Kitchen, Sheriff's Admin, Animal Control, and the Courthouse.
- Building utility metering can be improved significantly. This applies to electric, steam, and natural gas. Electric demand for nearly all facilities was estimated based on usage and overall demand patterns of the site.
- Of the 36 facilities visited, only Children's Village G and H Buildings had fully light-emitting diode (LED) lighting throughout. Continued conversion to LEDs throughout the campus will help to lower energy usage.
- Of the 36 buildings, 15 were heated with steam. Steam enters buildings at 120 psi and then is reduced and converted to hot water via shell and tube heat exchangers. The remainder of buildings that were not on steam were provided heat from gas-fired boilers, furnaces, and rooftop units. None of the facilities had fully electrified systems although there were some isolated mini-split systems.
- The age and condition of HVAC equipment was typically fair with limited equipment in significant disrepair or past its useful life.
- Twenty three of the 36 facilities are supported by back-up generators.
- Significant sources of waste heat loads were identified in the Information Technology building.
- Domestic hot water was typically provided by gas-fired boilers or, for those buildings connected to the central steam plant, by steam heat exchangers. Six of the facilities had electric domestic water heaters.
- Electrical infrastructure typically had significant headroom. Only four facilities were noted to have less than 50% headroom. These facilities would be more likely to require electrical upgrades to decarbonize, although additional analysis is needed.
- The facilities had a mixture of Aveva, Kors, and Niagara building automation systems. The County is in the process of converting to Niagara. There was a relatively equal mix of DDC and pneumatic controls throughout the campus. In buildings that did have BAS, not all equipment was necessarily connected to the BAS. Approximately half of buildings had constant air volume.
- Building exteriors condition and age varied by building. The majority of buildings had original, single-pane windows, especially those in the Children's Village.
- Commonly identified ECMs include conversion of lighting to LED, installation of lighting occupancy sensors, testing and balancing, boiler retrofits, VFD retrofits, updated control sequences, retrofit of pneumatic controls with DDCs, and added heat recovery.
- Commonly identified decarbonization measures include conversion to heat pumps and addition of solar PV.
- There were no major common end user complaints identified during the site walkthrough. However, some of this may be due to non-optimized HVAC operations, which included simultaneous heating and cooling in some buildings, which can be highly wasteful, but ensures occupant comfort.
- Potential barriers or complications to projects included space constraints in mechanical rooms, moving occupants during construction, funding and prioritization of deferred maintenance projects that may be necessary to achieve full energy savings, and uncertainty on the future of some facilities.

Recommendations for 12 East, 26 East, 34 East, 55 West, 41 West, 43 West, and 47 West are caveated with the understanding that the buildings are in the County's plans to be vacated, re-occupied, sold, or potentially decommissioned. This may render some of the identified projects and ECMs not required or change the recommendations depending on the requirements of new occupants. AECOM also understands that the Children's Village is currently undergoing a master plan that may impact space uses and space requirements.

Utility Analysis

Prior to going on site, AECOM collected utility data and conducted a desktop review. In 2024, total campus-wide utility consumption was approximately 255 million kBtu. Electricity usage accounted for approximately 88 million kBtu, steam

accounted for 162 million kBtu, and natural gas use totaled approximately 167 million kBtu. These figures represent the combined energy use across all metered buildings within the project scope included in the utility dataset.

Gaps in utility data were identified across two buildings: 51 West is missing meter information for steam and natural gas and 30 East is missing natural gas data. 73 West is missing natural gas, while 75 West is missing natural gas and electricity. However, it is assumed that these buildings share utility meters with 71 West and 77 West, which are adjacent facilities within the Children's Village complex.

Electric Rate Summary

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy, and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. This arrangement accurately distributes the cost of electricity consumption, but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand but high usage are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge: **$6.15/kW/Month**

Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

Natural Gas Rate Summary

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electric, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: **$1.33/MCF (1000 cubic feet or approximately 10 therms)**

Constallation NG Usage Charge (fixed Fee): **$3.48/dTh (decatherm, or 10 therms)**

Constallation NG Usage Charge (Day Gas): **$5.29/dTh (decatherm, or 10 therms)**

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for (16) separate buildings. The steam plant received natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings.

Existing Campus Infrastructure

The substations building main services are supplied by DTE cable poles PS-8138 and PS-8139 circuits at 13200V double-ended switchgear located in the main electrical room. The metal clad primary switchgear is rated 13.2kV, 1200A, 3-phase Main-Tie-Main bus. It is made by Westinghouse type DHP ID #56Y4083. This switchgear services most Oakland County buildings and they are split to North campus and South campus. Each service is supplied by one DTE meter (DE-10011871 for the North campus and DE-10011841 for the South campus). Each main feeder has a power meter (EATON IQ Analyzer).

We took various readings from these meters during our visit. We recorded the highest amperage reading of 215A on the South main breaker and 74A on the Norh main breaker. Spot readings were taken from the meters, and they varied from 8A to 34A. The substation has 6 breakers fed by 2 DTE feeders (A & B). DTE feeder A service feeds the South feeder loops “A”, “C”, and “E”, where DTE feeder B service feeds the North feeder loops “B”, “D”, and “F”. Each building is fed from 2 feeder loops for redundancy and reliability. **The peak demand readings from DTE meters indicate significant additional capacity for electric delivery to the campus, with less than 20% of the rated substation capacity being used. Based on these values, it is unlikely that the electrical substation will require upgrades for building electrification.** The County noted that the campus’s underground conductors are past their useful life. Aging underground conductors may present issues for reliability and resilience regardless of whether building electrification occurs, but capacity upgrades are not thought to be needed.

Central Heating Plant

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for (16) separate buildings across the site. Low pressure stead is generated and distributed across the site by the following equipment:

- 2x 30,000 lbs/hr steam boiler, original to building in 1947
- 1x 72,000 lbs/hr steam boiler, installed in 1972

During the site visit it was noted by the boiler operators that the two 30,000 lbs/hr boilers can no longer operate at full capacity. It was also noted that the steam distribution system operates with approximately 15% losses on average.

AECOM obtained data from the Building Automation System (BAS) for the Central Heating Plant that outlined the natural gas and steam consumption at each boiler, and at each building the plant serves. This data was provided in the form of monthly totals; thus a peak heating load could not be determined. However, based on conversations with the boiler operators, the peak heating load on the plant is estimated to be approximately **27,000 lbs/hr**, indicating that there is available boiler capacity to support all heating and DHW loads.

The steam boilers operate continuously throughout the year. This is primarily due to the DHW loads that the steam system serves. During the summer months (1) of the smaller boiler operates, with the lead boiler switching every 2-3 week. In winter all boilers operate as needed to meet heating loads. The higher-than-expected natural gas utilization in the summer months may be partially attributed to the two absorption chillers on campus, at the Courthouse and the Sheriff’s Administration building.

Outlined below is the monthly natural gas consumption and steam generation at the boilers, as outlined in the BAS data, for 2024. The load profiles for both gas consumption and steam generation are closely aligned, as would be expected. The largest discrepancy between the profile is seen in October and November. This may be attributed to faulty steam meters that were corrected for December

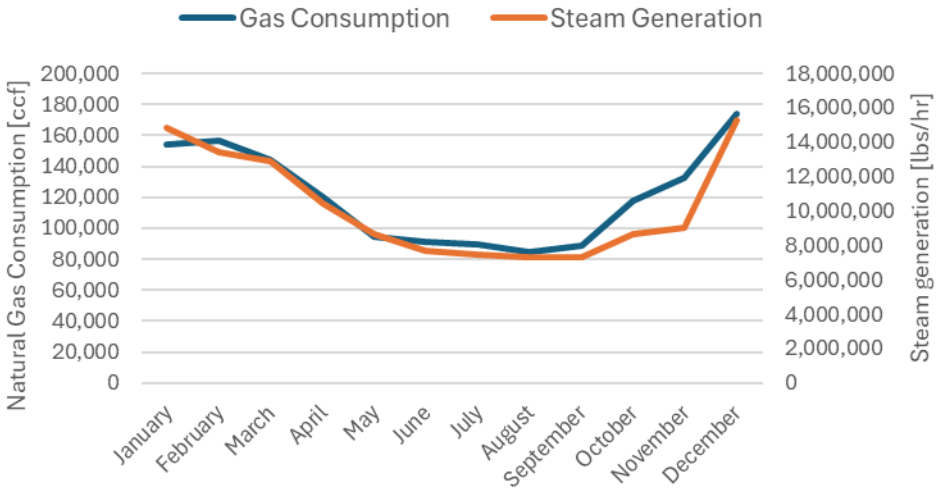

Figure 1: Boiler Gas Consumption and Steam Generation

When assessing the annual data, BAS trends indicated the following annual natural gas consumption and steam generation:

- Annual Gas Consumption = 147,724,254 MBH
- Annual Steam Generation = 127,978,408 MBH

This data indicates that the boiler operates at an efficiency of 87%. It would be expected that the steam boiler will operate at approximately 80% efficiency when operating optimally, thus this value appears to be high. When verifying the natural gas metered consumption against natural gas utility bills, there is alignment, thus it can be concluded that the steam meters at the boilers are likely slightly out of calibration, however, the data provides a reasonable guide to the annual steam load profile.

Facilities

AECOM evaluated the facilities' current operations, inventoried the gas equipment, reviewed the buildings' capacity for electrification, and identified opportunities to reduce their consumption and emissions. The following table summarizes the utilities serving the building and key findings. For more detail, see Deliverable 1, a detailed current load and capacity report for each building.

Table 1. Summary of Findings

County ID	Building	Utilities Serving				Findings (Equipment, Lighting Type, etc.)
		E[1]	NG	S	D	
47 West	Admin Annex I	•	•		•	Electric domestic water heater Building has no equipment running on steam ; was converted 20+yrs ago. Usage could be either due to leakage in the system, or poor calibration on the meter Sufficient remaining electric capacity. 200 kW generator

[1] E: Electricity, NG: Natural Gas, S: Steam, D: Diesel

County ID	Building	Utilities Serving				Findings (Equipment, Lighting Type, etc.)
		E[1]	NG	S	D	
18 East	Admin Annex II	•		•		Lighting Type: Fluorescent & LED lights LED exit signs, non-LED exit sign Steam to hot water heating HVAC systems operate 24/7. No central BAS. Sufficient remaining electric capacity.
42 East	Animal Control	•	•		•	Building constructed in 2018 Packaged natural gas-fire heating units VAVs Energy recovery units Fully DDC with BMS Limited remaining electric capacity. 500 kW generator
16 East	Central Garage	•		•	•	Lighting Type: Fluorescent & LED lights, LED exit signs, non-LED exit sign, T5 HO, HID Aged air handling unit No BAS. 80 kW generator Sufficient remaining electric capacity.
22 East	Central Heating	•		•	•	Lighting Type: Mix of Fluorescent & LED fixtures 250 kW generator Houses the central steam plant and its two boilers.
20 East	Central Services	•		•		Lighting Type: Mix of Fluorescent,& LED fixtures Steam to hot water heating Window AC units not connected to BAS. Sufficient remaining electric capacity.
65 West	Children's Village A Building	•	•			70 kW natural gas generator
71 West	Children's Village B Building	•	•			Lighting Type: Mix of Fluorescent,& LED fixtures Supplied heat via steam and generator power from Building C.

County ID	Building	Utilities Serving				Findings (Equipment, Lighting Type, etc.)
		E[1]	NG	S	D	
						Constant volume. Pneumatic controls.
73 West	Children's Village C Building	•	•		•	Lighting Type: Mix of Fluorescent & LED fixtures Steam boiler AHU at end of life. Pneumatic controls. Sufficient remaining electric capacity. 180 kW generator supporting 71 West.
77 West	Children's Village D Building	•	•		•	Lighting Type: Mix of Fluorescent,& LED fixtures Natural gas boiler VAVs 154 kW generator supporting 75 West Sufficient remaining electric capacity.
81 West	Children's Village G Building	•	•		•	Lighting Type: LED fixtures Natural gas boiler One old AHU Sufficient remaining electric capacity. 60 kW generator
83 West	Children's Village H Building	•	•		•	Lighting Type: LED fixtures Natural gas boiler Pneumatic controls Sufficient remaining electric capacity. 154 kW generator
63 West	Children's Village J Building	•	•			Lighting Type: Mix of Fluorescent,& LED fixtures Natural gas condensing boilers. Constant volume Pneumatic controls Sufficient remaining electric capacity. 85 and 175 kW natural gas generators

County ID	Building	Utilities Serving				Findings (Equipment, Lighting Type, etc.)
		E[1]	NG	S	D	
85 West	Children's Village Kitchen	•	•		•	Lighting Type: Mix of Fluorescent,& LED fixtures Natural gas boiler Electric domestic hot water. All kitchen controls are DDC Sufficient remaining electric capacity. 100 kW generator
87 West	Children's Village School	•	•			Lighting Type: Mix of Fluorescent,& LED fixtures Natural gas boilers Pneumatic controls with zone thermostats at end of life. Sufficient remaining electric capacity.
12 East	Courthouse	•	•	•		Lighting Type: Mix of Fluorescent,& LED fixtures Steam to hot water heating No VAV systems Sufficient remaining electric capacity
8 East	East Annex	•	•		•	Lighting Type: Mix of Fluorescent,& LED fixtures 22-year old gas-fired boilers in good condition 355 kW generator. Sufficient remaining electric capacity.
41 West	Executive Office Building	•	•	•	•	Lighting Type: Mix of Fluorescent,& LED fixtures 350 kW generator Sufficient remaining electric capacity.
49 West	Information Technology	•		•	•	Lighting Type: Mix of Fluorescent,& LED fixtures Steam to hot water heating. CRAC units in data center. Sufficient remaining electric capacity. 600 kW generator
10 East	Law Enforcement Complex	•	•	•	•	Lighting Type: Mix of Fluorescent,& LED fixtures Steam to hot water heating

County ID	Building	Utilities Serving				Findings (Equipment, Lighting Type, etc.)
		E[1]	NG	S	D	
						No VAV systems Limited remaining capacity 545, 335, and 90 kW generators
30 East	Little Oaks	•		•		Sufficient remaining electric capacity.
32 East	Resource & Crisis Center	•	•		•	Lighting Type: Fluorescent fixtures Renovated HVAC in 2012 Steam to hot water heating VAVs 600 kW generator Limited remaining electric capacity.
38 East	Sheriffs Admin	•	•	•	•	Lighting Type: Mix of Fluorescent,& LED fixtures Steam to hot water heating. VAVs Sufficient remaining electric capacity. There is natural gas to this facility, used for incinerator 300 kW generator
36 East	Pontiac Health Building	•		•		Steam to hot water heating. Electric domestic water heater
24 East	D Building	•	•			Lighting Type: Mix of Fluorescent,& LED fixtures This building is no longer in operation.
75 West	Children's Village Counseling Center	•	•			Lighting Type: Mix of Fluorescent,& LED fixtures Gas-fired furnaces. No BMS. Supported by generator at 77 West
28 East	Medical Examiners Facility	•	•		•	Lighting Type: Mix of Fluorescent,& LED fixtures Natural gas-fired steam boiler provides heat. VAVs 200 kW generator

County ID	Building	Utilities Serving				Findings (Equipment, Lighting Type, etc.)
		E[1]	NG	S	D	
						Sufficient remaining electric capacity.
34 East	North Oakland Health Center	•		•	•	Lighting Type: Mix of Fluorescent,& LED fixtures Steam to hot water heating. Old AHUs Small electric domestic hot water heat in addition to supplied by steam to hot water heat exchanger Fully DDC with BMS 450 kW generator Sufficient remaining electric capacity.
26 East	North Office Building	•		•		Lighting Type: Mix of Fluorescent,& LED fixtures Steam to hot water heating. Electric domestic water heater. AHUs beyond EUL. Sufficient remaining electric capacity.
Pontiac	Materials Management	•	•		•	Lighting Type: Mix of Fluorescent,& LED fixtures Gas-fired unit heaters No BAS. Sufficient remaining electric capacity. 125 kW generator.
57 West	Patrol Services	•	•			Lighting Type: Mix of Fluorescent,& LED fixtures Gas-fired package unit and gas boiler. Gas furnace was not functional. No BMS. Sufficient remaining electric capacity.
95 West	Public Works Building	•	•		•	Lighting Type: Mix of Fluorescent,& LED fixtures Gas-fired rooftop unit. AHUs at end of life. 360 kW generator. Limited remaining electric capacity

County ID	Building	Utilities Serving				Findings (Equipment, Lighting Type, etc.)
		E[1]	NG	S	D	
43 West	Farmer's Market	•	•			Natural-gas fired duct furnaces. Natural ventilation with no cooling Electric domestic hot water heater Sufficient remaining electric capacity.
55 West	*Easterseals*	•		•		
51 West	Credit Union	•	•			Gas-fired rooftop units. No BMS. Sufficient remaining electric capacity.
59 West	Road Commission Complex	•		•		Gas furnaces and gas-fired rooftop units. Constant volume. No BMS. Sufficient remaining electric capacity.

Next Steps

AECOM will use the information documented in this memorandum, received during the request for information, and collected during the site visit as a baseline understanding of the facilities' condition, capacity, and use. Findings from the site visit will be grouped into opportunities for the upcoming Opportunities Workshop. Upon completion of the workshop, AECOM will better define prioritized projects and ultimately phase the projects into decarbonization scenarios. In the next phase of work, AECOM will also deliver the ASHRAE audit reports, a steam plant decommissioning plan, and site-specific on-site renewable opportunities.

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Immediate Future Needs Memo

The Immediate Future Needs Memo (Deliverable 2) was developed to summarize the measures and projects that are recommended to be completed by Oakland County (the County) regardless of the broader pathway to decarbonization selected. These measures are agnostic of broader campus plans in development and focused on near-term measures or projects that can get started with limited planning. Some of the measures identified in this memo are to rectify inefficient operating conditions and should be considered prerequisites of future HVAC upgrades and retrofits. AECOM recommends taking steps to pursue the needs identified in this memo, while a broader decarbonization strategy is in development.

Executive Summary

AECOM conducted audits in April 2025 to better understand the operations, energy usage, and capacity of 36 County owned and operated facilities. This memo contains the immediate future needs of each facility identified during the audits. There are additional medium and long-term energy efficiency measures. These non-immediate measures may require more planning, financial investment, and have longer payback periods, but are highly recommended to enable a properly functioning decarbonized system. These additional measures may include transitioning to dual duct systems and transition from pneumatic controls to direct digital controls (DDC). The upcoming ASHRAE Level II audits (Deliverable 3) will include these measures. The upcoming Electrification Plan (Deliverable 5) will include projects related to electrification.

The measures in this Immediate Future Needs Memo generally fall into the following four categories of defined need:

Reducing Peak Electric Load

Certain energy reduction measures with defined payback periods such as conversion to more efficient light-emitting diode (LED) lighting are recommended for all facilities as a method of reducing the peak electric load of the facility. These types of energy reduction measures are to help ensure that HVAC electrification will not require electrical capacity upgrades in most facilities. These measures should be prioritized in facilities that are most likely to need electrical capacity upgrades. The four facilities that were estimated to be loaded over 50% of their capacity were Animal Control, Law Enforcement Complex, Resource and Crisis Center, and Public Works. For other facilities, these measures can continue to be implemented in a more gradual, phased approach (e.g., as light fixtures fail).

Improving Operational Efficiency

Low/no-cost retro-commissioning measures are recommended to improve the HVAC system's operational efficiency so that when electrification is eventually pursued (whether through centralized or decentralized pathways), the HVAC design load is reduced, and smaller equipment can be obtained. This may include updating setpoints, addressing leaks, configuring the building automation system (BAS), and calibrating sensors and controls.

End of Useful Life Upgrades

Old, inefficient equipment that is reaching its expected useful life (EUL) is more prone to sudden breakdowns. When equipment fails suddenly, especially during peak heating and cooling months, replacement in-kind can be rushed, rather than having the opportunity to consider electrification or more efficient equipment. Planning and budgeting for these replacements proactively can ensure that more efficient equipment is installed, and replacements are more thoughtful.

Reducing Steam Waste

These measures would improve the efficiency of the steam system and reduce steam waste. These low/no-cost solutions would have quick payback periods and not require major overhauls or investments. Based on it being unlikely that the steam plant is fully decommissioned prior to 2036, measures that have a return on investment (ROI) less than 10 years should be pursued. The more immediately the measures are enacted, the faster an ROI can be achieved prior to potential decommissioning. In addition to reducing natural gas usage, these measures will help reduce the steam load needed to support the buildings, which will allow for more accurate design of a centralized decarbonization solution and sizing of centralized equipment. Further investment in the steam system beyond these measures is contingent upon using the steam infrastructure in the decarbonization pathway (e.g., a centralized steam heat pump), or the timeline in which the County anticipates maintaining the system until decommissioning is possible.

Facility Summary

AECOM has identified opportunities to optimize existing operations within each facility that are low/no-cost and do not require upgrades to electrical infrastructure or major mechanical system renovations. **Table 1** summarizes these opportunities and should be considered by the County for immediate implementation.

Table 1. Immediate Opportunities by Building

Building and ID	Immediate Opportunities	Why Near Term
Admin Annex I (47 West)	- The fresh air supply system is malfunctioning and not properly integrated with the boiler burner. The supply fan should turn on whenever the combustion starts. Repair the fresh air supply system to the boiler room. - The uninterruptible power supply (UPS) room ventilation relies on the server room exhaust. Install dedicated ventilation to avoid overheating. - Balance the air distribution system and reduce the duct static pressure setpoint to reduce the fan power, and heating/cooling loads. - Update the control sequences of air handling units (AHUs) to optimize energy efficiency and better utilize free air side cooling. - There are three air-cooled chiller plants serving different zones. Update the control sequences to optimize each chiller plant. - The boilers are at the end of their EUL. A direct retrofit with a high efficiency condensing boiler is a viable near-term option if electrification isn't immediately pursued. - The heating hot water distribution pumps are constant volume and at the end of their EUL. Retrofit the pumps with variable frequency drive (VFD) pumps.	Identified projects reduce the peak heating demand and consequently will lower the capacity of future electric heating systems, however, the existing HVAC systems are outdated and major infrastructure improvements can significantly reduce the total building energy consumption. This building is a candidate for a deep-energy retrofit, which would be a complete overhaul of the existing systems. In this scenario, only rapid payback options should be considered such as retrocommissioning and controls optimization.

Building and ID	Immediate Opportunities	Why Near Term
	- Installation of heat recovery wheels on exhaust fans and on the AHUs with high exhaust rates is recommended, where possible. - The exhaust fans are constant volume, operating 24/7. Install new exhaust fans with VFD drives. These fans will reduce the fan power, assist balancing the building pressures, and reduce heating and cooling loads. - Some office spaces and mechanical rooms have low occupancy ratios. It would be feasible to install occupancy sensors in these zones. - During the audit, the outdoor lights were on during the day. Calibrate the photocell or timers to avoid wasteful lighting during the daytime.	
Admin Annex II (18 East)	- Retrocomissioning such as general setbacks and turning off equipment is recommended.	This building requires significant upgrades to increase overall efficiency. A larger planning process to determine HVAC retrofit options and begin planning process. For this reason, only rapid payback measures and repairs that impact safety and/or normal operation are recommended in this report.
Animal Control (42 East)	- Outside air temperature for rooftop units (RTUs) was inaccurate on at least one unit. The unit showed 45°F constant for the day. This inaccuracy may impact economization. Additionally, several energy recovery ventilators (ERVs) were not spinning according to the BAS. This setting may have been by design based on the supply air temperature setpoint, but the County should investigate to ensure the ERVs are working properly. There may be an issue with the sequence of operation, or it is possible the audit occurred on a mild day.	This is a new building and the primary strategy should be to optimize existing equipment and improve metering to better understand actual heating capacity requirements and to minimize electric replacement sizing.
Central Garage (16 East)	- Sections of the steam pipe in the basement were missing insulation. Adding insulation where missing will reduce heat loss and improve safety. - The AHU has a mixing plenum which takes heated air from the steam tunnel or outside air and mixes it with the space return air. The return air damper was stuck partially open, so it was not clear if it was functioning. Investigation and repair of the damper is recommended. - Repair holes in the mixed air plenum and insulation at AHU. - Initial planning for comprehensive HVAC, controls, and building envelope retrofit	This building requires significant upgrades to increase overall efficiency. A larger planning process to determine HVAC retrofit options and begin planning process. For this reason, only rapid payback measures and repairs that impact safety and/or normal operation are recommended in this report.

Building and ID	Immediate Opportunities	Why Near Term
Central Heating (22 East)	No immediate actions noted. Reference energy audit reports and electrification study for other recommended actions.	This building is identified for decommissioning as steam is phased out.
Central Services (20 East)	- Sections of the steam pipe in the basement were missing insulation. Adding insulation where missing will reduce heat loss and improve safety. - Most finned tube radiators (FTRs) had no covers. The County should install covers to prevent accidental burns from direct contact with the hot fins, and protect the finned tubes from dust, debris, and physical damage. Some covers also offer dampers for airflow control, allowing for heat output regulation and improved occupant comfort. - An exhaust fan (EF) was interlocked with the air intake damper. The fan was off, but the outside air intake damper was stuck in the open position. Repairing the damper is recommended. - Initial planning for comprehensive HVAC, controls, and building envelope retrofit	This building requires significant upgrades to increase overall efficiency. A larger planning process to determine HVAC retrofit options and begin planning process. For this reason, only rapid payback measures and repairs that impact safety and/or normal operation are recommended in this report.
Children's Village A Building (65 West)	Retrocomissioning such as general setbacks and turning off equipment is recommended.	This building requires significant upgrades to increase overall efficiency. A larger planning process to determine HVAC retrofit options and begin planning process. For this reason, only rapid payback measures and repairs that impact safety and/or normal operation are recommended in this report.
Children's Village B Building (71 West)	- Repair all steam traps and check condensate receiver tank. - Initial planning for comprehensive HVAC, controls, and building envelope retrofit	This building requires significant upgrades to increase overall efficiency. A larger planning process to determine HVAC retrofit options and begin planning process. For this reason, only rapid payback measures and repairs that impact safety and/or normal operation are recommended in this report.
Children's Village C Building (73 West)	- Repair all steam traps and check condensate receiver tank. - Some portions of the pipes in the mechanical room lack insulation. Adding insulation where missing will reduce heat loss and improve safety. - Initial planning for comprehensive HVAC, controls, and building envelope retrofit	This building requires significant upgrades to increase overall efficiency. A larger planning process to determine HVAC retrofit options and begin planning process. For this reason, only rapid payback measures and repairs that impact safety and/or normal operation are recommended in this report.

Building and ID	Immediate Opportunities	Why Near Term
Children's Village D Building (77 West)	- Upgrade or improve efficiency of windows. - Add insulation to the attic to reduce heat transfer. - Install occupancy sensors with daylight harvesting. - Perform hot water system capacity study to determine heating water temperature requirements.	Existing systems are suitable for use for electric heating infrastructure; however, additional investigation is needed to determine suitability of hot water piping, heating coils, and pumping systems to understand temperature requirements. Additional efficiency improvements are recommended here to reduce peak heating capacity.
Children's Village G Building (81 West)	- Insulate bare hot water pipes serving the AHU and domestic hot water (DHW) pipes in the mechanical equipment room to reduce heat loss and improve safety. - Retrofit restroom faucets with low-flow motion-activated faucets. - Retrofit AHU with a variable volume system. - Upgrade or improve efficiency of windows. - Add insulation to the attic to reduce heat transfer. - Upgrade pneumatic controls to DDC with BMS integration. - Install a timer controller on the DHW circulation pump to automatically turn off recirculation during off hours. Optionally, integration into the BMS system via DDC is recommended. - Perform hot water system capacity study to determine heating water temperature requirements.	Existing systems are suitable for use for electric heating infrastructure; however, additional investigation is needed to determine suitability of hot water piping, heating coils, and pumping systems to understand temperature requirements. Additional efficiency improvements are recommended here to reduce peak heating capacity.
Children's Village H Building (83 West)	- Insulate bare hot water pipes serving the AHU and DHW pipes in the mechanical equipment room to reduce heat loss and improve safety. - Retrofit restroom faucets with low-flow motion-activated faucets. - Retrofit AHU with a variable volume system. - Upgrade or improve efficiency of windows. - Add insulation to the attic to reduce heat transfer. - Upgrade pneumatic controls to DDC with BMS integration. - Install a timer controller on the DHW circulation pump to automatically turn off recirculation during off hours. Optionally, integration into the BMS system via DDC is recommended.	Existing systems are suitable for use for electric heating infrastructure; however, additional investigation is needed to determine suitability of hot water piping, heating coils, and pumping systems to understand temperature requirements. Additional efficiency improvements are recommended here to reduce peak heating capacity.

Building and ID	Immediate Opportunities	Why Near Term
	- Perform hot water system capacity study to determine heating water temperature requirements.	
Children's Village J Building (63 West)	- Install mixing valve on the supply side of the DHW tank. - Increase DHW storage temperature to 160°F. - The light levels in the basement corridor are too high. It is recommended to reduce lighting. - The HVAC equipment uses pneumatic control systems such as valve and damper actuators. Replace pneumatic controls with electric DDC. - The gym roof has no insulation and there are points of air leakage on the perimeter of the roof. Add insulation to the gym roof and seal air gaps to reduce heat transfer. - The AHU systems in the old block have no VFDs on the supply and return fans. Install variable air volume systems with VAV boxes. - Install VFDs on the heating hot water distribution systems. - Upgrade exhaust fan controls by linking them to the BMS. - Install air-side heat recovery where the AHUs have high exhaust ratios. - Perform hot water system capacity study to determine heating water temperature requirements.	Existing systems are suitable for use for electric heating infrastructure; however, additional investigation is needed to determine suitability of hot water piping, heating coils, and pumping systems to understand temperature requirements. Additional efficiency improvements are recommended here to reduce peak heating capacity.
Children's Village Kitchen (85 West)	- Repair leakage on the walk-in insulation and build a structure around it to protect it from ambient conditions and reduce heat gains. - Install Exhaust Energy Recovery Systems on AHUs. Install a heat recovery make-up air unit (MAU). - Perform hot water system capacity study to determine heating water temperature requirements.	Existing systems are suitable for use for electric heating infrastructure; however, additional investigation is needed to determine suitability of hot water piping, heating coils, and pumping systems to understand temperature requirements. Additional efficiency improvements are recommended here to reduce peak heating capacity.
Children's Village School (87 West)	- Implement heating outdoor air temperature reset on the heating hot water distribution (hot water reset). - Upgrade zone thermostats and link them to the BMS. - Reduce ventilation rates using demand control sensors (such as CO_2 sensors) when there is no occupancy in zones. This measure reduces the fan power, heating, and cooling loads. - Upgrade hot water circulation pumps with VFDs.	Existing systems are suitable for use for electric heating infrastructure; however, additional investigation is needed to determine suitability of hot water piping, heating coils, and pumping systems to understand temperature requirements. Additional efficiency improvements are recommended

Building and ID	Immediate Opportunities	Why Near Term
	- Retrofit RTUs with MAUs served by hot and chilled water coils with heat recovery options. - Recover energy from common area exhaust fans. - Add insulation to the roof to reduce heat transfer. - Upgrade or improve efficiency of windows. - Upgrade pneumatic actuators with electric actuators and link them to the BMS. - Perform hot water system capacity study to determine heating water temperature requirements.	here to reduce peak heating capacity.
Courthouse (12 East)	- The flow reading and the chiller capacity do not match. Calibrate chilled water flow meter. - Update equipment lists and schedule periodic monitoring and maintenance. - The cooling tower drifters are damaged and need to be replaced. - The piping above the cooling tower started to rust due to the deteriorating coating. Service the cooling tower piping and apply protective coating/painting. - Excessive air leakage was observed on the air distribution systems. Service AHU access doors and apply sealants to reduce air leakage on older AHU equipment. - Leaky steam traps were identified. The condensate return temperatures should not exceed 190°F during winter operation. Test and service all steam traps. - Install pressure reduction valves (PRVs) on the steam distribution system serving the coils in the AHUs and reduce the pressure setpoint from 8 psi to 1.5 psi. (This measure may not be an immediate need based on timing of projects.) - The sides of the coils in the roof mechanical room are not covered in the AHUs. Cover and seal the cooling coils on the AHUs located in the roof mechanical room in the tower. - The copper AHU coils are rusty and may pose health issues for the occupants. Clean all AHU coils and resurface the air mixing boxes to address health concerns. - Adjust setback temperatures:	Identified projects reduce the peak heating demand and consequently will lower the capacity of future electric heating systems, however, the existing HVAC systems are outdated, and major infrastructure improvements can significantly reduce the total building energy consumption. This building should undergo a complete retrocommissioning program, with a focus on controls optimization, which will help to identify specific systems and areas that require greater investment into HVAC retrofits. Areas identified as candidates for larger retrofits will require additional design and planning to fully understand the scope of project.

Building and ID	Immediate Opportunities	Why Near Term
	○ The winter mode setback setpoint 68°F for the auditorium is slightly high and should be reduced to 60°F and start preheating an hour earlier. ○ The summer mode setback setpoint of 60°F for the auditorium is slightly low and should be increased to 78°F and start precooling an hour earlier. ○ The winter setback setpoint for the East Wing is high. Reset from 70°F to 60°F. ○ The winter mode setback setpoint 68°F for the West Wing is slightly high and should be reduced to 60°F and start preheating an hour earlier. ○ The summer mode setback setpoint 60°F for the West Wing is slightly low and should be increased to 78°F and start precooling an hour earlier. - The baseboard heating return temperature reading is higher than the supply temperature reading. Calibrate the baseboard heating supply and return temperature sensors onto the Niagara System. - Install a temperature sensor on the baseboard heat exchanger condensate return pipe downstream of the steam trap. The temperature sensor should monitor the condensate temperature and send an alarm when the condensate return temperature exceeds 200°F, indicating a leaky steam trap. (This measure may not be an immediate need based on the timing of projects.) - Calibrate the outdoor air reset feature on the hot water distribution system on the Niagara System. The effective hot water set point is 188.5°F on a 55°F day. It is expected to have a lower temperature setpoint on mild days. The temperature setpoint can be adjusted upon trial-and-error method to ensure sufficient heating to all zones due to varying air distribution system. - The AC-1 outdoor air temperature sensor reading is 62.7°F and the global sensor reading is 57°F. Verify the global and AC-1 outside air temperature sensor readings' accuracy and calibrate, as necessary. Ensure that the AC-1 sensor is not exposed to direct sunlight at any time of the day. - Update the AHU economizer control algorithm. The AC-1 economizer enabling point is 65°F; however, the system is not in eco mode. If the outdoor air damper is 100% open, the return air damper should be closed 100% on eco mode. - The actuator arms at AC-0 serving the West Wing are not linked. Repair actuator arms.	

Building and ID	Immediate Opportunities	Why Near Term
	- The heating hot water circulation pumps are constant volume even though the zone temperature control valves control water flow on the perimeter fin tubes. Especially during shoulder seasons, when the zone fin tube radiator valves close, the hot water load reduces, and the velocity on main distribution pipes increases. The high velocity reduces pressure and causes noise due to cavitation. Install VFDs on heating hot water circulation pumps in the West Wing Extension. - Retrofit fluorescent lighting in the office spaces. The lighting systems have been partially upgraded to LED. Approximately 50% of the lighting upgrades in the tower are still being converted, depending on the engineering team's availability. It is recommended to replace the lights immediately in areas where no immediate architectural changes are expected. The measure is an immediate need if an electrical service upgrade is projected to be needed.	
East Annex (8 East)	- Insulate piping at DHW storage tanks. - Hot water system capacity study.	Existing systems are suitable for use for electric heating infrastructure.
Executive Office Building (41 West)	No immediate actions noted. Reference energy audit reports and electrification study for other recommended actions. Recommended to perform hot water system capacity study.	Existing systems are suitable for use for electric heating infrastructure.
Information Technology (49 West)	- The exhaust fan in the main power room was in manual mode and malfunctioning. Repair and link the exhaust fan to the BMS. - Hot water system capacity study.	Existing systems are suitable for use for electric heating infrastructure.
Law Enforcement Complex (10 East)	- Test and balance air distribution systems and reduce duct static pressure setpoints. - Reconfigure the condensate return system and avoid the steam trap submerge. - Install DHW preheat system with condensate return. - Test and repair leaky steam traps. - Install VFDs on heating hot water circulation pumps and optimize controls with sequence of operations. - Reduce heating enabling setpoint to 57°F and disable to 60°F. - Update control sequences of AHUs. - Optimize and update the control sequences of the chiller plant. - Install air side heat recovery where possible.	Identified projects reduce the peak heating demand and consequently will lower the capacity of future electric heating systems, however, the existing HVAC systems are outdated, and major infrastructure improvements can significantly reduce the total building energy consumption. This building should undergo a complete retrocommissioning program, with a focus on controls optimization, which will help to identify specific systems and areas that require greater investment into HVAC retrofits. Areas identified as candidates for larger retrofits will require additional design and

Building and ID	Immediate Opportunities	Why Near Term
	- Install lighting occupancy sensors in offices where applicable. - Upgrade exhaust fans with VFD-driven fans controlled by zone static pressure. - Retrofit high pressure sodium wall packs on roof with LEDs. - Convert dual duct air distribution systems to single duct. - Retrofit three water-cooled walk-ins using city water with air-cooled systems. - Retrofit three water-cooled air conditioning (AC) units using city water with mini splits (As an option, these zones can be added to the air distribution system during renovation). - Retrofit AC in the gym control booth with a split AC unit. - Connect the HV-9 to the BMS system. - Reset server room temperature setpoint to 76°F. - Replace filters more frequently. - The southwest garage switch gear room is excessively hot. It is recommended to upgrade the ventilation system. - The RTU intakes kitchen exhaust. It is recommended to divert the kitchen exhaust fan airstream far away from the AHU intakes. - Insulate bare hot water pipes serving the AHU and domestic hot water (DHW) pipes in the mechanical equipment room to reduce heat loss and improve safety. - Repair the steam trap serving the DHW heat exchanger. - Adjust the timer or photocell controlling the wall packs on the roof to ensure there is no wasteful lighting during the day. - Add insulation to the roof to reduce heat transfer. - Retrofit existing cooling tower pumps with high-efficiency variable speed pumps. - Install VFDs on the chilled and condenser water pumps.	planning to fully understand scope of project.
Little Oaks (30 East)	No immediate actions noted. Reference energy audit reports and electrification study for other recommended actions. Recommended to perform hot water system capacity study.	Existing systems are suitable for use for electric heating infrastructure.

Building and ID	Immediate Opportunities	Why Near Term
Resource & Crisis Center (32 East)	No immediate actions noted. Reference energy audit reports and electrification study for other recommended actions. Hot water system capacity study is recommended.	Existing systems are suitable for use for electric heating infrastructure.
Sheriffs Admin (38 East)	- Test and balance air distribution systems and reduce duct static pressure setpoints. - Reconfigure the condensate return system and avoid the steam trap submerge. - Install DHW preheat system with condensate return. - Test and repair leaky steam traps. - Install VFDs on the heating hot water distribution system. - Reduce heating enabling setpoint to 57°F and disable to 60°F. - Update control sequences of AHUs. - Optimize and update the control sequences of the chiller plant. - Retrofit pneumatic control valves with DDCs. Remove the compressed air system. - Install air side heat recovery where possible. - Install lighting occupancy sensors in offices where applicable. - Upgrade exhaust fans with VFD-driven fans controlled by zone static pressure. - Perform hot water system capacity study to determine heating water temperature requirements.	Existing systems are suitable for use for electric heating infrastructure; however, additional investigation is needed to determine suitability of hot water piping, heating coils, and pumping systems to understand temperature requirements. Additional efficiency improvements are recommended here to reduce peak heating capacity.
Pontiac Health Building (36 East)	No immediate actions noted. Reference energy audit reports and electrification study for other recommended actions. Perform hot water system capacity study to determine heating water temperature requirements.	Existing systems are suitable for use for electric heating infrastructure.
D Building (24 East)	No immediate actions noted. Reference energy audit reports and electrification study for other recommended actions. Perform hot water system capacity study to determine heating water temperature requirements.	Existing systems are suitable for use for electric heating infrastructure.
Children's Village Counseling Center (75 West)	No immediate actions noted. Reference energy audit reports and electrification study for other recommended actions.	Existing systems are suitable for use for electric heating infrastructure.

Building and ID	Immediate Opportunities	Why Near Term
Medical Examiners Facility (28 East)	- Natural gas fired Raypak DHW boiler is past its EUL. Replace with electric and downsize storage. - Adjust setback temperature. Controls are currently set to operate constantly 24/7. - Consider localized exhaust compared to larger units. May need sensors to determine how often exhaust fans need to run. - Retrocomissioning such as general setbacks and turning off equipment is recommended. - Perform hot water system capacity study to determine heating water temperature requirements.	Existing systems are suitable for use for electric heating infrastructure; however, additional investigation is needed to determine suitability of hot water piping, heating coils, and pumping systems to understand temperature requirements. Additional efficiency improvements are recommended here to reduce peak heating capacity.
North Oakland Health Center (34 East)	No immediate actions noted. Reference energy audit reports and electrification study for other recommended actions. Perform hot water system capacity study to determine heating water temperature requirements.	Existing systems are suitable for use for electric heating infrastructure.
North Office Building (26 East)	No immediate actions noted. Reference energy audit reports and electrification study for other recommended actions. Perform hot water system capacity study to determine heating water temperature requirements.	Existing systems are suitable for use for electric heating infrastructure.
Materials Management (Pontiac)	- Baseboard heaters in the office area and overhead heaters in the garage areas are not set back. - Look at setpoints for other energy conservation opportunities (e.g., turn off compressor at night). - There are FTR without covers in Central Services. The County should install covers to prevent accidental burns from direct contact with the hot fins, and protect the finned tubes from dust, debris, and physical damage. Some covers also offer dampers for airflow control, allowing for heat output regulation and improved occupant comfort. - The building was constructed as an uninsulated, unconditioned space, and AC was added later. Walls do not meet code for R value. Provide insulation on exterior walls and roof. - Provide interlocks to prevent heating when overhead doors are open.	Existing systems are suitable for use for electric heating infrastructure; however, additional investigation is needed to determine suitability of hot water piping, heating coils, and pumping systems to understand temperature requirements. Additional efficiency improvements are recommended here to reduce peak heating capacity.
Patrol Services (57 West)	- Repair Trane gas heat. - Repair BMS computer. - Perform hot water system capacity study to determine heating water temperature requirements.	This building has newer systems and the primary strategy should be to optimize existing equipment and improve metering to better understand actual heating capacity requirements and to minimize electric replacement sizing.

Building and ID	Immediate Opportunities	Why Near Term
Public Works Building (95 West)	Retrocomissioning such as general setbacks and turning off equipment is recommended.	This building requires significant upgrades to increase overall efficiency. A larger planning process to determine HVAC retrofit options and begin planning process. For this reason, only rapid payback measures and repairs that impact safety and/or normal operation are recommended in this report.
Farmer's Market (43 West)	No immediate actions noted. Reference energy audit reports and electrification study for other recommended actions.	Existing systems are suitable for use for electric heating infrastructure.
Easterseals (55 West)	*Under construction.*	
Credit Union (51 West)	No immediate actions noted. Reference energy audit reports and electrification study for other recommended actions.	Existing systems are suitable for use for electric heating infrastructure.
Road Commission Complex (59 West)	No immediate actions noted. Reference energy audit reports and electrification study for other recommended actions.	Existing systems are suitable for use for electric heating infrastructure, however there are many projects required to electrify the building and planning should begin immediately.

Campus-Scale Operational Recommendations

In addition to the immediate opportunities outlined above, several operational improvements could be made to the campus as a whole to reduce energy consumption. These include:

- Implement temperature setpoint setbacks for all HVAC zones during unoccupied hours. Align setpoints with building occupancy. Ventilation rates can be reduced by demand control sensors (such as CO_2 sensors) when there is no occupancy in zones. This measure reduces the fan power, heating, and cooling loads. Implementing temperature setbacks during unoccupied hours will reduce energy consumption without impacting occupant comfort.

- Windows in the Children's Village and Courthouse are single-pane and at the end of their useful life. The windows are drafty, impacting the thermal performance of the envelope. Replacing windows with modern double-pane windows, replacing weatherstripping, adding a window film, or installing window treatments are all ways to improve the heat transfer. This improvement allows heating and cooling loads to be reduced and improve occupant comfort. These improvements also allow new HVAC systems to be sized smaller than the original systems, limiting the impact of electrification on the electrical system.

- Establish a program for regular systematic inspection, testing, and repair of steam traps. A standardized reporting mechanism can both ensure thoroughness and provide a means of documenting energy and monetary savings. The DOE recommends that high-pressure traps (150 psig and above) are tested weekly to monthly, medium-pressure traps (30 to 150 psig) are tested monthly to quarterly, and low-pressure traps (below 30 psig) are tested annually.[1] In systems with a regularly scheduled maintenance program, leaking traps should account for less than 5% of the traps. The energy savings of maintenance programs can be realized immediately. Maintenance of the steam traps will also reduce the load on the steam boilers to support the County in better understanding the actual heat load of the buildings and support the design of a new centralized system.

[1] U.S. Department of Energy (2012). *Energy Tips: Steam.* https://www.energy.gov/sites/prod/files/2014/05/f16/steam1_traps.pdf

- Steam and hot water pipes were found to be uninsulated in many basements and mechanical rooms. A campus survey and rectification of missing insulation is recommended. This measure is a low-cost in-house energy savings mechanism that can also protect from pipe bursts in the winter and improve safety in crowded mechanical rooms.
- A regular survey of potential lighting improvements is recommended. The survey may include identifying malfunctioning photocells or timers, adding occupancy sensors in offices where installation make most sense, and transitioning to LED lighting in high-use areas. Measures to bring down the lighting load on a building leaves additional electric capacity for electrification.

Next Steps

The County should take action to address the identified immediate needs as soon as possible, especially those that may have longer payback periods. The following are additional next steps:

– Address immediate needs that can be easily done in-house through simple inspections of sequence of operations or malfunctioning equipment.

– Continue to replace overdue, inefficient HVAC equipment with modernized, efficient equipment with variable frequency drives, variable air volume systems, and direct digital controls that allow better control of motors and air flow.

– Assess hot water temperature requirements and calibrate an effective hot water set point.

– Analyze where to invest in the steam infrastructure and where systems may be reconfigured and re-designed in the near to medium term.

– Conduct energy models where needed to determine if there is sufficient payback on investments.

– Review upcoming energy audits (Deliverable 3) and begin to identify other larger medium-term projects, so that assessments, design, and capital budgeting can get started.

– Continue to build EV charging infrastructure to meet upcoming near-term fleet electrification needs, while monitoring the impact on the building’s spare capacity.

– Short-term renewable energy needs should focus on the four facilities that are currently over 50% loaded and therefore are more likely to require electrical upgrades from electrification. These facilities were Animal Control, Law Enforcement Complex, Resource Crisis Center, and Public Works. Evaluate renewable energy opportunities identified in Deliverable 6.

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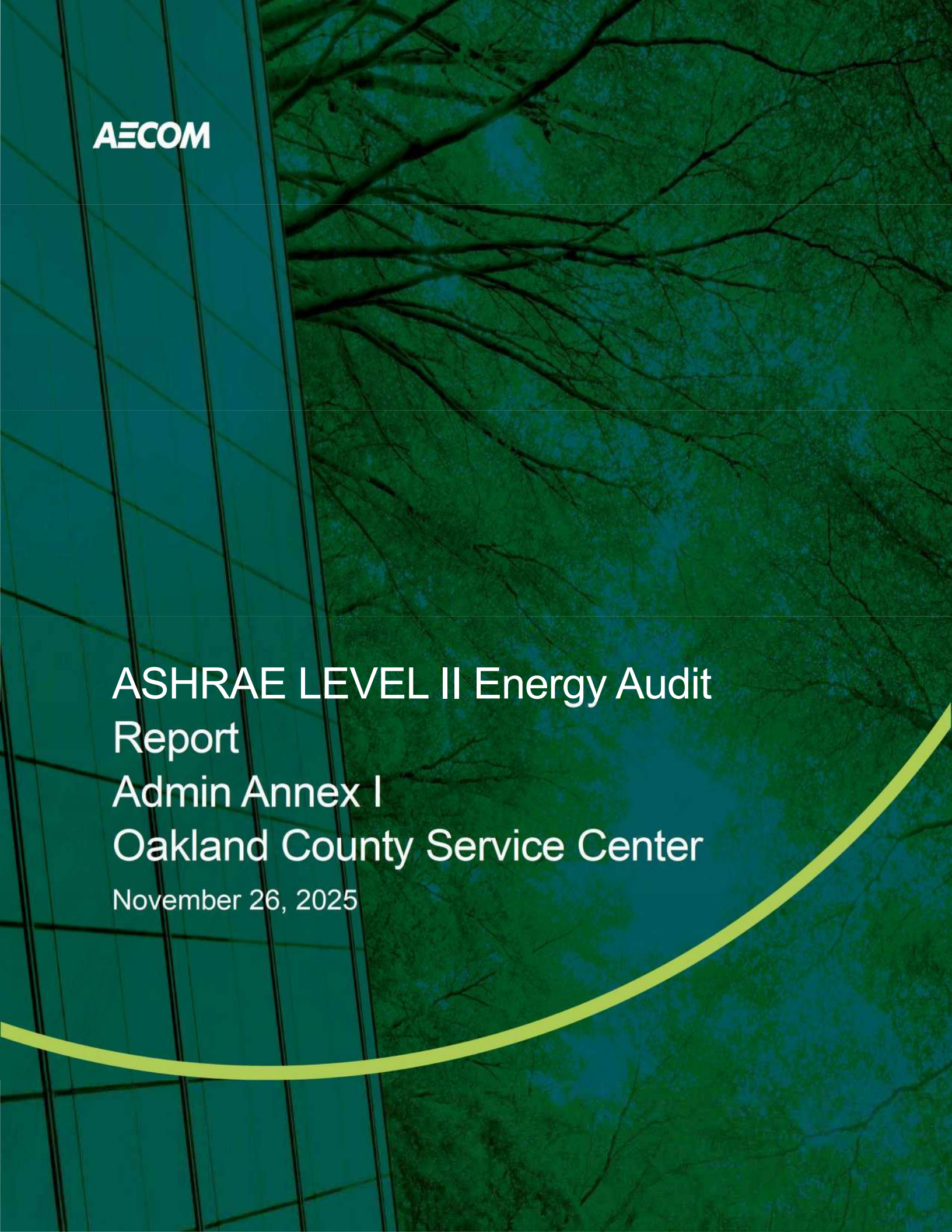

AECOM

ASHRAE LEVEL II Energy Audit Report
Admin Annex I
Oakland County Service Center

November 26, 2025

Quality information

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Revision History

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OAKLAND COUNTY, MI Government

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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Admin Annex I in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

All identified energy reduction opportunities have been characterized in this report as ECMs regardless of scope and scale of capital investment. Additionally, AECOM recognizes that Oakland County wishes to pursue the future electrification of its facilities to the extent practical, as described in AECOM's Service Center-wide assessment report of future electrification options. The ECMs listed in this report address opportunities identified within existing conditions and existing energy infrastructure. The report's proposed ECMs may or may not be relevant to an energy infrastructure environment evolved from fossil fuel-driven energy infrastructure to fully electrically powered energy infrastructure.

The Oakland County Admin Annex I is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Friday, April 18, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates 8 ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The seven recommended measures represent a projected 23% annual energy cost savings with an aggregate simple payback of 7.2 years. Five of the eight measures are prioritized as “Recommended” for implementation; three are recommended for further study before proceeding or are not recommended.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Deliverable. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Admin Annex I Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	MTCO2e	$/yr	$/yr	$	Years
1	Retro-commissioning	HIGH	R	40,400	0	270	0	417.9	32.7	$0	$5,791	$30,579	5.3
2a	Replace fluorescent fixtures with LED equivalents	HIGH	R	22,845	5	0	0	77.9	10.1	$934	$3.446	$21,000	6.1
2b	Install Motion Sensors for Lighting Controls	HIGH	R	10,494	0	0	0	35.8	4.6	$0	$1,154	$7,225	6.3
2c	Calibrate Exterior Light Photocell Sensors	HIGH	R	491	0	0	0	1.7	0.2	$0	$54	$400	7.4
3a	Replace electric water heater with ASHP	HIGH	R	3,122	0	0	0	10.7	1.4	$0	$343	$3,125	9.1
4	Install VFDs on Heating Hot Water Pumps	HIGH	R	27,095	0	0	0	92.4	12.0	$0	$2,980	$3,000	1.0
5	Convert from Pneumatic Controls to Direct Digital Controls (DDC)	MED	R	28,523	5.1	65	0	164.8	16.2	$3,380	$6,842	$83,397	12.2
Sum of Recommended Measures				**132,969**	**10**	**335**	**0**	**801**	**77**	**$4,314**	**$20,611**	**$148,726**	**7.2**
Overall % Reduction				**25%**	**0%**	**13%**	**0%**	**17%**	**20%**	**--**	**23%**	**--**	**--**

Energy Conservation Measures Not Recommended													
ECM #	Measure Description	Priority	Measure Status	Year -1 Electricity Savings	Demand Reduction	Year -1 Gas Savings	District Steam Savings	Total Energy Saved	Year - 1 GHG Savings	O&M and Water Savings	Year - 1 Cost Savings	Project Cost (Est)	Simple Payback Period
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	MTCO2e	$/yr	$/yr	$	Years
3b	Replace electric water heater with instantaneous under sink water heaters	HIGH	RS	1,070	0	0	0	3.7	0.5	0	$118	$1,800	15.3
6	Install Exhaust Energy Recovery Systems on AHUs	LOW	RS	1,672	0	152	0	163.7	9.1	0	$944	$56,000	59.3
7	Install High-Efficiency Condensing Boilers	LOW	NR	0	0	118	0	122.7	6.5	0	$590	$500,500	848.0

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu

*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Oakland County Admin Annex I Building, located at 1200 N Telegraph Road, Building 47 West, Pontiac, MI 48341, is the largest full-service sheriff's department in Michigan. It serves a jurisdictional population of approximately 1.2 million residents, providing direct law enforcement services to over 343,000 individuals through contracts with 15 communities. The total area of the building is 27,799 ft^2.

The building consists of three blocks shaping a U shape. The northeast block is two stories above grade and one below grade. The center and the southwest are single stories, constructed in 1971. The facility includes office spaces, 911 dispatch, server room, lounges, and conference rooms. This 24/7 operating facility has undergone renovations since its construction. The dispatch room, operating 24/7, has numerous workstations with six monitors. The regular offices operate during regular business hours.

2.1 Building Systems

2.1.1 Building Envelope

The northeast block is two stories above grade, and its window wall ratio is about 30%. The window wall ratios of the single-story blocks are approximately 70%. The windows are double-pane, except in certain zones such as restrooms and mechanical and electrical rooms (MERs), where single-pane windows are present.

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	CMU, brick veneer	Good
Roof	Insulation above concrete deck, black tar roof membrane	Good
Glazing	Double pane, tinted, aluminum frame	Good

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The building is heated by two Weil-McLain boilers installed in 2002. The boilers are generally in good condition; however, they are nearing the end of their useful life as they approach their 25-year mark. The heating input capacities of these boilers are 1,430 MBH, with a combustion efficiency rated at 85%. The boilers are set to operate between 160°F and 180°F according to the local controller. The heating water is distributed by two 5 horsepower (HP) pumps that are 82.5% efficient and operate at a constant volume. These pumps are also nearing the end of their useful life and retrofitting them with variable frequency drive (VFD) pumps is recommended. The primary heating source is the perimeter radiator/fin tubes.

The perimeter heating systems are controlled by JCI dial thermostats. These thermostats are linked to zone valves in each zone and open and close depending on the zone temperature reading. The hot water distribution pumps are not VFD-controlled, and this control configuration

inherently demands VFDs on the pumps to modulate the flow based on the heating load. Otherwise, by assuming a parallel hot water grid, as the water velocities in the system increase the pressures will drop. The high velocity will cause water hammering and create a nuisance for the employees, aside from increased energy usage.

The four air handling units (AHUs), also known as air conditioning (AC) units (AC 1, 2, 3, and 4), are not directly ducted through the perimeter wall. Outside and return air mix in the MER, and the mixture is tempered for heating and cooling. The AC unit serving to central dispatch has 5 main air distribution branches in a dual duct air distribution configuration.

The facility utilizes three different air-cooled chiller systems. The two 18-ton York chillers serving AC-1 were manufactured in 2007 and uses R-22 refrigerant. The 56-ton York chiller, installed in 2014, serves 28 fan coil units in A and C wings. The zone temperatures are controlled by fan speed control.

In addition to the chilled water system, the 15-ton Trane air cooled condenser unit (ACCU) serving AC-2, installed in 1992, has exceeded its useful life, as it is now 31 years old. Two ACCUs reject heat from offices served by cassette units with 5-ton capacity. Another ACCU-3 has a heat rejection capacity of 3.5 Tons. These units cool the server room, therefore operating 24/7.

The AHUs were assumed to operate 24/7 given that the building is at least partially occupied at all times. The boilers and chillers were assumed to operate 24/7 during the heating and cooling seasons respectively.

2.1.2.2 Plumbing

A 50-gallon electric heater provides domestic hot water. The general condition of this equipment is good.

2.1.2.3 Building Controls

The building control system is located in the Sheriff's Admin building. There is a hybrid system with pneumatic and electric actuators.

2.1.3 Lighting Systems

The building's lighting consists of 32W T8 or T12 fluorescent lamps controlled by manual wall switches. The fixture type varies between ceiling mounted, recessed, can downlighting, and suspended fixtures, depending on location and lighting necessity. The outdoor lighting has been converted to photocell-controlled LED. The following fixture counts are based on the provided plot sets for 47W.

Table 3: Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
Fluorescent Lights	47	1 lamp
Fluorescent Lights	89	2 lamp
Fluorescent Lights	4	4 lamp

The approximate total wattage of all interior lighting is 7,712 watts. The approximate area per drawing is 27,799 ft^2. The lighting density is calculated as 0.28 W/ft^2. To estimate the annual

electricity usage attributable to lighting, it was assumed that the lights operate 18 hours per day to average the 24/7 occupancy in the dispatch center with the offices' conventional business hours, giving a total electricity use of 57,840 kWh.

2.1.4 Electrical Infrastructure

The service to 47W Admin Annex I is fed from Feeder A and Feeder B. Under normal operating conditions, Feeder A supplies the main service to 47W. Feeder A is connected to a 120/208V, 3-phase, 4-wire, 1600A Westinghouse switchboard, dated 10/1969. This switchboard is located within Electrical Equipment Room 6. Meter number 53782386 had been partially removed or disconnected from the unit prior to the site visit, so demand data could not be collected.

Feeder B supplies the emergency electrical equipment for 47W, located in Electrical Equipment Room 5. Feeder B is connected to a General Electric AV-Line 120/208V, 3-phase, 4-wire switchgear rated at 800A. Meter number 30930272 displayed an instantaneous demand of 8475 x160 = 1,356,000 kWh.

The on-site, automatic backup power is supplied via a 120/208V, 3-phase, 4-wire, 200kW 250kV, Cummins model C200 DCD diesel generator. The generator has a 3000-gallon capacity and an estimated run time of 10 days under full load conditions, feeding panel DP-5 and Panel PP-QE.

2.1.5 Additional Information

The facility has a 900 SF server room housing eleven 911 dispatch server racks cooled by two direct expansion (DX) mini-split systems. The third mini-split DX is for redundancy. Two 50 kVA UPS systems service the server rooms for power outages.

The facility has a telecommunication tower on its electric meter. The energy consumption maybe impacted significantly.

The kitchen has three residential-type refrigerators and two vending machines.

The city gravity tank is located near the facility. It's unclear if the electric meter of this gravity tank is included on this facility's meter.

3 Utility Billing Analysis

3.1 Utility Type and Usage

Admin Annex I receives electric service, natural gas service, and is not connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

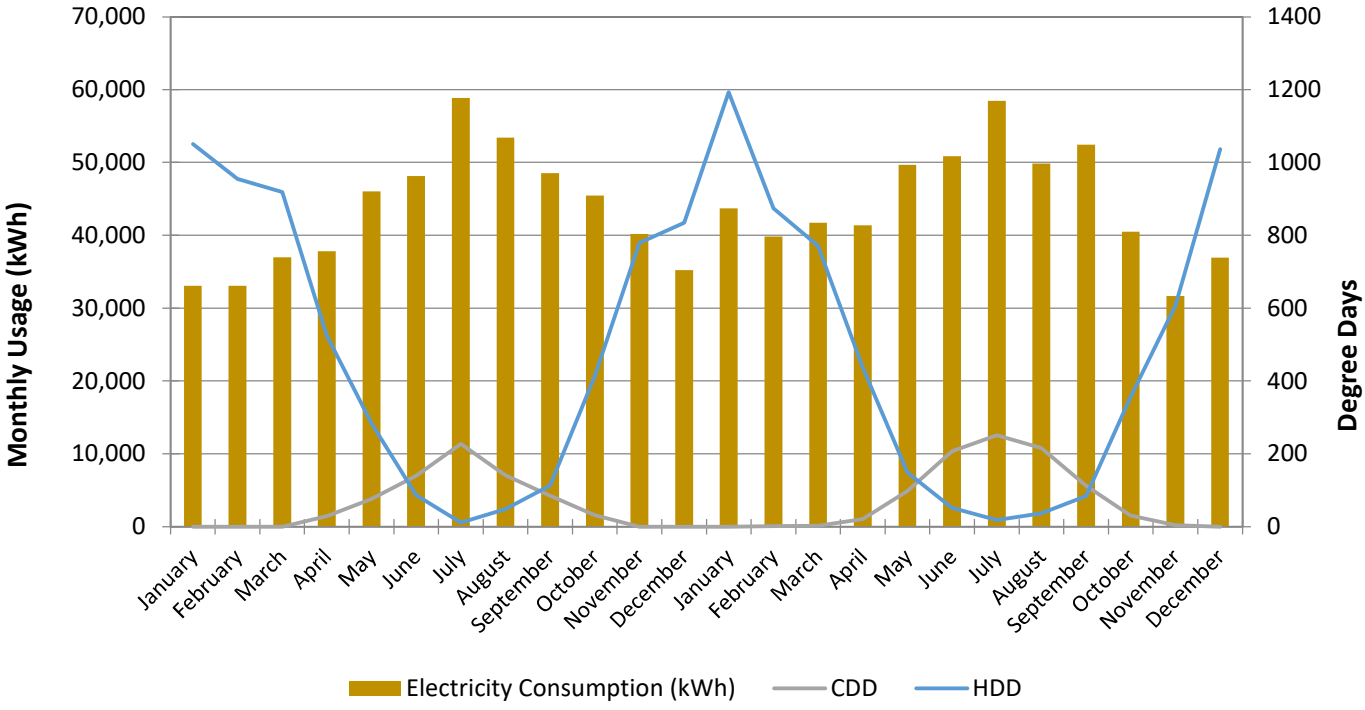
Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	536,880 kWh	1,832	$59,057	$0.11/kWh	0.0004427	238
Natural Gas	2,646 MCF	2,747	$13,212	$4.98/MCF	0.0549206	145
Total		**4,579**	**$72,269**			**383**

**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a minor correlation to weather data, indicating the majority of electricity usage consists of baseload usage. This usage does not vary much from month to month and includes loads such as lighting, fans, and pump loads. The annual usage for the baseline 12-month period from January to December 2024 is 536,880 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 5: Electric Capacity Results

Maximum Building Capacity at Service Transformer	Unknown
Maximum Capacity at Switchgear (A*V*Ph)	860 kW (combined)
Estimated Peak Demand	112 kW (estimated)
Remaining Capacity	**748 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate, which is later used to estimate cost savings resulting from the recommended ECMs. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge:	**$0.057/kWh**
DTE Electric Demand Charge:	**$6.15/kW/Month**
Average Dollar per kWh Used in Calculations:	**$0.11/kWh**

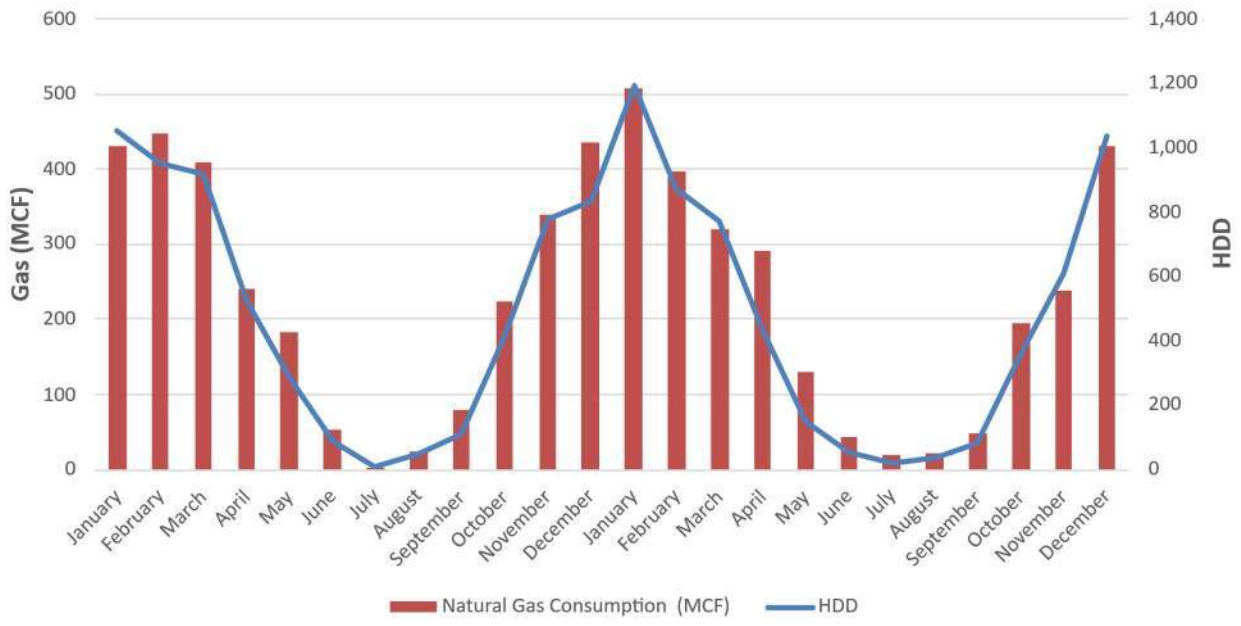
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows a direct correlation to weather data, as natural gas is only used for space heating. The annual usage for the baseline 12-month period from January to December 2024 is 2,466 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: **$1.33/MCF (1000 cubic feet)**

Constellation NG Usage Charge (fixed Fee): **$3.48/dTh (decatherm, 1.038 MCF)**

Constellation NG Usage Charge (Day Gas): **$5.29/dTh (decatherm, 1.038 MCF)**

Average Dollar per MCF Used in Calculations: **$4.98/MCF**

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$59,057
Natural Gas	$13,212
Total	$72,269
ECI	$2.6/SF/yr

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

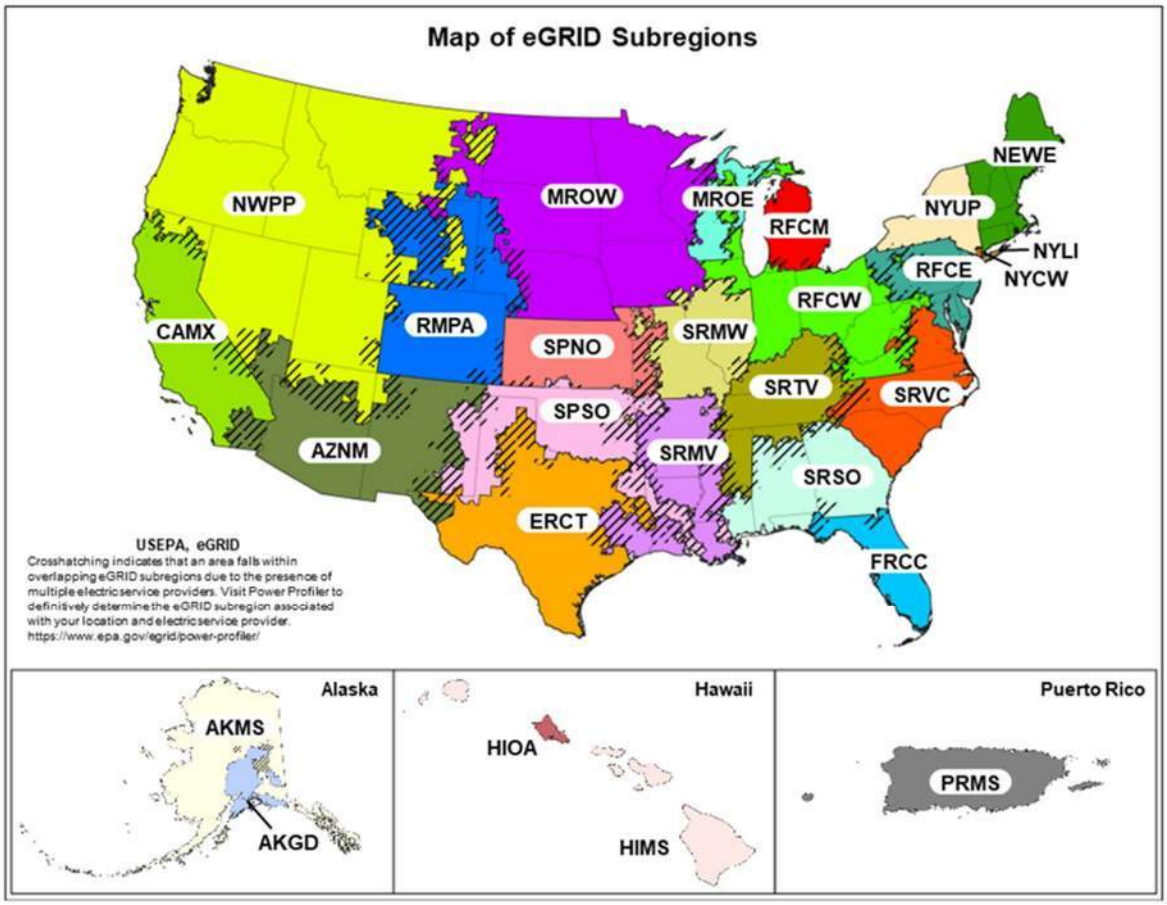
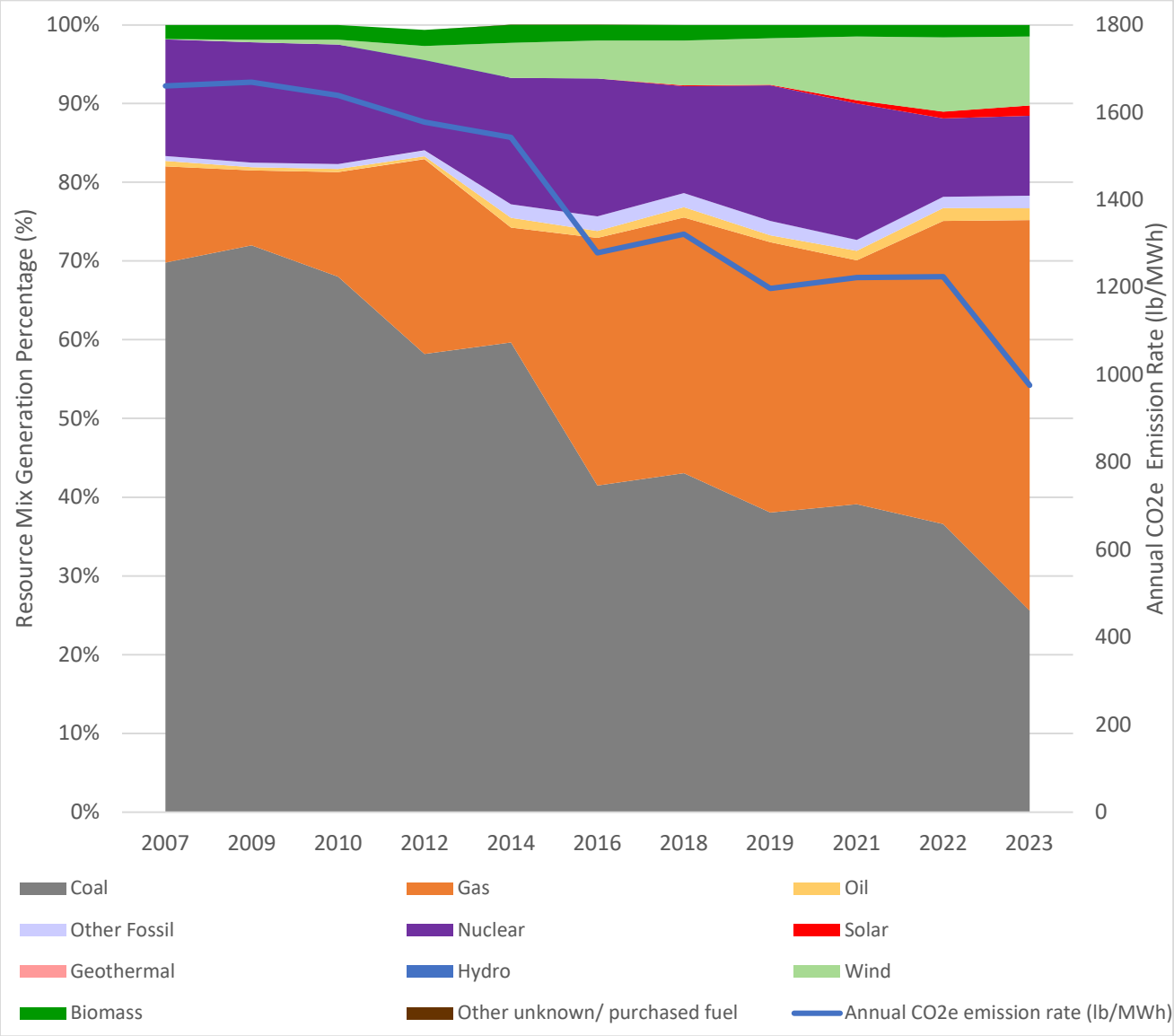


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 38 percent of carbon emissions are attributed to natural gas and 62 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 145 tCO2e (campus-level Scope 1) and 238 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 383 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for Admin Annex I are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Admin Annex I					**Electric EUI:**	66	kBTU/SF/yr
GFA:	27,799	SF				**Gas EUI:**	99	kBTU/SF/yr
eGRID Subregion:	RFCM					**Current EUI**	165	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	536,880	kWh	3.412	1,832	0.0004427	238	$59,057	82%
Natural Gas	2,646	MCF	1.038	2,747	0.0549206	145	$13,212	18%
		Totals		**4,579**		**383**	**$72,269**	**100%**

According to the US EPA, the average site energy use intensity for a police station is 85.6 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 165 kBTU/SF, which is significantly higher than the national benchmark. It’s important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison indicates there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Parking	Parking		N/A	N/A	None Available
Public Services	Courthouse*		211.4	101.2	CBECS - Courthouse
	Drinking Water Treatment & Distribution (Average EUI presented in Energy per Flow in gallons per day)		5.90	2.27	AWWA - Water Treatment Plant
	Fire Station		124.9	63.5	CBECS - Fire Station/Police Station
	Library		143.6	71.6	CBECS - Library
	Mailing Center/Post Office		96.9	47.9	CBECS - Service
	Police Station		124.9	63.5	CBECS - Fire Station/Police Station
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Social/Meeting Hall		109.6	56.1	CBECS - Social/Meeting
	Transportation Terminal/Station		112.0	56.2	CBECS - Public Assembly
	Wastewater Treatment Plant* (Average EUI presented in Energy per Flow in gallons per day)		7.51	2.89	AWWA - Wastewater Plant
	Other - Public Services		89.3	40.1	CBECS - Other
Religious Worship	Worship Facility*		58.4	30.5	CBECS - Religious Worship
Retail	Convenience Store*	Convenience Store with Gas Station	883.5	350.9	Industry Survey
		Convenience Store without Gas Station			
	Mall	Enclosed Mall	170.7	65.7	CBECS - Enclosed Mall
		Lifestyle Center	228.8	103.5	CBECS - Strip Shopping Mall
		Strip Mall			
		Other - Mall	225.3	101.6	CBECS - Enclosed Mall and Strip Shopping Mall
	Retail Store*		120.0	51.4	CBECS - Retail Store
	Supermarket/Grocery Store*		444.0	196.0	CBECS - Grocery Store/Food Market
	Vehicle Dealership*		138.2	71.9	Industry Survey

3.8 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees and visitors. Table 8 and Figure 7 and Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	2,698	0	2,716,936	101	148
Space Cooling	151,143	0	0	515,701	19	67
Fans	195,036	0	0	667,362	24	86
Pumps	57,818	0	0	175,281	7	26
DHW	4,856	0	0	16,568	1	2
Conveyance	0	0	0	0	0	0
Lighting	57,840	0	0	197,350	7	26
Plug Loads	25,613	0	0	87,390	3	11
Process Loads	0	0	0	0	0	0
Refrigeration	0	0	0	0	0	0
Cooking	0	0	0	0	0	0
Information Technology	30,600	0	0	104,407	4	14
TOTAL	**522,906**	**2,698**	**0**	**4,584,287**	**165**	**380**
Historical Billing	536,800	2,646	0			
Percent of Actual	97%	102%	0%			
per sqft	19	1	0			

Figure 7: Existing Electricity End Use Distribution

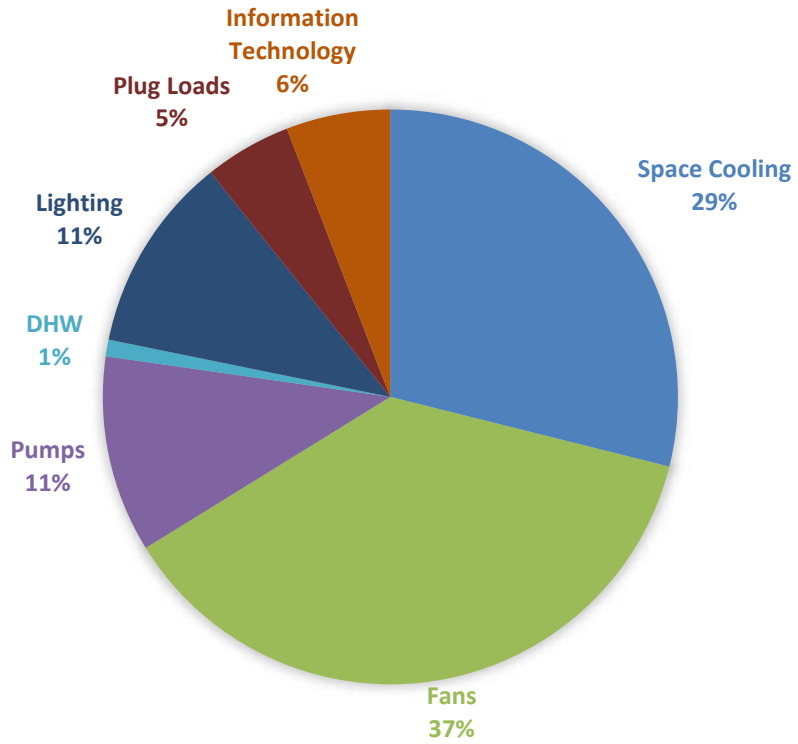
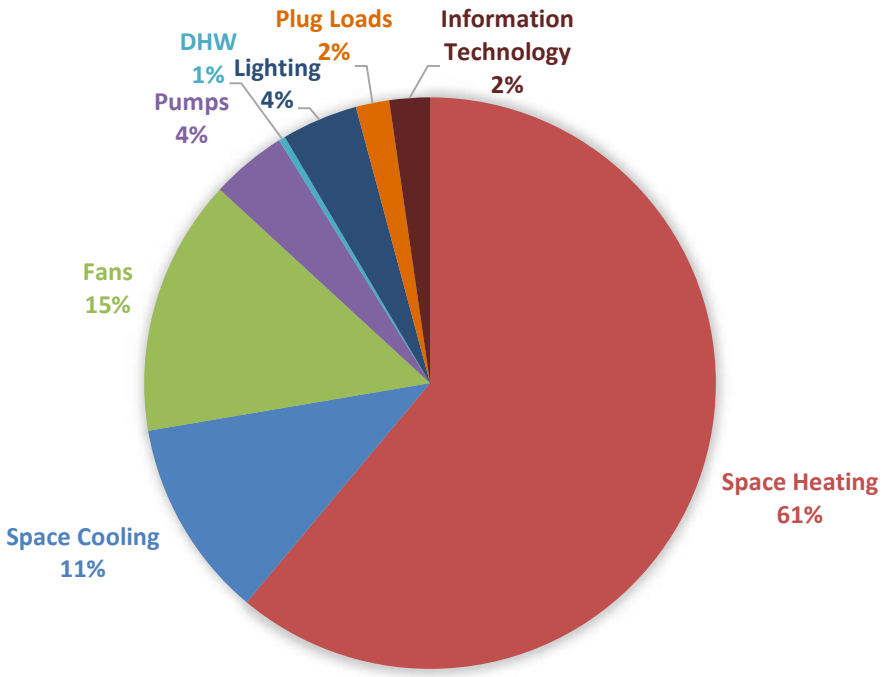


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures (ECM)

The measures discussed in this section are economically viable when bundled together but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent. Admin Annex I currently utilizes a building controls system which allows for advanced control of HVAC systems and scheduling. However, RCx is an extremely valuable measure that should be implemented to its fullest extent to ensure systems are operating effectively and efficiently. The following list represents RCx opportunities that should be evaluated to validate operation, repair if discrepancies identified or implement if not active and feasible for major HVAC systems. This effort will proactively improve building system operation and optimize energy usage.

- Repair boiler room fresh air supply
- Reconfigure uninterruptible power supply (UPS) room ventilation
- Perform testing, adjusting, and balancing of airside systems
- Optimize AHU control sequences for energy efficiency and free air-side cooling
- Optimize chiller control sequences with air-side cooling

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 10% reduction in estimated heating, cooling, fan and pump end-use energy consumption.
- Additional study of equipment capacity requirements could be performed as part of this measure. This would support electrification studies such as hot water system capacity assessments, heating system utilization trends, and energy use submetering.

- $1.1/sqft was used to estimate the cost for the 27,799 SF building.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: This measure proposes engaging a third-party contractor to determine if this building is eligible for the DTE RCx program and systematically evaluate and prioritize major HVAC and control systems and complete retro-commissioning to restore systems to optimize system performance.

Table 9: ECM 1 Savings and ROM Cost

ECM Savings and ROM Cost:

	Savings Summary							
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Annual O&M Savings ($)	Est Project Cost	Simple Payback (Yrs)
RCx	270	40,400	409.5	32.3	$5,751	$0	$30,579	5.3
Overall % Reduction	**10%**	**8%**	**9%**	**9%**	**9%**	**--**	**--**	**--**

4.2 ECM 2 – LED Lighting and Controls

This measure proposes upgrading all remaining (estimated at 144 fixtures) fluorescent lighting to Light-emitting diode (LED) lightbulbs with sensors to reduce energy consumption and electrical demand. LEDs are highly energy efficient as most of the electrical energy supplied to the fixture is converted into light – 80% or more depending upon the LED lamp. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements.

Incorporating lighting controls allows for better management and customization of lighting systems, leading to reduced energy consumption, and increased overall efficiency by limiting the time lighting is on to only when necessary. For indoor lighting, lighting controls consist of occupancy, daylighting, timers, scheduling, and dimming features to optimize light levels based on external lighting availability and usage of a space. For outdoor lighting, the lighting controls consist of motion sensors, photocells, and timers to turn the lighting ON/OFF. The interior lighting in Admin Annex I consists of 32W fluorescent T8 and T12 fixtures. The exterior lights are photocell-controlled LEDs. See Section 2.1.3 for the lighting counts used to estimate energy consumption; a scaling factor of 1.5 was used to increase the number of fixtures estimated from the building plans shown in the lighting count table. Additionally, Admin Annex I already has photocell controls installed on the exterior lights. However, the lights were observed to be on during the assessment. Thus, it is recommended that the existing photocell sensors be recalibrated to ensure the lights only turn on at night.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.



Figure 9: Example Fixture with Integrated Occupancy Controls

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture. Lighting controls that include dimming will likely require full fixture replacement, which drive up the total cost of implementation for the measure.
- Interior lights operate 18 hours per day for 252 business days per year, which averages the different occupancy schedules for different parts of the building (24/7 and normal business hours).
- Exterior lights, assumed to consist of four 28W fixtures, operate 24 hours per day due to the faulty photocell sensors.
- O&M savings assume an average cost of $3.81/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- This measure assumes a 0.18 W/ft² or approximately 30% reduction in interior lighting power and a 30% reduction in hours of operation for adding new controls and a 50% reduction in power for the exterior lights through repair of photocells.
- LED upgrades cost $215/fixture, which include integrated control sensors and no additional wiring and control circuits. Low-cost fixtures and external controls can be used as an alternative to this implementation method. The costs have been split out between the fixtures and controls in the summary table below.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, if integrated controls are not included in each fixture, subsequent steps are

required that may consist of conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. Following this assessment, a controls contractor can be engaged to install the lighting controls and assist building engineers in configuring the schedule to optimize lighting usage.

Table 10: ECM 2 Savings and ROM Cost

ECM Savings and ROM Cost:

	Savings Summary							
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**Annual O&M Savings ($)**	**Est Project Cost ($)**	**Simple Payback (Yrs)**
LED Upgrade	0	22,845	77.9	10.1	$2,513	$934	$21,000	6.1
Lighting Controls	0	10,494	35.8	4.6	$1,154	$0	$7,225	6.3
Calibrate Photocell Controls	0	491	1.7	0.2	$54	$0	$400	7.4
Total	**0**	**33,830**	**115**	**15**	**$3,721**	$934	$28,625	6.1 (avg)
Overall % Reduction	**0%**	**6.1%**	**3%**	**4%**	**5%**		**--**	**--**

4.3 ECM 3 – Domestic Hot Water Upgrades

Domestic hot water systems provide heated water for handwashing, cleaning, and miscellaneous system usage. Maintaining proper water temperature and control is not only critical for energy efficiency but also for health and safety – temperatures must be 140F to prevent bacteria growth such as Legionella, yet low enough to prevent scalding and prevent excessive energy use. This measure proposes two options for replacing the existing 4,500 W American Water Heater Company electric domestic hot water heater.

Option 3a recommends installing an air source heat pump (ASHP) water heater. Switching from a conventional electric water heater to an air-source heat pump (ASHP) water heater can significantly reduce energy use, as ASHP units operate at roughly 40% of the energy consumption of standard electric models, making them a far more efficient option.

Option 3b recommends installing instantaneous electric under-sink water heaters for each bathroom or break room sink in place of the central tank-type water heater. Unlike traditional hot water heaters with storage, under-sink electric heaters provide hot water on-demand and eliminate the need to continuously maintain a storage tank of hot water. As the sink tap turns on, cold water flows through an electric resistance heating element and is quickly heated before flowing through the faucet. This method of water heating for bathroom and break room use during regular business hours reduces energy consumption by eliminating standby heat losses associated with hot water storage tanks and heat loss associated with piping between water heaters and their end use. Additionally, switching from an electric central water heater to electric under-sink heaters improves operational comfort. This report recommends option 3A, however, the overall impact of the measure is minimal and therefore 3B is also considered a viable option.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Domestic hot water use assumed 1.5 gallons hot water/person per occupied day, 96% water heater efficiency given the current water heater specifications, and 10,000 BTU/day standby losses.
- Instantaneous water heater calculations assume 1,800W to meet the same demand.
- The ASHP water heater calculation assumes a COP of 2.8.
- Unit costs of $200/MBH and $300/sink were used to estimate costs for Option A and B respectively.
- There are approximately 6 sinks in the building, as estimated from the floorplan.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Replace the existing electric water heater with an air-source heat pump water heater.

Table 11: ECM 3 Savings and ROM Cost

ECM Savings and ROM Cost:

	Savings Summary - Option 3a (Air Source Heat Pump Water Heater)							
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**Annual O&M Savings ($)**	**Est Project Cost ($)**	**Simple Payback (Yrs)**
Option 3a: ASHP Water Heater	0	3,122	10.7	5.6	$343	$0	$3,125	9.1
Option 3b: Tankless Electric	0	1,070	3.7	0.5	$118	$0	$1,800	15.3
Overall % Reduction	**0%**	**2%**	**1%**	**1%**	**2%**		**--**	**--**

4.4 ECM 4 – Install Variable Frequency Drives for HHW Pumps

Variable Frequency Drives (VFDs) on pumps motors will provide a dynamic and energy-efficient solution by allowing precise control of pump speed, optimizing performance, and reducing unnecessary energy consumption during periods of lower demand. Currently, there are two 5 HP pumps with 82.5% efficiency used for distributing heating hot water (HHW) that do not have VFDs. This ECM proposes evaluating the HHW pumps for feasibility to add VFDs to reduce pump energy.

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- VFDs will be most effective when paired with a BAS to automatically control speeds.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed. VFDs will likely increase the service life of the equipment if properly selected and installed.
- The savings for this measure assume an average 20% reduction in equipment speed.

- If coupled with routine upgrades to include premium efficiency motors additional energy savings may be achieved.
- $300/HP was used to estimate the cost to install one VFD for each pump.
- No M&V savings are included in this measure, however it is possible that the motor may see extended life due to soft-starting from VFD start up. Alternatively, if the system operated at below recommended minimum speed (usually 25-40%), the motor could overheat and measure life will be shortened.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Evaluate the two 5 HP HHW pumps for compatibility with a VFD and assess the usage pattern and energy consumption. Once this data is collected, select the appropriate type of VFD. Choose VFD based on compatibility with current systems, programmability, and reliability. This measure is recommended for implementation.

Table 12: ECM 4 Savings and ROM Cost

ECM Savings and ROM Cost:

	Savings Summary							
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**Annual O&M Savings ($)**	**Est Project Cost ($)**	**Simple Payback (Yrs)**
VFDs on HHW Pumps	0	27,095	92.4	12.0	$2,980	$0	$3,000	1.0
Overall % Reduction	**0%**	**5%**	**2%**	**3%**	**4%**		**--**	**--**

4.5 ECM 5 – Upgrade Pneumatic Controls to DDC

Pneumatic controls upgrades refer to the process of upgrading legacy pneumatic control systems and components to direct digital controls (DDC) and integrating it with a centralized control system. Pneumatic controls use compressed air to operate valves and dampers and are prone to operational and maintenance issues. Upgrading these controls to DDC will enhance the overall efficiency, functionality, and manageability of HVAC system operation. This measure directly produces electricity savings by eliminating the need for a compressed air system, but also indirectly contributes additional energy savings by enabling better control and functionality such as scheduling and optimization. Admin Annex I currently has a hybrid system with both pneumatic and electric actuators. Thus, it is recommended that the county continue to replace the pneumatic controls with electric alternatives for enhanced performance and reduced electricity consumption.

Figure 10: Pneumatic (left) and Electric (right) Controls



Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- Upgrading pneumatic controls to DDC will improve existing control functionality.
- There would be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed.
- Energy savings assume a 2% reduction in outdoor air supply. There is also energy savings from eliminating the air compressors used for control air in the building.
- The implementation cost is estimated as $3/SF for the 27,799 SF building.
- O&M Savings are based on an average reduction of 1hr of comfort control issue correction per week, at a labor rate of $65 for in-house labor support.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Identify equipment to be connected to the central control system and engage a building controls integration company to plan and price the system integration. Coordinate with planned capital upgrades and renovations where possible to optimize benefits. This measure is recommended for implementation.

Table 13: ECM 5 Savings and ROM Cost

ECM Savings and ROM Cost:

	Savings Summary							
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**Annual O&M Savings ($)**	**Est Project Cost ($)**	**Simple Payback (Yrs)**
Pneumatic to DDC Conrtrols	65	28,523	164.8	16.2	$3,462	$3,380	$83,397	12.2
Overall % Reduction	**2%**	**5%**	**4%**	**4%**	**5%**		**--**	**--**

5 Measures Requiring Additional Consideration

This section provides details on measures that were analyzed but are not recommended for immediate implementation at this time. This includes measures that require further study, such as capital-intensive replacements of existing equipment, but are not justified through energy savings alone. This section may also include measures that conflict with building electrification plans, or projects that are simply not recommended due to being financially impractical or not being technically feasible.

5.1 ECM – Install Exhaust Energy Recovery on AHUs

AHUs are critical for maintaining a comfortable indoor environment for building occupants primarily through regulating temperature and humidity. These systems are also responsible for maintaining healthy indoor air quality to protect occupant safety by removing air containing indoor air pollutants using exhaust fans which allows for fresh air to replace the stale air. Heating season energy savings in such systems involves recovering heat from the already conditioned indoor air before it is exhausted, which reduces the energy required to heat outdoor supply air to the desired indoor conditions. Admin Annex I has four AHUs each rated 12,000 CFM, creating an opportunity for heat recovery from the exhausted air. Thus, it is recommended to install air-side heat recovery wheels on the AHU exhaust fans.

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- Energy savings assume 71% sensible heat recovery effectiveness from the proposed energy recovery wheels.
- $14,000/AHU was used to estimate the implementation cost of installing exhaust heat recovery systems on the four AHUs.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Detailed planning and design should be undertaken to determine the engineering specifications of the new system and to ensure the existing AHU fans are compatible with the proposed heat recovery wheels. Coordinate with planned capital upgrades and renovations where possible to optimize benefits.

Table 14: ECM 7 Savings and ROM Cost

ECM Savings and ROM Cost:

Savings Summary							
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**Est Project Cost ($)**	**Simple Payback (Yrs)**
Exhaust Heat Recovery on AHUs	152	1,672	163.7	9.1	$944	$56,000	59.3
Overall % Reduction	**6%**	**0.3%**	**4%**	**2%**	**1%**	**--**	**--**

5.2 ECM – Install Condensing Boilers

Upgrading outdated HVAC systems is a highly effective energy conservation measure as newer systems can offer higher efficiencies and reduced maintenance requirements. For example, condensing boilers offer increased efficiency as they recover heat from the water vapor that is exhausted in conventional boilers. This heat is returned to the boiler, allowing for reduced fuel consumption to heat the water. Admin Annex I is heated by two 1,430 Weil McLain boilers which are in good condition but are nearing their end of useful life. Thus, this measure proposes upgrading the existing boilers to high efficiency condensing boilers at their end of life.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- HVAC equipment identified is due for routine end-of-life replacement.
- This measure assumes energy savings resulting from an improved efficiency of 89% as compared to the 85% efficient existing boilers.
- One 1,430 MBH boiler is in operation at a time, though both boilers will be replaced at $350/MBH.
  - A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Detailed planning and design should be undertaken to ensure the new boilers are appropriately sized and configured to meet the building's specific needs. This should include ensuring the new system is "electrification-ready" such that it either uses hot water for heating and/or is a dual-fuel heat pump that can use either source as the RFCM grid emissions improve or Oakland County renewable energy procurement makes it more favorable to use electricity over gas for heating to meet decarbonization goals. This process should be integrated into the facility's routine capital upgrade schedule to optimize the benefits of the new equipment and ensure seamless implementation along with other county priorities.

Table 15: ECM 9 Savings and ROM Cost

ECM Savings and ROM Cost:

Savings Summary							
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**Est Project Cost ($)**	**Simple Payback (Yrs)**
Upgrade to Condensing Boilers	118	0	122.7	6.6	$599	$500,500	836.0
Overall % Reduction	**4%**	**0%**	**3%**	**2%**	**1%**	**--**	**--**

6 Appendix A

Table 16: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	431	$2,644	33,040	$3,546	44	59	1,051	0
Feb-23	447	$2,611	33,040	$3,112	49	61	955	0
Mar-23	409	$1,246	36,980	$3,317	50	79	918	0
Apr-23	241	$834	37,820	$3,328	53	86	525	28
May-23	183	$548	46,040	$3,631	62	101	283	76
Jun-23	53	$130	48,120	$3,604	67	105	86	139
Jul-23	3	$13	58,840	$4,762	79	110	11	227
Aug-23	23	$67	53,400	$4,242	72	106	48	141
Sep-23	79	$224	48,540	$4,468	67	110	113	85
Oct-23	224	$646	45,460	$3,699	61	98	415	31
Nov-23	339	$1,264	40,160	$3,084	56	94	779	0
Dec-23	37	$181	35,220	$2,500	47	60	834	0
Jan-24	509	$2,240	43,680	$1,008	59	78	1,194	0
Feb-24	397	$2,164	39,820	$4,073	59	74	874	1
Mar-24	321	$1,815	41,700	$3,364	56	90	771	2
Apr-24	291	$607	41,380	$3,630	69	113	437	21
May-24	130	$265	49,660	$4,178	67	109	148	98
Jun-24	43	$141	50,840	$4,671	71	111	51	207
Jul-24	18	$60	58,440	$5,206	79	109	18	251
Aug-24	23	$48	49,860	$4,585	67	99	37	215
Sep-24	49	$119	52,420	$4,203	73	119	84	112
Oct-24	195	$523	40,480	$3,845	54	87	356	31
Nov-24	239	$828	31,660	$3,415	44	74	607	4
Dec-24	430	$956	36,940	$3,106	50	63	1,037	0
2023 Sum	2,468	$10,408	516,660	$37,203			6,019	727
2024 Sum	2,646	$9,767	536,880	$43,294			5,614	942

7 Appendix B

Table 17: Building Equipment List

Unit Tag	No of Units	Unit Name	Make	Model	Capacity 1	Efficiency	Capacity 2	Approx Year Installed
AC1 to AC4	4	Air Handling Units	Trane	MCCA012GAE0ABA000				
CH-3	1	Air Cooled Chiller	York	YCAL0056EE17XE	56 TON			2014
CH-1, CH-2	2	Air Cooled Chiller	York	YCAL0018EC17XD	18 TON			2007
	1	Air Cooled Condensing Unit	Trane	TTA190B300BA	15 TON			1992
ACCU-1, ACCU-2	2	Air Cooled Condensing Unit	Trane	2TTA0060A3000AA	5 TON			2007
ACCU-3	1	Air Cooled Condensing Unit	Mitsubishi Electric	PUY-A42NKA7	3.5 TON			2018
Boiler 1	2	Boiler	Weil-McLain	LGB12w/sn	1,430 MBH	85.1%		
DWH	1	Domestic Water Heater	American Water Heater Company	E6N-50R 100	4.5 kW	92.5% (UEF)	50 gal	
Pump 1, 2	2	Heating Hot Water Pumps	U.S. Motors	E658A	5 HP	82.5%		

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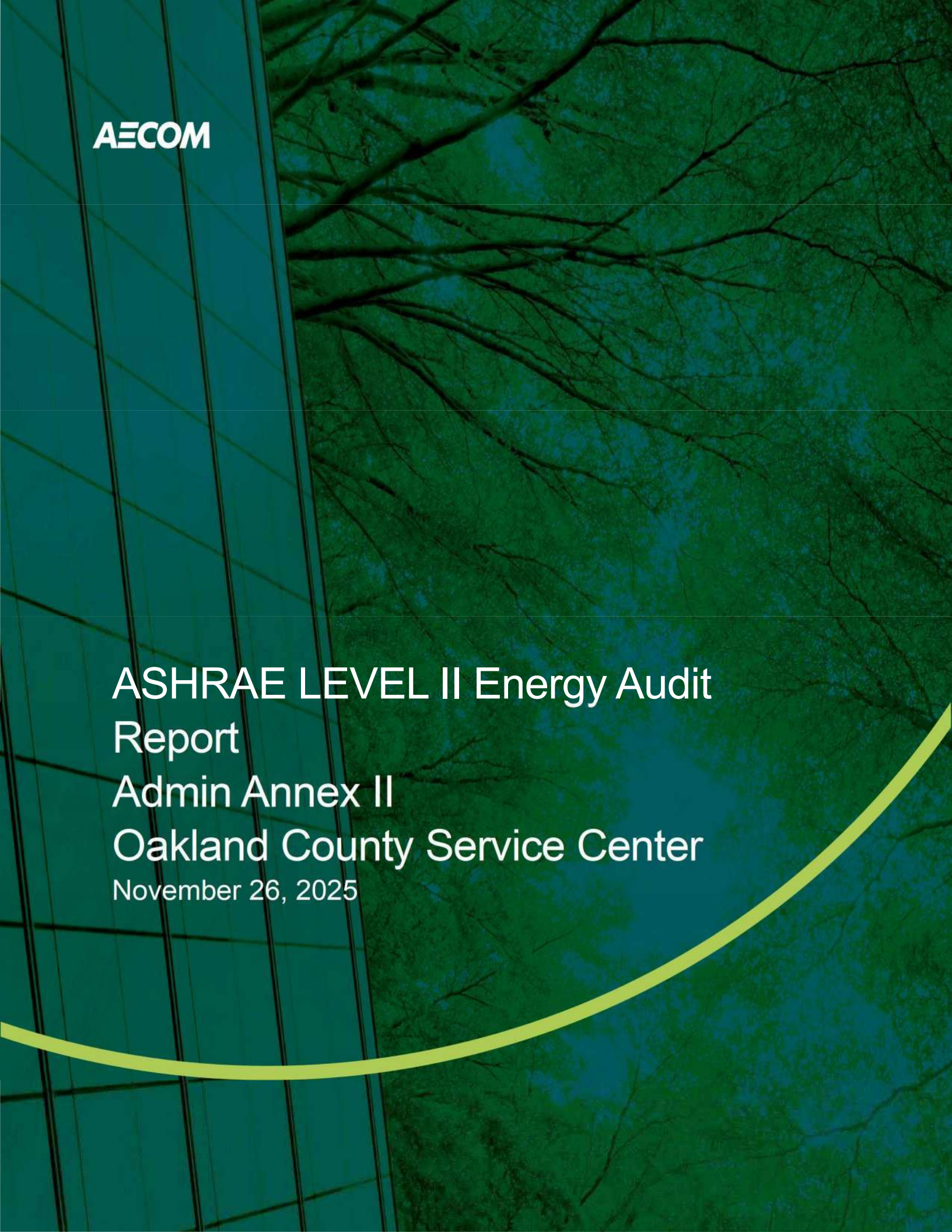

AECOM

ASHRAE LEVEL II Energy Audit Report
Admin Annex II
Oakland County Service Center

November 26, 2025

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

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Disclaimer

The intent of this ASHRAE Level II Energy Audit study is to present the results of the AECOM assessment of the Oakland County Campus located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Admin Annex II Building, 18 East, in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation" or "Not Recommended" measures based on simple payback period or foreseen feasibility issues.

All identified energy reduction opportunities have been characterized in this report as ECMs regardless of scope and scale of capital investment. Additionally, AECOM recognizes that Oakland County wishes to pursue the future electrification of its facilities to the extent practical, as described in AECOM's Service Center-wide assessment report of future electrification options. The ECMs listed in this report address opportunities identified within existing conditions and existing energy infrastructure. The report's proposed ECMs may or may not be relevant to an energy infrastructure environment evolved from fossil fuel-driven energy infrastructure to fully electrically powered energy infrastructure.

The Oakland County Admin Annex II Building is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Monday April 7, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Savings Summary

This energy audit report evaluates two ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The recommended measures represent a projected 36% annual energy cost savings with an aggregate simple payback of 15 years. Both measures are prioritized as “Recommended” for implementation.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Admin Annex II Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	tCO2e	$/yr	$/yr	$	Years
1a	LED Lighting Upgrade	MED	R	40,008	9	0	0	136.5	17.7	$1,707	$4,401	$51,450	8.4
1b	LED Lighting Controls	MED	R	9,602	0	0	0	32.8	4.3	$0	$1,056	$8,575	8.1
2	BAS Controls Installation and Commissioning	LOW	R	8,047	0	0	37	71	7.9	$0	$1,252	$68,314	54.5
Sum of Recommended Measures				**57,656**	**9**	**0**	**37**	**241**	**30**	**$1,707**	**$6,667**	**$128,339**	**15.3**
Overall % Reduction				**41%**	**28%**		**11%**	**29%**	**30%**	**--**	**36%**	**--**	**--**

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

Admin Annex II was originally constructed in 1927 and has undergone minor renovations over the years but no major modernization. The facility serves primarily as record storage space, with approximately 95% of the building area dedicated to archival functions and the remaining 5% occupied by office spaces. The area of the building is 34,157 ft².

The record storage area has three to four occupants on-site with scheduled hours of occupancy from 7:00 AM to 3:30 PM, while the office area supports eight staff members within eight cubicles and six private offices, with scheduled hours of occupancy from 7:00 AM to 3:00 PM.

Heating, ventilation, and air conditioning (HVAC) systems operate 24/7 unless manually overridden by local controls. The building is 100% conditioned and operates year-round.

2.1 Building Systems

2.1.1 Building Envelope

The envelope components are summarized in the table below. The construction performance was not documented during the site visit.

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Exterior concrete or stone block with sheet rock interior	Unknown
Roof	Built up with rubber ballast	Unknown
Glazing	Double-pane	Unknown

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

Admin Annex II is served by a combination of localized HVAC systems, including six window-mounted direct expansion (DX) air conditioning units and several split-system condensers tied to interior air-handling units (AHUs). The window units, which serve multiple office spaces, operate with R22 refrigerant and are in fair condition. The condensers include units by International Comfort Products (model HAC048AKA4), Rheem (model 13AJA60C01115, manufactured in 2015), and Arcoaire (model unknown), all using R22. AHUs are manufactured by Carrier and include models 4OFS220310 and 40RM-007-B600GC, serving both the basement and first floor record storage areas. These AHUs operate in recirculation mode only, with no outdoor air intake or humidification.

The HVAC system operates continuously (24/7) unless locally overridden. Thermostats vary by zone, and some programmable capabilities are present in specific areas (e.g., document retention spaces). However, distributed controls contribute to inefficiencies—simultaneous heating and cooling were observed during the audit. Taco baseboard valves were found

manually set to “open” rather than “auto,” resulting in noticeable heating even during summer months. The basement was consistently warmer than other zones, despite low occupancy. Overall, HVAC systems are aged, with portions nearing the end of their useful life and operating under minimal automation.

Heating is provided via a central steam system that enters the building in the basement and is converted to hot water through a steam-to-hot-water heat exchanger. Hot water is distributed via inline circulator pumps, including one by B&G (nameplate worn off) and one Emerson pump (model AF30-D2E2D, 2 HP, 77% efficient). A Marathon condensate return pump (model 5KC37FN65HX, 1/3 HP) supports the system. There are no natural gas or electric resistance systems in the building.

Toilet room exhaust fans are controlled by a wall switch located about six feet above the floor and most likely operate continuously.

2.1.2.2 Plumbing

As described above, the building includes a hot water recirculation system supported by two inline circulation pumps. Domestic hot water is assumed to be provided via a steam-to-hot-water system, although further details on storage tanks, water heaters, or fixtures were not documented during the site visit.

2.1.2.3 Building Controls

The Admin Annex II building is primarily controlled by localized thermostats with no centralized Building Management System (BMS) in place. Each cooling unit and heating zone operates independently. Programmable thermostats are installed for specific spaces, such as the document retention area while other areas have older non-programmable thermostats. Much of the heating system operates manually. Heating baseboards were found set to a constant "open" mode rather than automated control, resulting in simultaneous heating and cooling during warmer months. This lack of coordinated controls contributes to inefficiencies and occupant comfort issues.

There is one air compressor dedicated to building controls. It is a Speedaire model 5Z701A 3HP/80 gallon and was not observed to run excessively.

2.1.3 Lighting Systems

The lighting system includes a mix of fluorescent and light emitting diode (LED) fixtures. Fixtures are recessed, ceiling-mounted, or suspended, depending on the area, such as offices, hallways, and common spaces. Fluorescent fixtures are typically 32W, and LED fixtures are around 12W.

Based on the drawings, the lighting fixture counts are as follows:

Table 3: Lighting Summary

Lighting Type	Total Fixtures	Lamps per Fixture
Fluorescent Lights	245	2 lamps
Fluorescent Lights	98	4 lamps
LED Lights	90	2 lamps
Non-LED Exit Signs	1	-
LED Exit Signs	6	-

The total approximate quantity of light fixtures is 440, including 245 fluorescent lights, 98 fluorescent lights, 90 LED lights, one non-LED exit sign, and six exit sign lights (LED). The approximate total wattage is 30,468 watts. The approximate area per drawing is 34,157 ft². The lighting density is approximately 0.89 W/ft².

2.1.4 Electrical Infrastructure

The facility is powered by a 500 KVA transformer, which is located outside. The main electrical service is rated at 120/240V, 1600A, 3-phase, suitable for buildings with mixed lighting, HVAC, and equipment loads, allowing for efficient power distribution and balanced load handling. The meter number used for tracking electricity consumption was not provided, and no data is available on peak electrical demand. Additionally, there is no backup power system such as a generator.

3 Utility Billing Analysis

3.1 Utility Type and Usage

Admin Annex II receives electric service, is connected to the steam network, and is not connected to natural gas service. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Steam:** Oakland County Internal Tracking

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

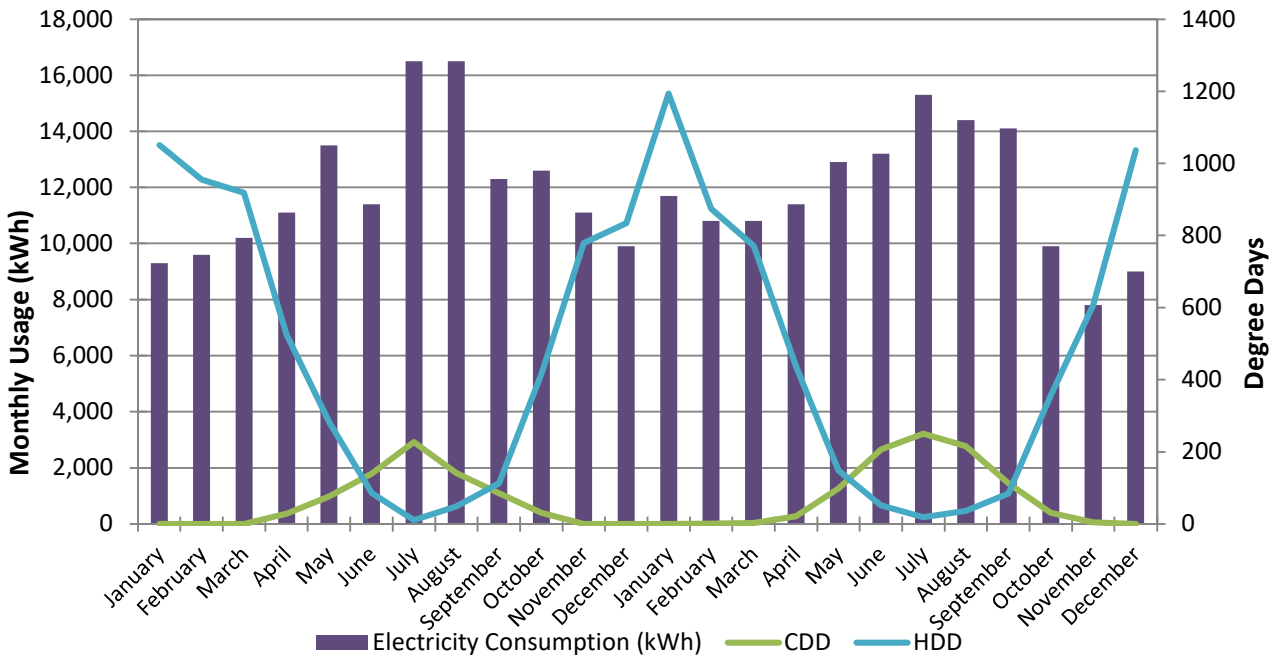
Utility	Annual Usage	Annual Usage (MMBtu)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	141,300 kWh	482	$15,543	$0.11/kWh	*0.0004427*	63
Steam	327 klbs	391	$3,274	$10.00/klb	*0.119*	39
Total		**873**	**$18,817**			**102**

**Steam (1 klb = 1,194,000 Btu); Electricity (1 kWh = 3413 Btu)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage does not show a strong correlation to weather data, indicating the majority of electricity usage consists of baseload usage. This usage does not vary much from month to month and includes loads such as lighting and fan loads. The annual usage for the baseline 12-month period from January to December 2024 is 141,300 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



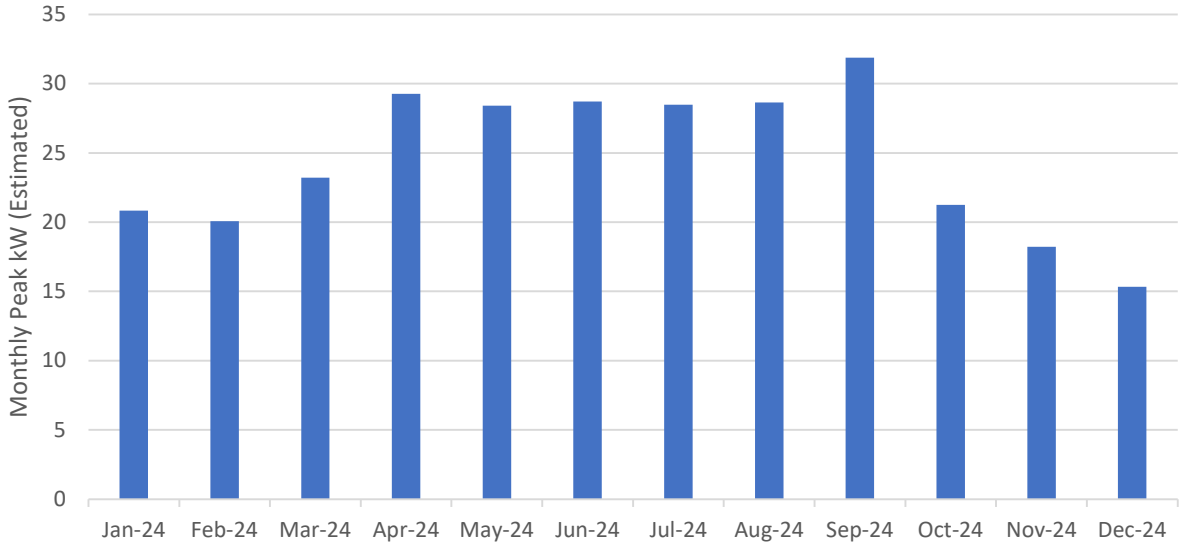
3.3 Building Electrical Capacity Analysis

AECOM has developed a methodology to estimate the peak demand of the building which uses the metered consumption of the building, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 5: Electric Capacity Results

Maximum Building Capacity at Service Transformer	500 kW
Maximum Capacity at Switchgear (A*V*Ph)	600 kW
Estimated Peak Demand	31 kW (from meter)
Remaining Capacity	**469 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

The base does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge:	**$0.057/kWh**
DTE Electric Demand Charge:	**$6.15/kW/Month**
Average Dollar per kWh Used in Calculations:	**$0.11/kWh**

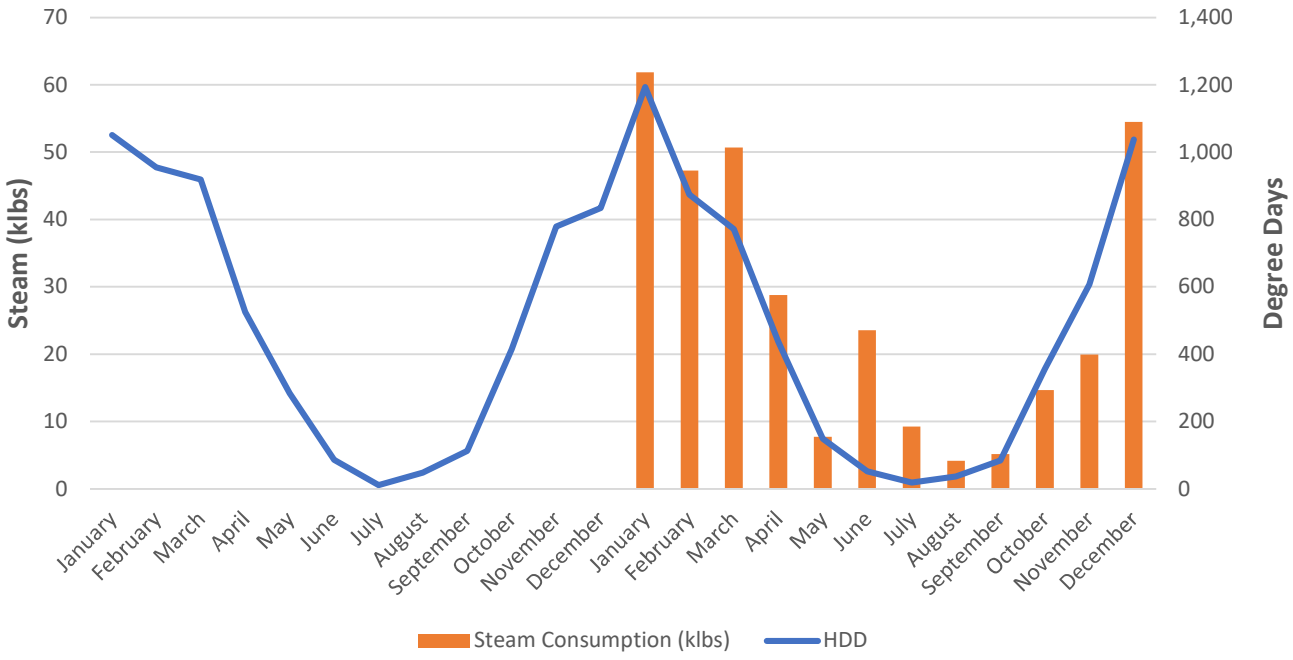
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Steam Usage Profile

Figure 3 compares the monthly steam usage profile for 2024 with local monthly weather data for 2023 – 2024 indicated by HDD. Steam data for 2023 is not available. Steam usage shows a direct correlation to weather data, as steam is primarily used for space heating. The annual usage for the baseline 12-month period from January to December 2024 is 327 klbs. Detailed monthly steam usage and costs are in Appendix A.

Figure 3: Steam Usage Profile (January 2023 to December 2024)



3.4.1 Steam Rate Structure

Unlike electricity and natural gas, which are billed directly by external utilities, steam is an internal utility produced on campus. The cost allocation for steam is derived from the total natural gas cost at the central steam plant, as well as costs to operate the plant. Each steam-served building is billed proportionally based on its metered steam usage relative to the campus total. As a result, there are no separate delivery, demand, or third-party charges; the unit cost of steam reflects the cost of natural gas, plant operating cost and efficiency, and distribution system performance.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings.

Average Dollar per klb Used in Calculations: $10.00/thousand lbs

3.5 Energy Cost Index

The energy cost analysis is based on the information provided by the County for 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$15,543
Steam	$3,274
Total	$18,817
ECI $/yr/sf	$0.55

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within the RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

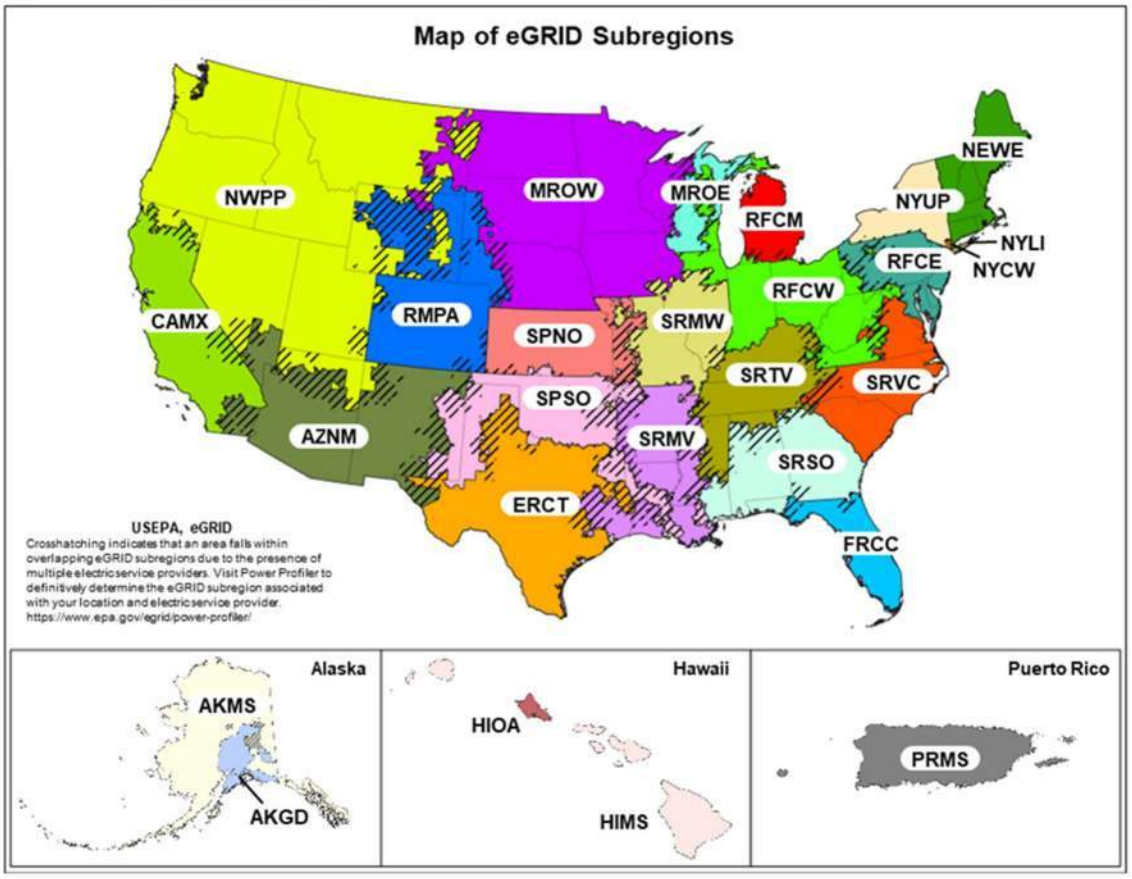
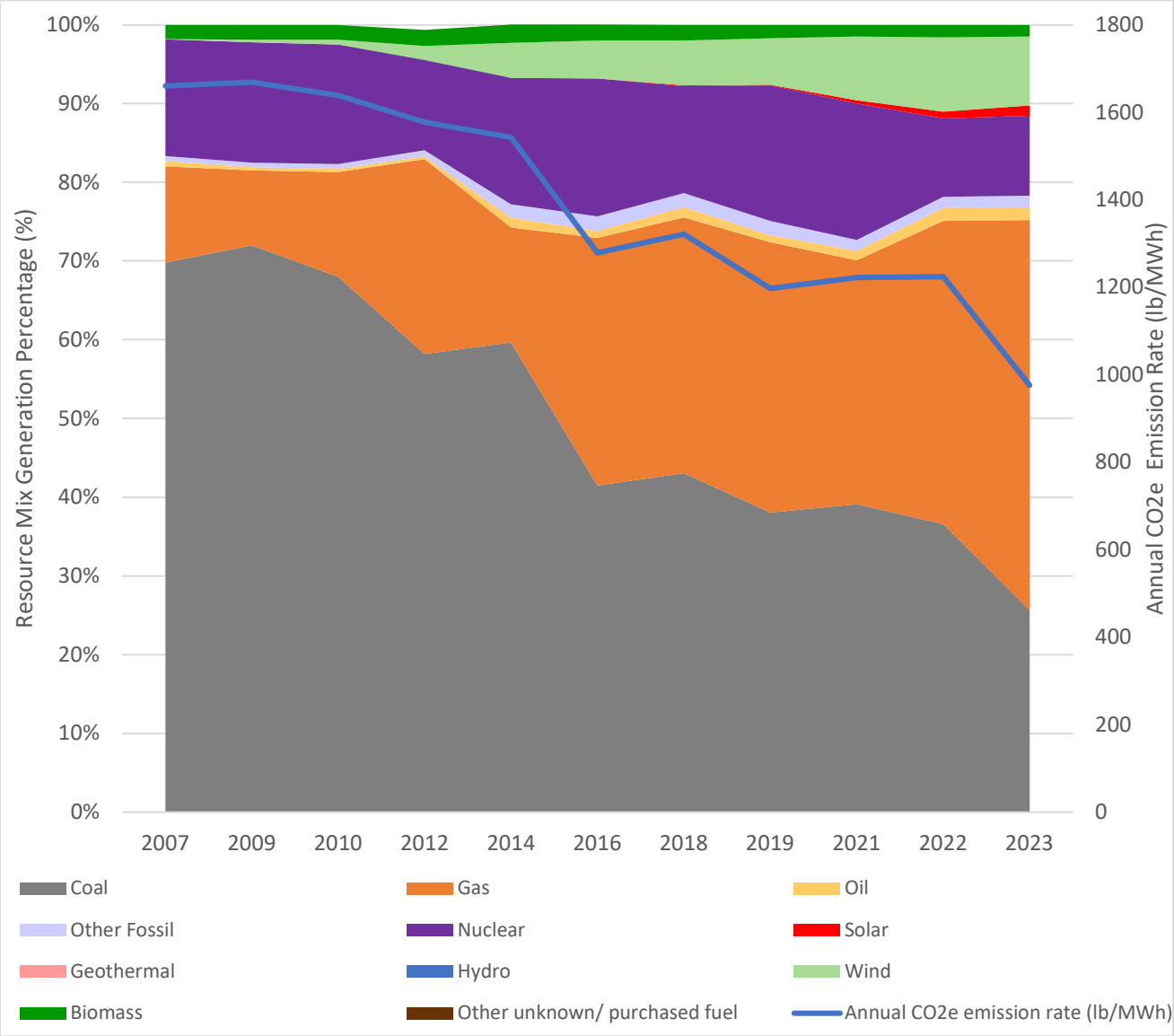


Figure 5 displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Building portfolio Scope 1 emissions include the emissions generated from on-site combustion, and Scope 2 emissions are based on the emissions factor of imported electricity. Approximately 35% of carbon emissions are attributed to Steam and 65% associated with electricity. Steam for space heating and imported electricity resulted in 34 tCO2e (Scope 1) and 63 tCO2e (Scope 2) emissions, respectively, for a total of 96 tCO2e emissions. Oakland County does not currently purchase RECs or EACs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend how energy-efficient a building is per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBtu) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and steam for Admin Annex II are converted to kBtus units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Admin Annex II					**Electric EUI:**	14	kBtu/SF/yr
GFA:	34,157	SF				**Steam EUI:**	11	kBtu/SF/yr
eGRID Subregion:	RFCM					**Current EUI**	26	kBtu/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	141,300	kWh	3.412	482	0.0004427	63	$15,543	83%
Natural Gas	0	MCF	1.038	0	0.0549206	0	$0	0%
Steam	327	klbs	1194	391	0.1190000	39	$3,274	17%
		Totals		**823**		**102**	**$18,817**	**100%**

According to the US EPA, the average site energy use intensity is 20.2 kBTU/SF/yr for a storage facility and 52.9 kBTU/SF/yr for an office. Given that the Admin Annex II is 95% storage facility and 5% office space, the average site EUI is approximately 21.8 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 26 kBTU/SF, which is slightly higher than the national benchmark. However, observations from the site visit indicate there are opportunities to optimize existing systems to reduce energy consumption and improve the efficiency of the facility. The low steam usage may also be attributed to a metering issue and may actually be higher, as simultaneous heating and cooling was observed and the building did not appear to have much setback of HVAC systems.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager®

Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient
Technology/Science	Data Center* *(Average PUE presented in place of EUI: PUE = Total Energy / IT Energy)*		1.82	1.82	EPA - Data Center
	Laboratory		318.2	115.3	CBECS - Laboratory
	Other – Technology/Science		89.3	40.1	CBECS - Other
Services	Data Center* *(Average PUE presented in place of EUI: PUE = Total Energy / IT Energy)*		1.82	1.82	EPA - Data Center
	Personal Services (Health/Beauty, Dry Cleaning, etc.)		96.9	47.9	CBECS - Service
	Repair Services (Vehicle, Shoe, Locksmith, etc.)				
	Other - Services				
Utility	Drinking Water Treatment & Distribution *(Average EUI presented in Energy per Flow in gallons per day)*		5.90	2.27	AWWA - Water Treatment Plant
	Energy/Power Station		89.3	40.1	CBECS - Other
	Wastewater Treatment Plant* *(Average EUI presented in Energy per Flow in gallons per day)*		7.51	2.89	AWWA - Wastewater Plant
	Other - Utility		89.3	40.1	CBECS - Other
Warehouse/Storage	Self-Storage Facility		47.8	20.2	CBECS – Non-refrigerated Warehouse
	Warehouse/Distribution Center	Distribution Center*	52.9	22.7	CBECS – Non-refrigerated Warehouse & Distribution Center
		Non-Refrigerated Warehouse*			
		Refrigerated Warehouse*	235.6	84.1	CBECS – Refrigerated Warehouses

3.8 End Use Breakdown

The table below shows the estimated energy usage breakdown as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based on an annual hot water usage estimation by factoring in the water heater efficiency and number of employees. Table 8 and Figure 6 and Figure 7 below show the full estimated breakdown of each end use and their contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Breakdown (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (klbs)**	**Site Energy Total (kBtu)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	0	306	365,510	**10.7**	**36.4**
Space Cooling	23,651	0	0	80,697	2.4	10.5
Fans	26,346	0	0	89,894	2.6	11.7
Pumps	13,677	0	0	46,667	1.4	6.1
DHW	0	0	21	25,431	0.7	2.5
Conveyance	0	0	0	0	0.0	0.0
Lighting	70,244	0	0	239,674	7.0	31.1
Plug Loads	4,001	0	0	13,653	0.4	1.8
Process Loads	3,380	0	0	11,532	0.3	1.5
Refrigeration	0	0	0	0	0.0	0.0
Cooking	0	0	0	0	0.0	0.0
Information Technology	0	0	0	0	0.0	0.0
TOTAL	141,300	0	327	873,056	25.6	101.5
Historical Billing	141,300	0	327			
Percent of Actual	100%	0%	100%			
per sqft	4.1	0	0.0			

Figure 7: Existing Electricity End Use Distribution

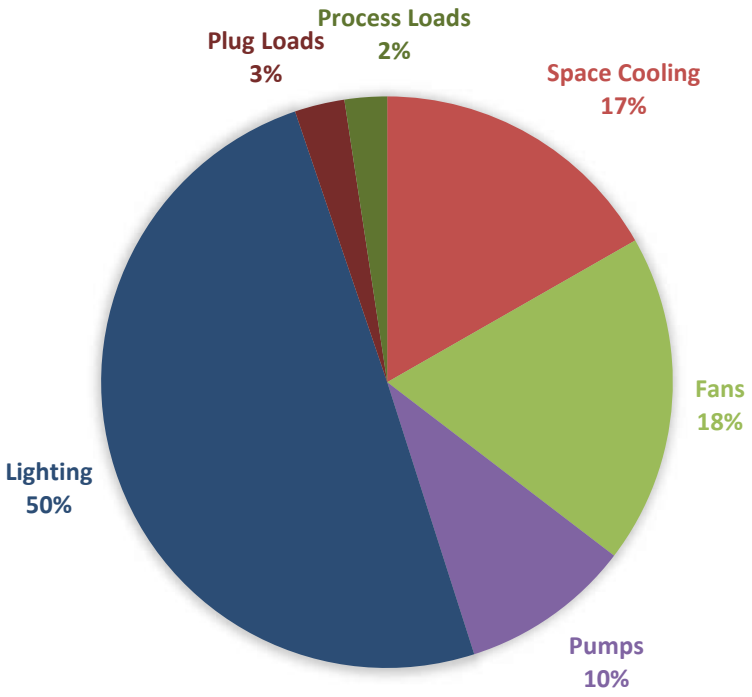
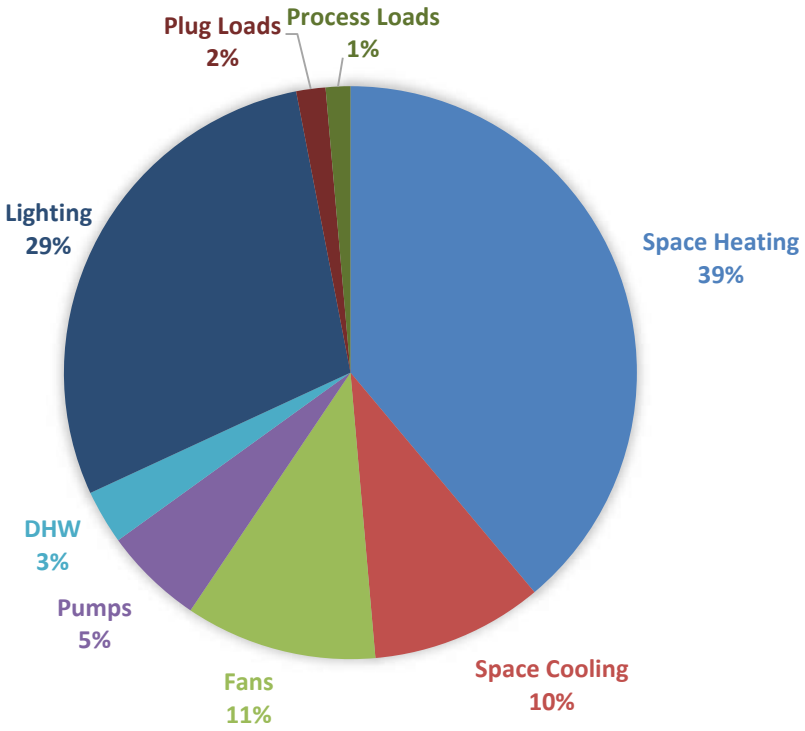


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The projects discussed in this section are economically viable but are not intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures. These measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure, but it reveals their potential impact on the economic and energy standpoint. The main goal of these measures is to provide options for facility management and set the baseline for proceeding with the implementation of selected projects. On the other hand, some of these measures may interact with capital improvement projects. In this case, the project selection and planning for implementation must be meticulously considered the future projects to avoid double dipping, emphasizing the need for caution and attention to detail in decision-making.

The cost estimates are rough orders of magnitude (ROM) numbers that show an estimated price for each measure. Once the project enters the design phase, more precise cost estimates may be created. The cost estimates used information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – LED Lighting and Controls

This measure proposes upgrading all remaining fluorescent lighting (approximately 343 fixtures) to Light-emitting diode (LED) lightbulbs with motion sensors and dimming functionality where appropriate to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements.

Incorporating lighting controls allows for better management and customization of lighting systems, leading to reduced energy consumption, and increased overall efficiency by limiting the time lighting is on to only when necessary. For indoor lighting, lighting controls consist of occupancy, daylighting, timers, scheduling, and dimming features to optimize light levels based on external lighting availability and usage of a space. For outdoor lighting, the lighting controls consist of motion sensors, photocells, and timers to turn the lighting ON/OFF. The current lighting in Admin Annex II is approximately 23% LED and 77% fluorescent and the estimated wattage is approximately 0.89 W/ft². See Section 2.1.3 for the lighting counts used to estimate energy consumption.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture. Lighting controls that include dimming will likely require full fixture replacement, which drive up the total cost of implementation for the measure.

- This measure assumes lighting savings of approximately 0.52 W/ft² or 60% reduction in lighting power and a 40% reduction in hours of operation for adding new controls.
- Lights are assumed to be turned on 9 hours per day for 252 business days of the year.
- LED upgrades cost $150/fixture and motion sensors, costing $250 per sensor, would be placed on 10% of the fixtures.
- O&M savings assume an average cost of $1.94/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, the subsequent steps would involve conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. Following this assessment, a controls contractor can be engaged to install the lighting controls and assist building engineers in configuring the schedule to optimize lighting usage. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 9: ECM 1 Savings and ROM Cost

	Savings Summary							
ECM	**District Steam Savings (klbs)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
LED Upgrade	0	40,008	137	18	$1,707	$4,401	$51,450	8.4
Lighting Controls	0	9,602	33	4	$0	$1,056	$8,575	8.1
Total	**0**	**49,609**	**169**	**22**	**$1,707**	**$5,457**	**$60,025**	**8.4**
Overall % Reduction	0%	35.1%	20.6%	22.8%	--	29.7%	--	--

4.2 ECM 2 – BAS Controls Integration and Commissioning

This combined measure involves installing a building automation system (BAS) and completing retro commissioning (RCx) once the BAS is operational. Together, these steps enable centralized control, improve system coordination, and ensure building operations are optimized for efficiency and reliability.

ECM 2 is recommended despite a long simple payback because the BAS and commissioning provide critical controls infrastructure, address observed simultaneous heating/cooling and 24/7 operation, protect archival spaces, and enable future ECMs and electrification projects across the Service Center.

BAS Integration

BAS integration refers to connecting and coordinating various building systems and components through a centralized control platform. The goal is to enhance the overall efficiency, functionality, and manageability of building operations. While BAS installation does not directly yield energy savings, it enables the optimization of other measures. In Admin Annex II, BAS integration would allow centralized monitoring and optimization of the AHUs and split system condensing units, RTUs, steam-to-hot-water distribution pumps, and terminal baseboard heaters which currently operate independently with minimal automation and often run simultaneously while AHUs are in cooling mode.

Commissioning

With BAS installed, Annex II will have centralized visibility and control of major HVAC systems for the first time. Commissioning is a critical follow-on activity to ensure the BAS is properly configured, sequences of operation are optimized, and long-standing inefficiencies are resolved. Commissioning includes systematically evaluating and fine-tuning HVAC, controls, and other energy-consuming systems to restore them to design intent and reduce energy waste.

The following list represents commissioning opportunities that should be evaluated to validate operation, repair if discrepancies identified or implement if not active and feasible for major HVAC systems. This effort will proactively improve building system operation and optimize energy usage.

- Optimize HVAC scheduling in non 24/7 occupied spaces
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water supply reset
- Discharge air setpoint reset
- Outside air temperature lockouts

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing a BAS will have no change to existing controls capabilities and will increase customization of equipment.
- Commissioning will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 12% reduction in estimated heating, cooling, fan, and pump end use energy consumption.
- Project cost is estimated at $2 per square foot of building area.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Identify equipment to be connected to the central control system and engage a building controls integration company to plan and cost the system integration. Coordinate with planned capital upgrades and renovations where possible to optimize benefits. This measure is recommended for implementation.

ECM Savings and ROM Cost

Table 10: ECM 2 Savings and ROM Cost

Savings Summary								
ECM	**District Steam Savings (klbs)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
Controls Integration & RCx	37	8,047	71	8	$1,252	$68,314	54.5	71
Overall % Reduction	11.2%	5.7%	8.2%	7.8%	6.7%			8.2%

5 Considered But Not Currently Recommended

No additional measure recommended at this time.

6 Appendix A

Table 11: Monthly Utility Data (2023 to 2024)

Month	Steam Consumption (klbs)	Steam Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	-	-	9,300	$998	13	17	1,050.9	0
Feb-23	-	-	9,600	$904	14	18	954.6	0
Mar-23	-	-	10,200	$915	14	22	918.4	0
Apr-23	-	-	11,100	$977	15	25	525.3	28.1
May-23	-	-	13,500	$1,065	18	30	283.4	76.3
Jun-23	-	-	11,400	$854	16	25	86.3	139.1
Jul-23	-	-	16,500	$1,335	22	31	11.3	226.9
Aug-23	-	-	16,500	$1,311	22	33	48.3	140.6
Sep-23	-	-	12,300	$1,132	17	28	112.5	84.9
Oct-23	-	-	12,600	$1,025	17	27	414.5	31.1
Nov-23	-	-	11,100	$852	15	26	779.2	0
Dec-23	-	-	9,900	$703	13	17	834.1	0
Jan-24	61.84	$618	11,700	$270	16	21	1,193.6	0
Feb-24	47.26	$473	10,800	$1,105	16	20	873.9	1
Mar-24	50.68	$507	10,800	$871	15	23	771.2	2.1
Apr-24	28.75	$288	11,400	$1,000	18	29	437.1	20.9
May-24	7.70	$77	12,900	$1,085	17	28	148.4	98
Jun-24	23.56	$236	13,200	$1,213	18	29	51.4	206.7
Jul-24	9.22	$92	15,300	$1,363	21	28	18.4	250.9
Aug-24	4.18	$42	14,400	$1,324	19	29	36.6	215.4
Sep-24	5.17	$52	14,100	$1,131	20	32	84	112.3
Oct-24	14.65	$147	9,900	$940	13	21	356	30.7
Nov-24	19.93	$199	7,800	$841	11	18	606.9	4.2
Dec-24	54.48	$545	9,000	$757	12	15	1,036.80	0
2023 Sum	-	-	144,000	$12,071			6,019	727
2024 Sum	327.42	$3,274	141,300	$11,900			5,614	942

7 Appendix B

Table 12: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity	Units	Approx Year Installed
AHU-1,2	2	Air handling unit (Dx), recirc only	Basement records	Carrier	4OFS220310	1	HP	
AHU-3	1	Air handling unit (Dx), recirc only	Records 1st floor	Carrier	40RM-007-B600GC	2.4	HP	
	1	Rooftop unit (Dx)		Carrier	48FCFA06A2A5A0A0A0	150	MBH	
	1	Rooftop unit (Dx)		Carrier	50TFF006---511HQ	5	Ton	
	6	Window AC (Dx)	Multiple offices			0.5	Ton	
	1	Air Compressor	HVAC controls	Dayton	5Z701A	3	HP	
	1	Condenser unit	Records AHUs	Intl Comfort Products	HAC048AKA4	4	Ton	2002
	1	Condenser unit	Records AHUs	RHEEM	13AJA60C01115	5	Ton	2013
	1	Condenser unit	Records AHUs	Arcoaire	CA5560VHC1; CBA060HA1	5	Ton	1995
	1	Steam to hot water heat exchanger				N/A		
	1	HW Recirculation Pump		B&G	Illegible	2	HP	
	1	HW Recirculation Pump		Emerson	AF30-D2E2D	2	HP	
	1	In-line Condensate Return and Pump		Marathon	5KC37FN65HX	0.333	HP	
	1	Exhaust fan, in-line	Shredder room	Greenheck	BCF type, illegible model #	0.5	HP	
	1	Exhaust fan	Women's TR			0.5	HP	
	1	FTR	Corridor 1st floor					

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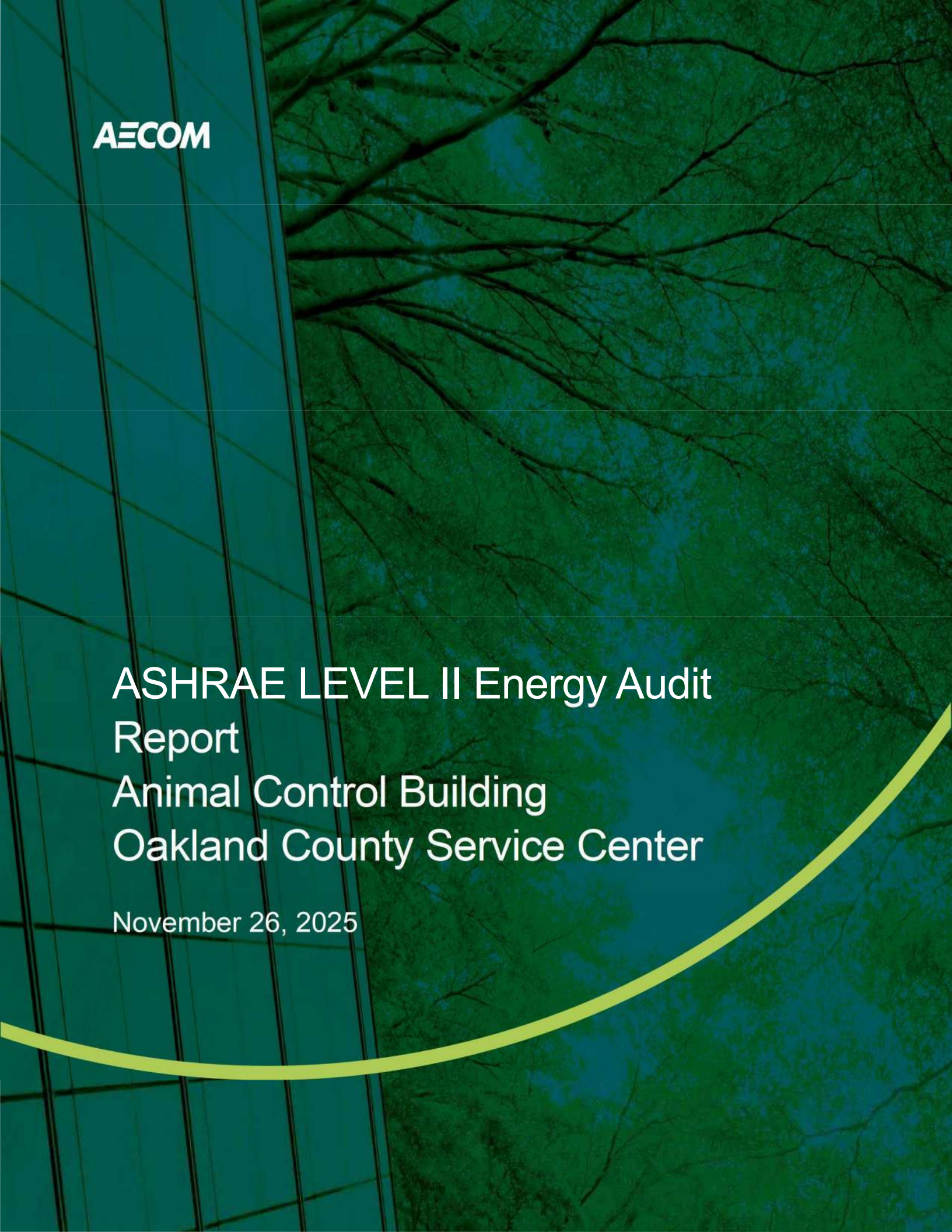

AECOM

ASHRAE LEVEL II Energy Audit Report
Animal Control Building
Oakland County Service Center

November 26, 2025

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

Prepared for:
OAKLAND COUNTY, MI Government

Prepared by:
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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Animal Control in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County Animal Control Building is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Wednesday April 9, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates one ECM for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The recommended measure represents a projected 12% annual energy cost savings with an aggregate simple payback of 1 year.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Animal Control Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	tCO2e	$/yr	$/yr	$	Years
1	Retro-commissioning	HIGH	R	120,513	0	1,102	0	1,555	113.9	$0	$18,747	$21,259	1
Sum of Recommended Measures				**120,513**	**0**	**1,102**	**0**	**1,555**	**114**	**$0**	**$18,747**	**$21,259**	**1**
Overall % Reduction				**12%**	**0%**	**13%**	**0%**	**13%**	**12%**	**--**	**12%**	**--**	**--**

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

Animal Control is a 35,000 ft^2 building constructed in 2021 that is primarily used as a shelter and veterinary center for sick, stray, and lost animals in the county. The building operates 24/7.

2.1 Building Systems

2.1.1 Building Envelope

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Masonry construction with slab exteriors in some areas	Good
Roof	Flat roof with black membrane, insulation above deck	Good
Glazing	Double pane with a very low window to wall ratio	Good

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

This building was completed in 2018, and its major equipment is in very good condition. Three packaged natural gas fired heating and direct expansion (DX) cooling rooftop units (RTUs) serve the building. RTU-1 with a heating capacity of 156 MBH and cooling capacity of 181 MBH serves the front office areas, RTU-2 serves the adoption lobby and has a heating capacity of 73 MBH and cooling capacity of 90 MBH, while RTU-3 serves the community rooms and has a heating capacity of 156 MBH and cooling capacity of 154 MBH. The RTUs are all manufactured by AAON. The conditioned air is supplied through VAVs to the rooms.

Seven Energy Recovery Units (ERUs) with multistage scroll compressors for cooling and natural gas fired heating serve the remaining areas of the facility. ERU-01 does not have an energy recovery wheel despite its name. There are 14 exhaust fans located on the roof.

Table 3: ERU Summary

ERU	Heating Capacity (MBH)	Cooling Capacity (MBH)	Rooms Served
ERU-1	560	452	146-148, 168-170
ERU-2	200	241	160-167, Corridor 181
ERU-3	160	150	-
ERU-4A	120	128	-
ERU-4B	150	150	-
ERU-5	120	129	-
ERU-6	200	222	-

Heating inside the building is generated by two natural gas fired condensing boilers which are in very good condition. The output capacity is 1,203 MBH each. Two heating hot water pumps (HHWPs) are operated by variable frequency drives (VFDs) having 5 HP motors each. The hot water system operates with a reset sequence from 180°F to 150°F at outdoor air temperatures of 25°F to 60°F, respectively.

There is one heating and ventilating unit serving the sally port with a heating output capacity of 168 MBH and a snow melt heat exchanger with 237 MBH capacity which has a pump powered by a 0.25 horsepower (HP) motor.

There are two split air conditioning (AC) units. AC-1 has an 18,000 BTUh capacity and serve the COM 127 room, and AC-2 serves the SX 150 room and has a capacity of 9,500 BTUh.

The total cooling capacity of the systems serving this building is 176 tons and the total gas space heating capacity is 3,351 MBH.

2.1.2.2 Plumbing

Two 75-gallon natural gas fired domestic hot water heaters with an input capacity of 100 MBH serve the facility.

2.1.2.3 Building Controls

The building is controlled by a fully direct digital control (DDC) Niagara building management system (BMS) in good condition. The BMS provides centralized DDC-based control over HVAC systems, allowing for scheduling, temperature-based setpoint control, and override functions. Lighting controls are predominantly manual wall switches, with occupancy sensor automation in select spaces.

2.1.3 Lighting Systems

The building lighting systems use a variety of fixture types, depending on the purpose of space. All lighting is LED except for specialty purposes, which are not significant. Lighting controls are mostly local wall switch, but occupancy sensors exist in some areas.

2.1.4 Electrical Infrastructure

The building is served by a 1000A 480/277V 3-phase service that fed from a pad mounted 750 kVA transformer on the exterior space around the building.

3 Utility Billing Analysis

3.1 Utility Type and Usage

The Animal Control Building receives electric service and natural gas service and is not connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed includes the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

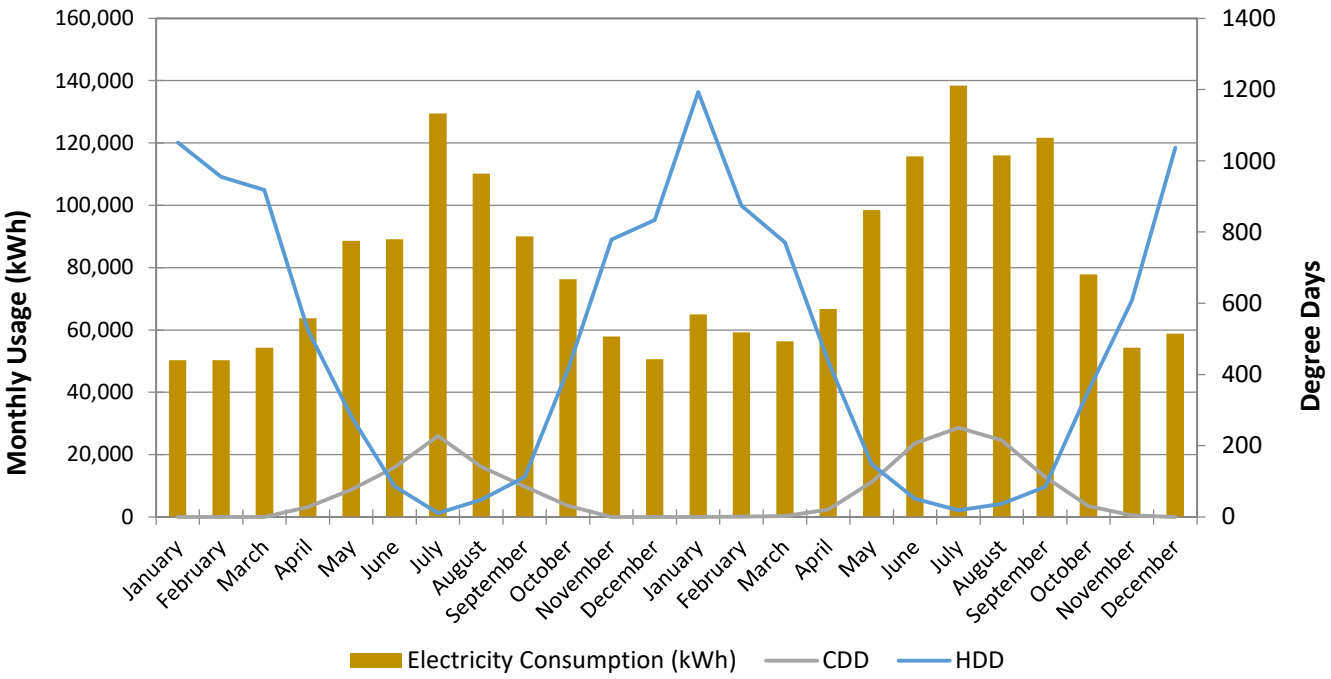
Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	1,028,396 kWh	3,509	$113,124	$0.11	0.0004427	455
Natural Gas	8,535 MCF	8,860	$42,526	$4.98	0.0549206	469
Total	--	**12,369**	**$155,650**	**--**	**--**	**924**

**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a strong correlation to CDD with electricity usage peaking in the summer months when cooling loads are highest. This is expected due to the high ventilation and outdoor air requirements to maintain proper indoor air quality. The annual usage for the baseline 12-month period from January to December 2024 is 1,028,396 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



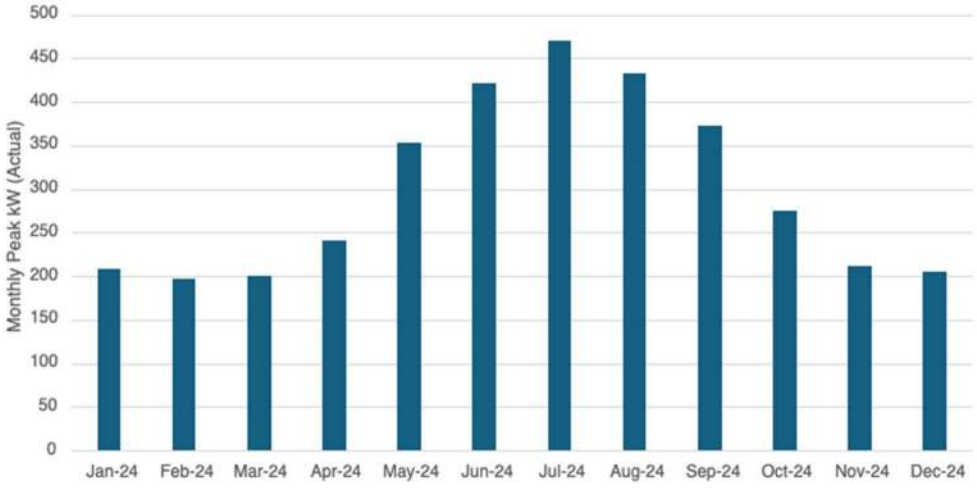
3.3 Building Electrical Capacity Analysis

The facility's electrical demand is metered through SEL735 power monitors integrated with LIMBACH's Energy Management System. Based on the client-provided 2024 daily demand data, the highest recorded monthly peak demand was approximately 469.47 kW in July 2024.

Table 5: Electric Capacity Summary

Maximum Building Capacity at Service Transformer	750 kW
Maximum Capacity at Switchgear (A*V*Ph)	831 kW
Estimated Peak Demand	470 kW
Remaining Capacity	**281 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge:	**$0.057/kWh**
DTE Electric Demand Charge:	**$6.15/kW/Month**
Average Dollar per kWh Used in Calculations:	**$0.11/kWh**

Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

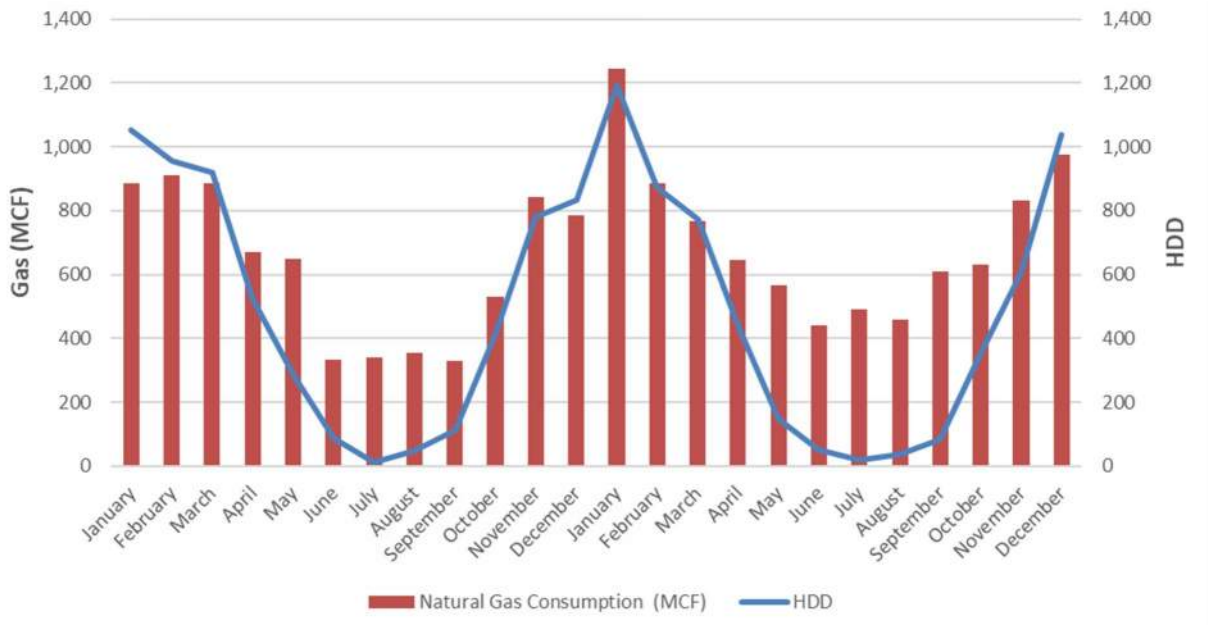
Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. The annual usage for the baseline 12-month period from January to December 2024 is 8,535 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Natural gas usage shows a direct correlation to weather data, as natural gas peaks in the winter months for space heating due to the high ventilation and outdoor air requirements. However, it's important to note there is a significant gas baseload year-round. A portion of this is related to domestic hot water use for bathrooms, laundry, and cleaning, but based on the major mechanical equipment its appears there is a significant amount of gas heating occurring during the spring and summer months likely due to a combination of high ventilation loads and 24/7 operations and potentially unnecessary reheat or simultaneous heating and cooling. This is an opportunity to evaluate and optimize gas usage in a comprehensive retro-commissioning project (ECM 1).

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): $3.48/dTh (decatherm, or 1.038 MCF)

Constellation NG Usage Charge (Day Gas): $5.29/dTh (decatherm, or 1.038 MCF)

Average Dollar per MCF Used in Calculations: $4.98/MCF

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$113,124
Natural Gas	$42,526
Total	$155,650
ECI $/yr/sf	$4.39

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American

Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

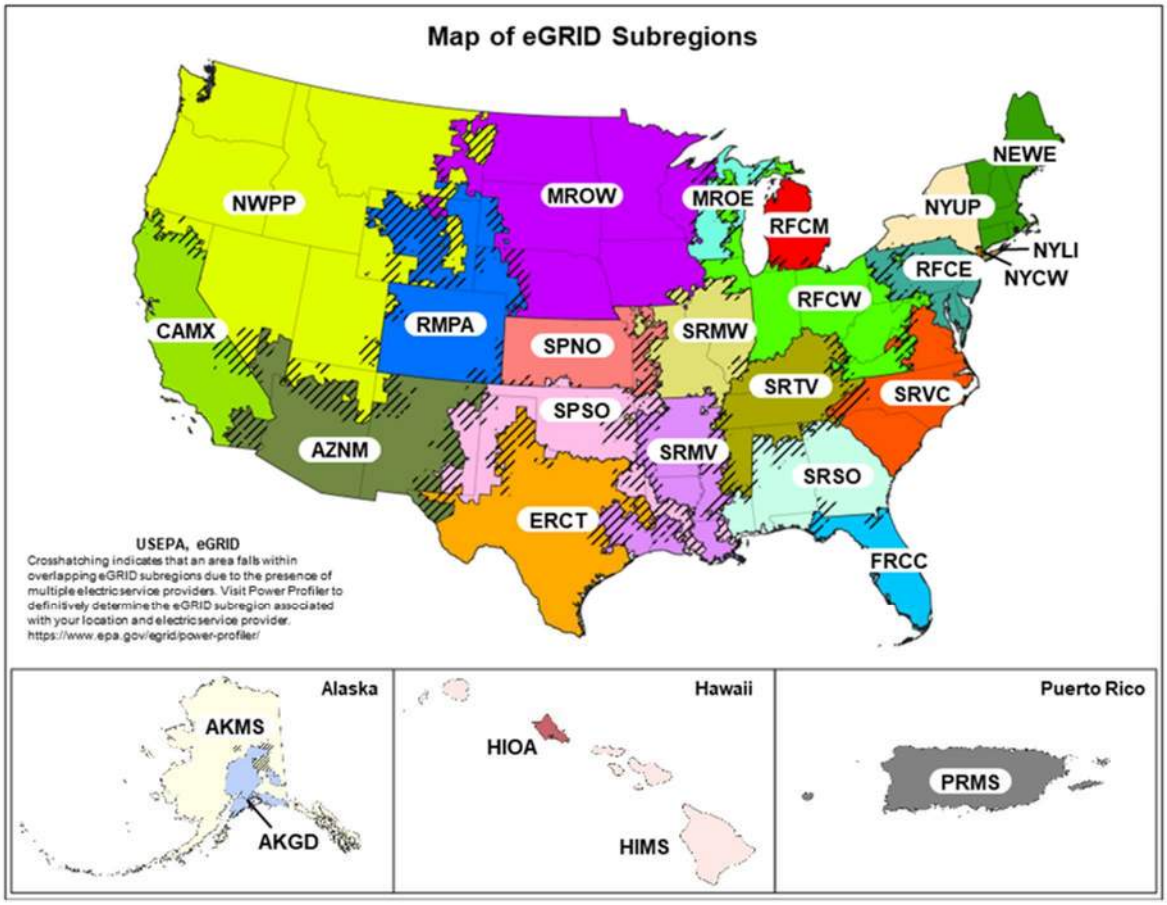
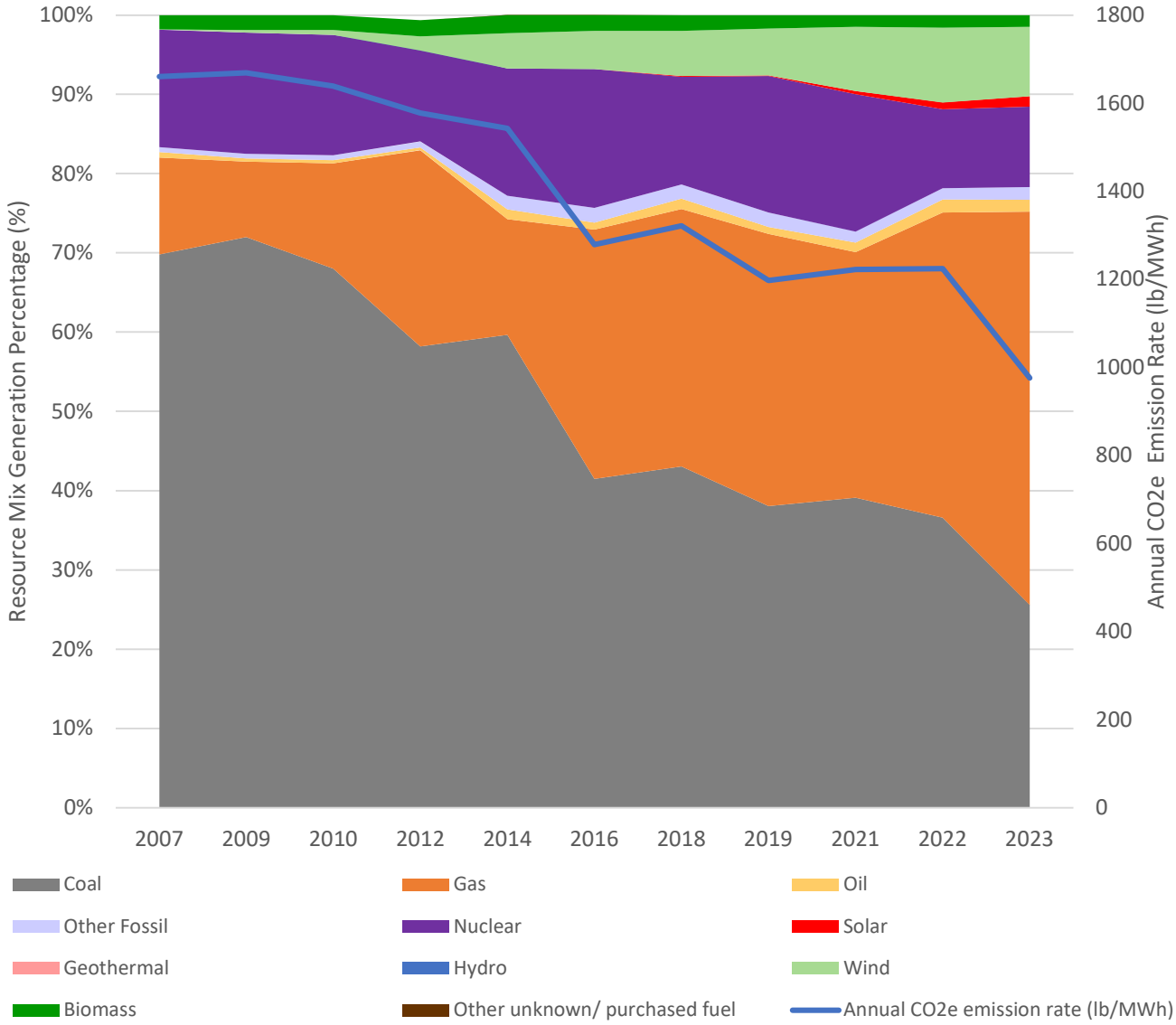


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 51 percent of carbon emissions are attributed to natural gas and 49 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 469 tCO2e (campus-level Scope 1) and 455 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 924 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for Animal Control are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Animal Control				**Electric EUI:**		99	kBTU/SF/yr
GFA:	35,431	SF			**Gas EUI:**		250	kBTU/SF/yr
eGRID Subregion:	RFCM				**Current EUI**		349	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	1,028,396	kWh	3.412	3,509	0.0004427	455	$113,124	73%
Natural Gas	8,535	MCF	1.038	8,860	0.05294	469	$42,526	27%
Steam	0	klbs	1194	0	0.0000076	0	$-	0%
		Totals		**12,369**		**924**	**$155,650**	**100%**

This facility is unique and does not have a direct EUI benchmark category, however, according to the US EPA, the average site energy use intensity for a veterinary office is 131.2 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 349 kBTU/SF, which is significantly higher than the national benchmark. It's important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI is even significantly higher than a hospital, which has a median EUI of 234.3 kBTU/SF/yr and also has high ventilation and outdoor air loads. This comparison indicates there is a significant opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient

3.8 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is estimated using the baseload summer gas usage and water heater specifications and efficiency. Table 8 and Figures 7 & 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (klbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	7,347	0	7,625,902	215	403
Space Cooling	245,515	0	0	837,696	24	109
Fans	557,903	0	0	1,903,566	54	247
Pumps	10,971	0	0	37,433	1	5
DHW	0	1,189	0	1,233,720	35	65
Conveyance	0	0	0	0	0	0
Lighting	124,150	0	0	423,601	12	55
Plug Loads	18,554	0	0	63,306	2	8
Process Loads	69,303	0	0	236,461	7	31
Refrigeration	2,000	0	0	6,824	0	1
Cooking	0	0	0	0	0	0
Information Technology	0	0	0	0	0	0
TOTAL	**1,028,396**	**8,535**	**0**	**12,368,509**	**349**	**924**
Historical Billing	1,028,396	8,535	0			
Percent of Actual	100%	100%	0%			
per sqft	29	2.5	0			

Figure 7: Existing Electricity End Use Distribution

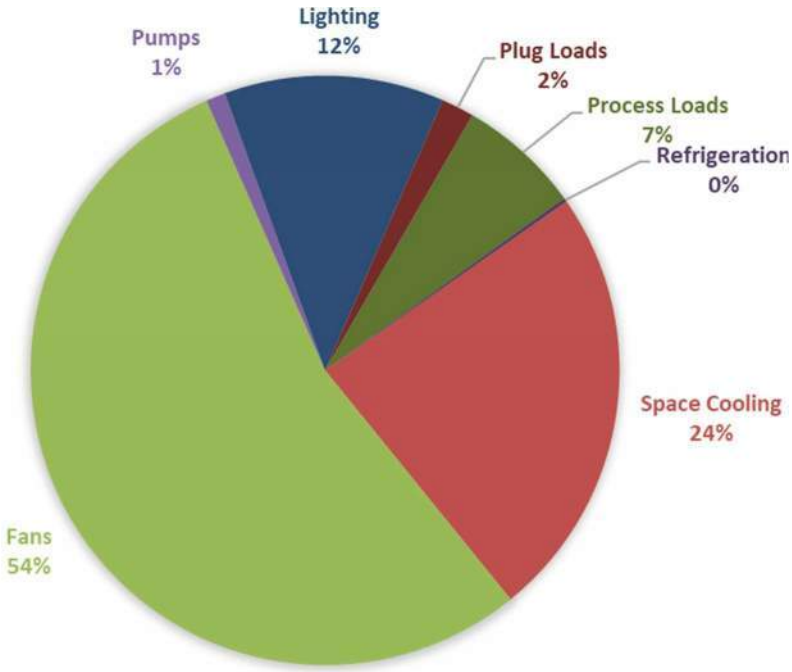
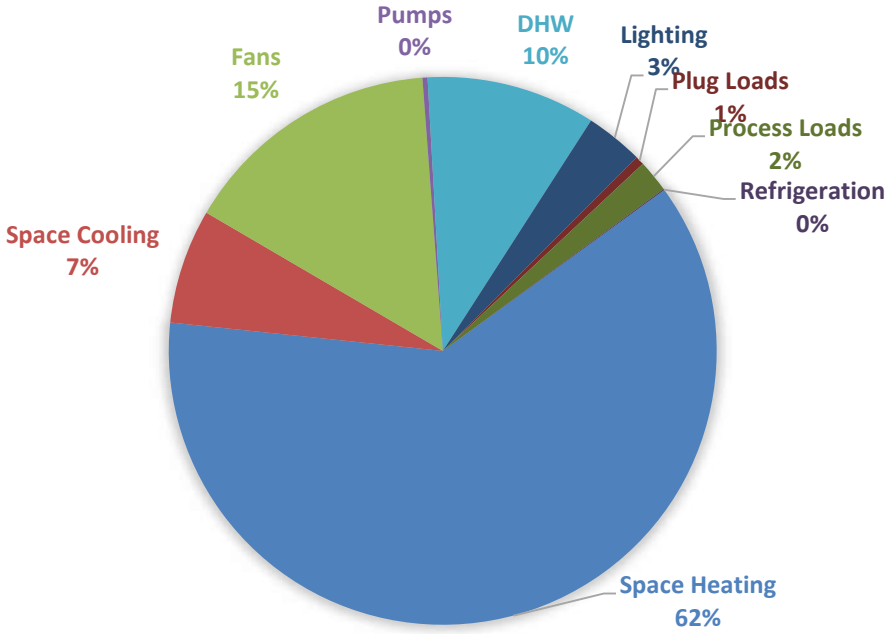


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures (ECM)

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 - Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent. The Animal Control Building is a relatively new building with modern HVAC systems and controls, designed with energy-efficient technologies and sequences of operation. However, this building is designed for 24/7 occupancy with high ventilation and outdoor air loads due to the space function to maintain indoor air quality when the building is at full capacity with animals and staff. It's recommended to RCx this building at least every 4-5 years to ensure its operating as intended and as efficiently as possible as systems tend to drift over time.

Observations from the site visit, utility data analysis, and high-level review of the BAS system indicate that not all systems are operating optimally or may have opportunities to optimize operation. A few examples include:

- The EUI is significantly higher than the median veterinary office and hospital benchmarks, indicating excessive energy use likely associated with high ventilation loads.
- Not all areas of the building are occupied 24/7 and there appears to be an opportunity to optimize setback temperatures and schedules in certain areas while maintaining minimum comfort levels in areas occupied with animals.
- The outdoor air temperature sensor is inaccurate for at least one RTU.
- ERU-3 and ERU-4B show unoccupied but the fan is operating at 100% with the energy recovery wheel off and supply air is 55°F. ERU-5 shows unoccupied, but the fan and energy recovery wheel are operating. ERU-2 and ERU-6 are showing occupied and operating but the energy recovery wheel speed is 0%. These instances are likely increasing the heating load on the terminal heating coils to maintain 70°F. The ERU and terminal unit sequences of operation should be reviewed.

While each of these individual examples are minor concerns, these illustrate an opportunity to systematically evaluate all major systems to identify and resolve similar operational discrepancies to optimize system performance and reduce energy usage. The following list represents RCx opportunities that should be evaluated to validate operation, modify and/or repair if discrepancies identified if systems not scheduled for timely replacement. This effort will proactively improve building system operation and optimize energy usage.

- Optimize HVAC scheduling where appropriate
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water supply reset
- Discharge air setpoint reset
- Outside air temperature lockouts
- Outside air damper control
- Duct static pressure reset
- Repair airside economizing
- Demand-controlled ventilation

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 15% reduction in estimated cooling, heating, and fan end use energy consumption.
- $0.60/sqft was used to estimate the cost of RCx.
- Additional study of equipment capacity requirements could be performed as part of this measure.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: This measure proposes engaging a third-party contractor to determine if this building is eligible for the DTE RCx program and systematically evaluate and prioritize major HVAC and control systems and complete retro-commissioning to restore systems to their original design intent. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 9: ECM 1 Savings and ROM Cost

	Savings Summary							
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Annual O&M Savings ($)	Est Project Cost	Simple Payback (Yrs)
RCx	1,102	120,513	1,555	114	$18,747	$0	$21,259	1.1
Overall % Reduction	13%	12%	13%	12%	12%		--	--

5 Measures Requiring Additional Consideration

No additional ECMs have been considered.

6 Appendix A

Table 10: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	886	$5,439	50,267	$5,395	68	89	1,051	0
Feb-23	912	$5,330	50,267	$4,735	75	93	955	0
Mar-23	884	$2,690	54,327	$4,873	73	117	918	0
Apr-23	671	$2,324	63,741	$5,609	89	145	525	28
May-23	647	$1,935	88,579	$6,986	119	195	283	76
Jun-23	332	$820	89,101	$6,674	124	194	86	139
Jul-23	339	$1,359	129,520	$10,483	174	241	11	227
Aug-23	353	$1,017	110,122	$8,749	148	219	48	141
Sep-23	330	$937	90,075	$8,291	125	204	113	85
Oct-23	532	$1,532	76,324	$6,210	103	164	415	31
Nov-23	841	$3,137	57,901	$4,446	80	135	779	0
Dec-23	783	$3,865	50,613	$3,593	68	86	834	0
Jan-24	1,242	$5,472	64,937	$1,498	87	116	1,194	0
Feb-24	884	$4,817	59,221	$6,057	88	110	874	1
Mar-24	766	$4,335	56,342	$4,546	76	121	771	2
Apr-24	643	$1,342	66,770	$6,292	137	223	437	21
May-24	565	$1,147	98,436	$9,220	132	217	148	98
Jun-24	442	$1,434	115,709	$10,632	161	252	51	207
Jul-24	490	$1,586	138,372	$12,326	186	258	18	251
Aug-24	459	$978	116,021	$10,670	156	231	37	215
Sep-24	608	$1,475	121,629	$9,753	169	275	84	112
Oct-24	629	$1,687	77,865	$7,396	105	167	356	31
Nov-24	832	$2,880	54,270	$5,854	75	127	607	4
Dec-24	974	$2,165	58,824	$4,947	79	100	1,037	0
2023 Sum	7,509	$30,385	910,837	$76,044			6,019	727
2024 Sum	8,535	$29,318	1,028,396	$89,191			5,614	942

7 Appendix B

Table 11: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity	Units	Efficiency	Capacity	Units	Approx Year Installed
RTU-1	1	Rooftop Unit (NG, Dx-VAV)	Office areas	AAON	RN-015-3-0-EA09-EF9	15	TON	80%	15	TON	2016
RTU-2	1	Rooftop Unit (NG, Dx-VAV)	Adoption lobby	AAON	RN-015-3-0-EA09-329	8	TON	80%	8	TON	2016
RTU-3	1	Rooftop Unit (NG, Dx-VAV)	Community rooms	AAON	RN-015-3-0-EA09-3F9	13	TON	80%	13	TON	2016
ERU-1	1	Air Handling Unit (NG, Dx)	Rooms 146-148, 168-170	Greenheck	RV-120-35	6,800	CFM		38	TON	2016
ERU-2	1	Air Handling Unit (NG, Dx)	Rooms 160-167, Corridor 181	Greenheck	RVE-80-58P-30H-20	6,425	CFM		20	TON	2016
ERU-3	1	Air Handling Unit (NG, Dx)	Rooms 149-156	Greenheck	RVE-50-52P-15H-12.5	3,890	CFM		13	TON	2016
ERU-4A	1	Air Handling Unit (NG, Dx)	Rooms 157-159, Corridor 180	Greenheck	RVE-35-36P-30H-10	3,000	CFM		11	TON	2016
ERU-4B	1	Air Handling Unit (NG, Dx)	Rooms 116, 118, 119, 121-124	Greenheck	RVE-50-52P-15H-12.5	4,365	CFM		13	TON	2016
ERU-5	1	Air Handling Unit (NG, Dx)	Long term dog housing	Greenheck	RVE-35-36P-30H-10	3,150	CFM		11	TON	2016
ERU-6	1	Air Handling Unit (NG, Dx)	Dog adoption	Greenheck	RVE-80-58P-30H-17.5	6,300	CFM		19	TON	2016
AC-1	1	Split system	Building	Daikin	RX15FVJU (outdoor); FTXS18HVJU (indoor)	18	MBH				2016
AC-2	1	Split system	Building	Daikin	RKN09JEVJU (outdoor); FTKN09JEVJU (indoor)	8.5	MBH				2016
B-1, B-2	2	Boiler (NG)	Building	Lochinvar	FBN 1251	1,203	MBH	96.2%			2016
GWH-1, GWH-2	2	Domestic water heater	Building	A.O Smith	BT-XL	100	MBH	96%	75		2016
CP-1, CP-2	2	Heating hot water pumps w/ VFDs	Building	Bell & Gossett	Series 1510-2BD	5	HP				2016

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity	Units	Efficiency	Capacity	Units	Approx Year Installed
EF-1 ,2,5,8	13	Centrifugal exhaust fan	Various (see site prework sheet)	Greenheck	GB-101	1,2,5=0.25, 8 = 0.33	HP				2016
EF-3,6,7,14	14	Centrifugal exhaust fan	Various (see site prework sheet)	Greenheck	GB-081	0.16666667	HP				2016
EF-4,12	15	Centrifugal exhaust fan	Various (see site prework sheet)	Greenheck	GB-121	4=0.5, 12=0.33	HP				2016
EF-9	1	In-line exhaust fan	Toilet rooms 104/105	Greenheck	CSP-A700	0.213	kW				2016
EF-10,11	16	Centrifugal exhaust fan	Various (see site prework sheet)	Greenheck	GB-071	0.16666667	HP				2016
EF-13	17	Centrifugal exhaust fan	Various (see site prework sheet)	Greenheck	GB-091	0.25	HP				2016
HX-1	1	Heat exchanger (snow melt)	Building	Bell & Gossett	BP-410-40	237	MBH				2016

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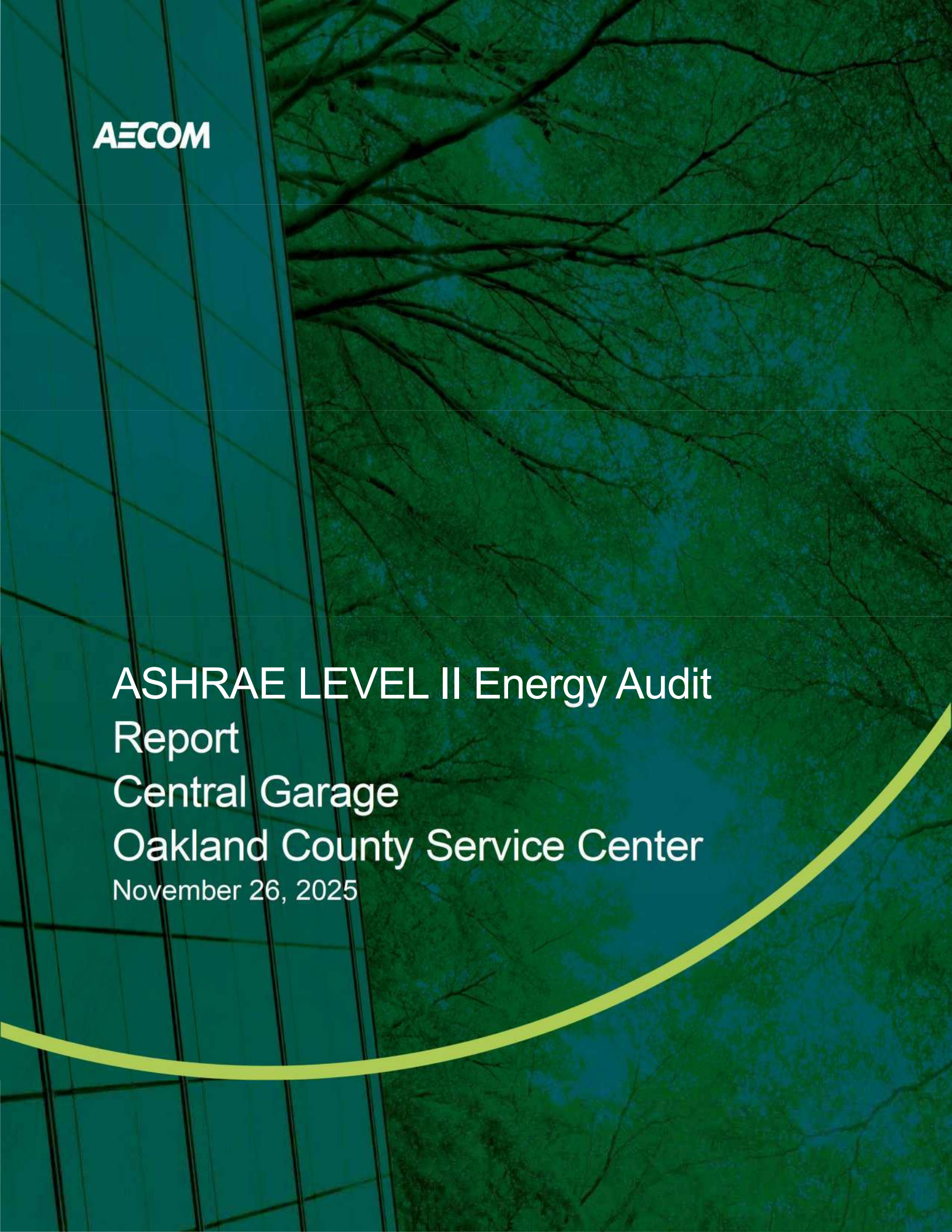

AECOM

ASHRAE LEVEL II Energy Audit Report
Central Garage
Oakland County Service Center

November 26, 2025

Quality information

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Disclaimer

The intent of this ASHRAE Level II Energy Audit study is to present the results of the AECOM assessment of the Oakland County Campus located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Central Garage Building, 16 East, in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation" or "Not Recommended" measures based on simple payback period or foreseen feasibility issues.

All identified energy reduction opportunities have been characterized in this report as ECMs regardless of scope and scale of capital investment. Additionally, AECOM recognizes that Oakland County wishes to pursue the future electrification of its facilities to the extent practical, as described in AECOM's Service Center-wide assessment report of future electrification options. The ECMs listed in this report address opportunities identified within existing conditions and existing energy infrastructure. The report's proposed ECMs may or may not be relevant to an energy infrastructure environment evolved from fossil fuel-driven energy infrastructure to fully electrically powered energy infrastructure.

The Oakland County Central Garage Building is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Monday April 7, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Savings Summary

This energy audit report evaluates five Energy Conservation Measures (ECMs) for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. Four of the Five ECMs are recommended and represent a projected 35% annual energy cost savings with an aggregate simple payback of 6.2 years. One measure is not recommended at this time due to negative payback.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be "electrification-ready" to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE's prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Central Garage Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	tCO2e	$/yr	$/yr	$	Years
1	LED Lighting Upgrade	HIGH	R	45,402	9	0	0	154.91	20.10	$1,429	$4,994	$30,960	4.8
2	BAS Controls Installation and Commissioning	MED	R	17,255	0	0	208	306.99	32.37	3380.00	$3,976	$65,676	8.9
3	New Window AC Units	MED	R	2,487	0	0	0	8.49	1.10	$0	$274	$4,000	14.6
4	Steam pipe insulation	HIGH	R	0	0	0	332	396.53	39.52	0.00	$3,321	$5,000	1.5
Sum of Recommended Measures				**73,403**	**9**	**0**	**540**	**867**	**93**	**4,809**	**12,565**	**105,636**	**6.1**
Overall % Reduction				**31%**	**24%**	**0%**	**39%**	**36%**	**36%**		**34%**		
Measures Considered but not recommended													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
5	Electric Infrared Heaters	Low	NR	-361,745	0	0	190	-1,007.05	-137.50	$0	-$37,889	$230,914	-6.1

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Central Garage spans 32,838 ft2 and is used for fleet maintenance and operations support. The facility was constructed in 1957, with 2,000 ft2 being renovated in 1965 and 3,283 ft2 being renovated in 2014. The space types are summarized below.

Table 2. Building Space Types Summary

Space Type	% of Building	# of Occupants	Scheduled Hours of Occupancy	HVAC Operating Hours
Upstairs	~3%	-	-	24/7 (unless locally overridden by individual thermostats)
Office	15%	7	8:00am – 4:00pm	
Garage	80%	13	6:00am – 1:00am	
Radio Shop	~3%	10	8:00am – 4:00pm	

The building is 100% heated, and approximately 23% is cooled (limited to the radio shop and office areas). Garage doors are often left open in the summer. The building features double-pane windows.

2.1 Building Systems

2.1.1 Building Envelope

The Central Garage building was built in 1957, and as such, its building envelope would not be expected to meet modern performance standards. The brick construction does not provide any added insulation; however, its low window-to-wall ratio and use of double-pane windows will reduce heat loss.

Table 3. Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Masonry construction	Good appearance from visual inspection, however, older construction and may not be adequately insulated
Roof	Flat roof with black membrane	Assumed R-20 or less (age-dependent)
Glazing	Double pane with a very low to low window to wall ratio	Moderate

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The Central Garage uses a combination of central ventilation, rooftop packaged units, and steam-based heating systems. The primary air-handling unit (AHU-1) provides ventilation only and serves the entire building. This unit features a Buffalo Vane Axial fan (Model M-8665) with 24 MB housing. The unit is significantly aged and in very poor condition, with compromised

insulation and leaking housing. It includes a mixing plenum that draws either heated air from the adjacent steam tunnel or outside air, mixing it with return air. The return air damper was found partially open, with unclear operational status.

Cooling is limited to a Trane rooftop packaged remote terminal unit (RTU-1) serving the conditioned spaces (office and radio shop). The RTU operates with direct expansion (DX) cooling and gas heating, and was reported to be in good condition, though the nameplate information was unreadable.

Heating is provided via a steam-to-hot-water system, where incoming steam from a central plant is used to charge a glycol loop that serves space heating throughout the building. In some areas, electric resistance (ER) heaters have been installed to replace hot water systems. The building also includes an electric domestic water heater (Lochinvar model KMA050KD, 4.5 kW, installed 2018), which was in new condition at the time of inspection.

2.1.2.2 Plumbing

The facility includes a domestic water heater with a 50-gallon capacity.

2.1.2.3 Building Controls

No centralized building management system is in place.

2.1.3 Lighting Systems

Based on the site visit, lighting fixtures throughout the building are installed in recessed, ceiling-mounted, or suspended configuration. The lighting system includes a mix of fluorescent fixtures rated at 32W and light emitting diode (LED) fixtures rated at 64W and 12W. Additionally, LED exit signs rated at 12W are installed to mark emergency exits.

Based on the drawings, the lighting fixture counts are as follows:

Table 4. Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
Fluorescent Lights	72	2 lamps
Fluorescent Lights	47	3 lamps
LED Lights	180	2 lamps
LED Lights	3	3 lamps
LED Lights	18	4 lamps
LED Lights BULBS	4	1 lamp
LED Lights 64W	3	1 lamp
T5 HO	9	6 lamps
T5 HO	8	4 lamps
HID	4	1 lamp
Non-LED Exit Sign	4	-
LED Exit Signs	3	-

The total approximate quantity of light fixtures is 364. The approximate total wattage is 18,200 watts. The approximate area per drawing is 32,838 ft2. The lighting density is approximately 0.55 W/ft².

2.1.4 Electrical Infrastructure

The facility is powered by a 150 KVA transformer, which is located outside the building. The main electrical service is rated at 120/240V, 600A, 3-phase, suitable for building buildings with mixed lighting, HVAC, and equipment loads. This configuration allows for effective power distribution and load balancing. The meter number used for monitoring electricity consumption was not provided, and no data is currently available on peak electrical demand. It is recommended that spot measurements be conducted to determine actual demand levels and evaluate capacity utilization. The building is equipped with backup power provided by an 80 KW generator.

3 Utility Billing Analysis

3.1 Utility Type and Usage

The Central Garage receives electric service, is connected to the steam network, and is not connected to natural gas service. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Steam:** BAS Data tracking steam use, estimated if not reliably metered.

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 5: Total Energy Usage and GHG Emissions (2024)

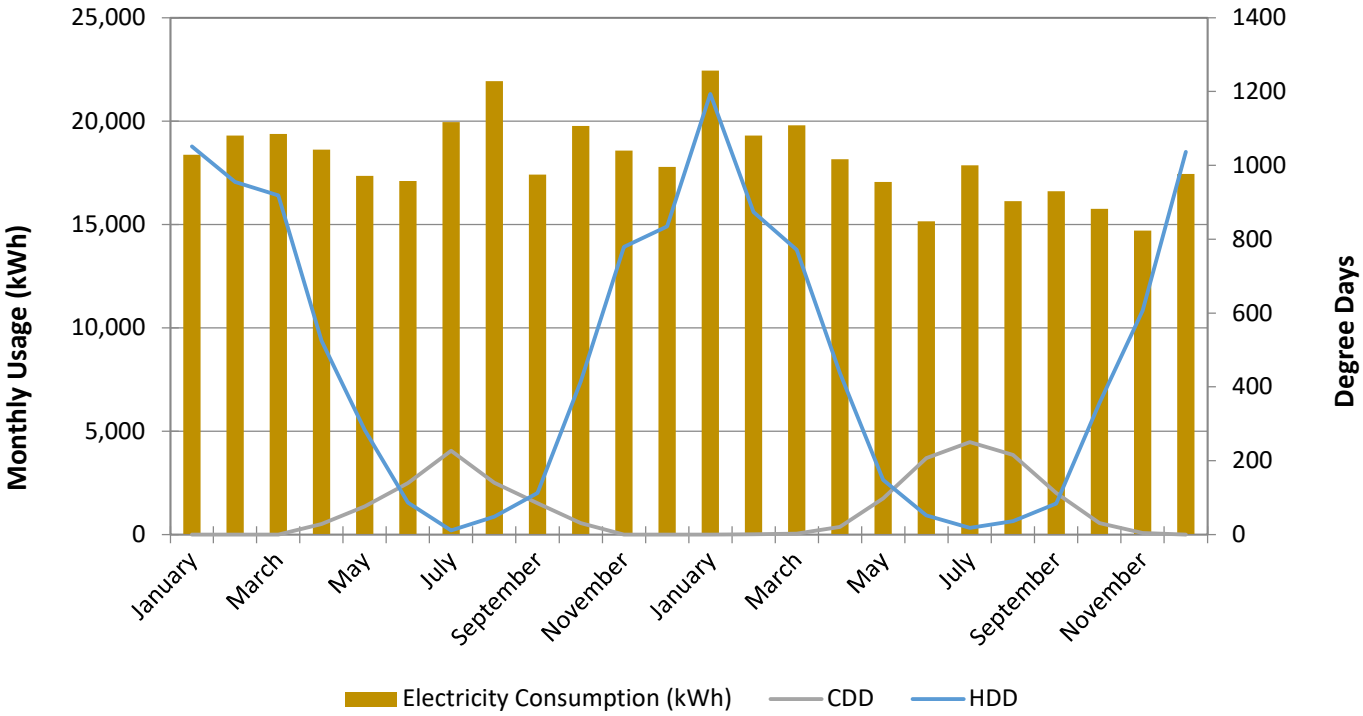
Utility	Annual Usage	Annual Usage (MMBtu)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	210,370 kWh	718	$23,140	$0.11/kWh	0.0004427	93
Steam	1,402 klb	1,674	$14,017	$10/klb	0.1190000	167
Total		**2,392**	**$37,158**			**260**

**Steam (1 klb = 1,194,000 Btu); Electricity (1 kWh = 3413 Btu)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage does not show a strong correlation to weather data, indicating the majority of electricity usage consists of baseload usage. This usage does not vary much from month to month and includes loads such as lighting, fans, and pump loads. The annual usage for the baseline 12-month period from January to December 2024 is 210,370 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



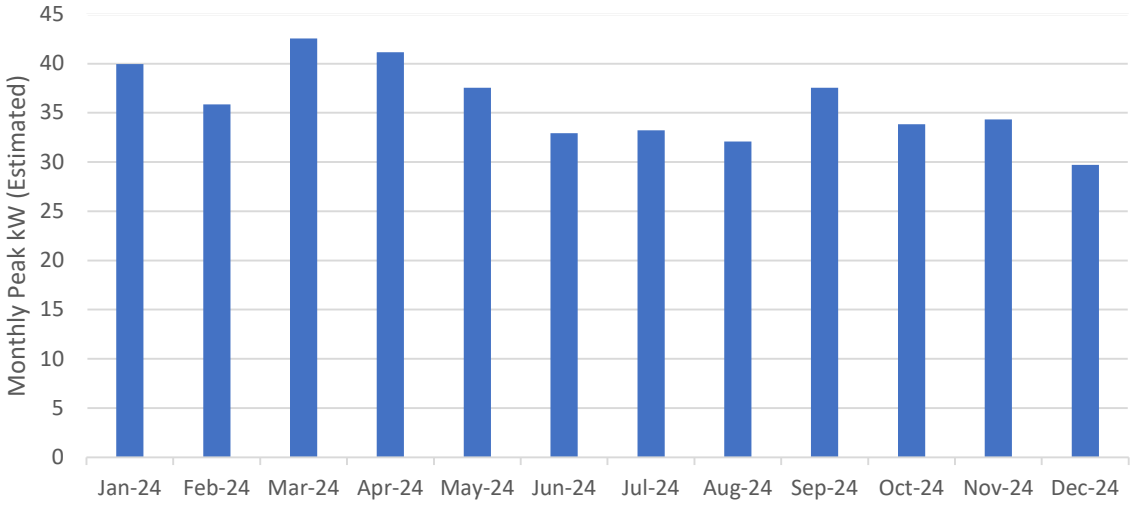
3.3 Building Electrical Capacity Analysis

AECOM has developed a methodology to estimate the peak demand of the building which uses the metered consumption of the building, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 6. Electric Capacity Results

Maximum Building Capacity at Service Transformer	150 kW
Maximum Capacity at Switchgear (A*V*Ph)	144 kW
Estimated Peak Demand	42 kW (Estimated)
Remaining Capacity	**108 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

The base does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy, and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. This arrangement accurately distributes the cost of electricity consumption, but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand but high usage are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge: **$6.15/kW/Month**

Average Dollar per kWh Used in Calculations: **$0.11/kWh**

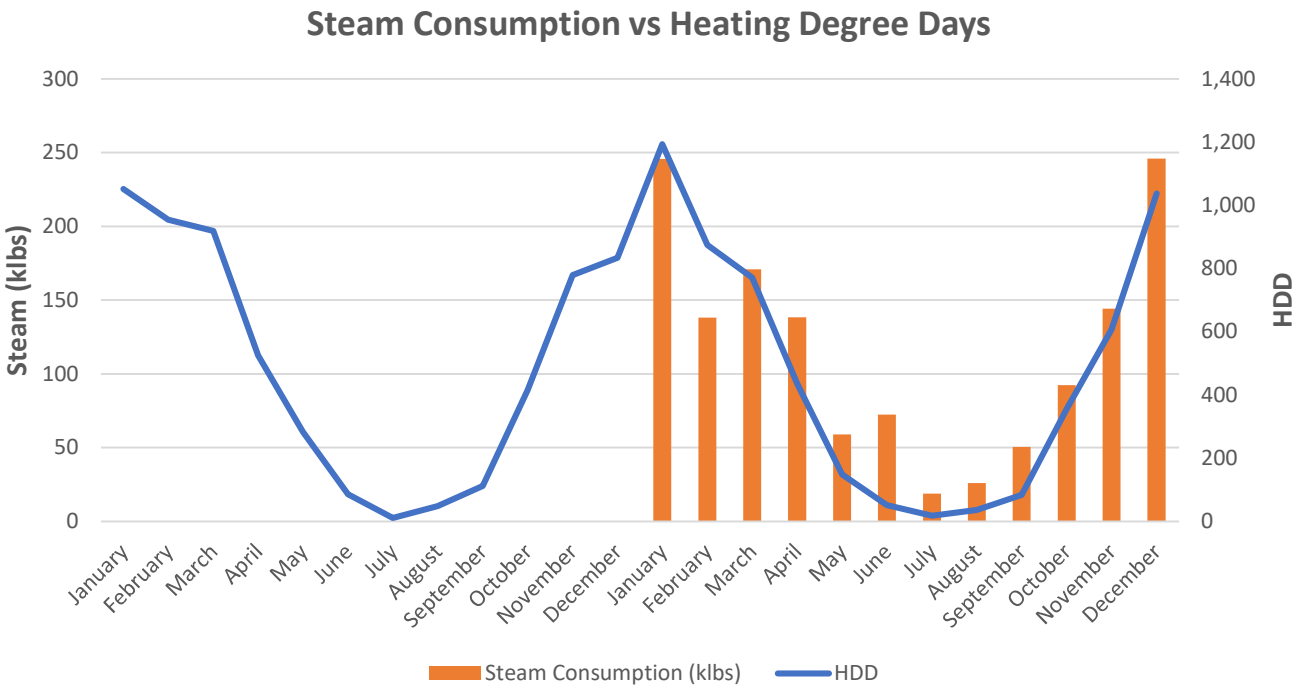
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Steam Usage Profile

Figure 3 compares the monthly steam usage profile for 2024 with local monthly weather data for 2023 – 2024 indicated by HDD. Steam data for 2023 is not available. Steam usage shows a direct correlation to weather data, as steam is primarily used for space heating. The annual usage for the baseline 12-month period from January to December 2024 is 1,402 klbs. Detailed monthly steam usage and costs are in Appendix A.

Figure 3: Steam Usage Profile (January 2023 to December 2024)



3.4.1 Steam Rate Structure

Unlike electricity and natural gas, which are billed directly by external utilities, steam is an internal utility produced on campus. The cost allocation for steam is derived from the total natural gas cost at the central steam plant, as well as costs to operate the plant. Each steam-served building is billed proportionally based on its metered steam usage relative to the campus total. As a result, there are no separate delivery, demand, or third-party charges; the unit cost of steam reflects the cost of natural gas, plant operating cost and efficiency, and distribution system performance.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings.

Average Dollar per klb Used in Calculations: $10.00/thousand lbs

3.5 Energy Cost Index

The energy cost analysis is based on the information provided by an annual purchase request statement for 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 7 below.

Table 7: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$23,140
Steam	$14,018
Total	$37,158
ECI $/yr/sf	$1.13

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4. Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within the RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

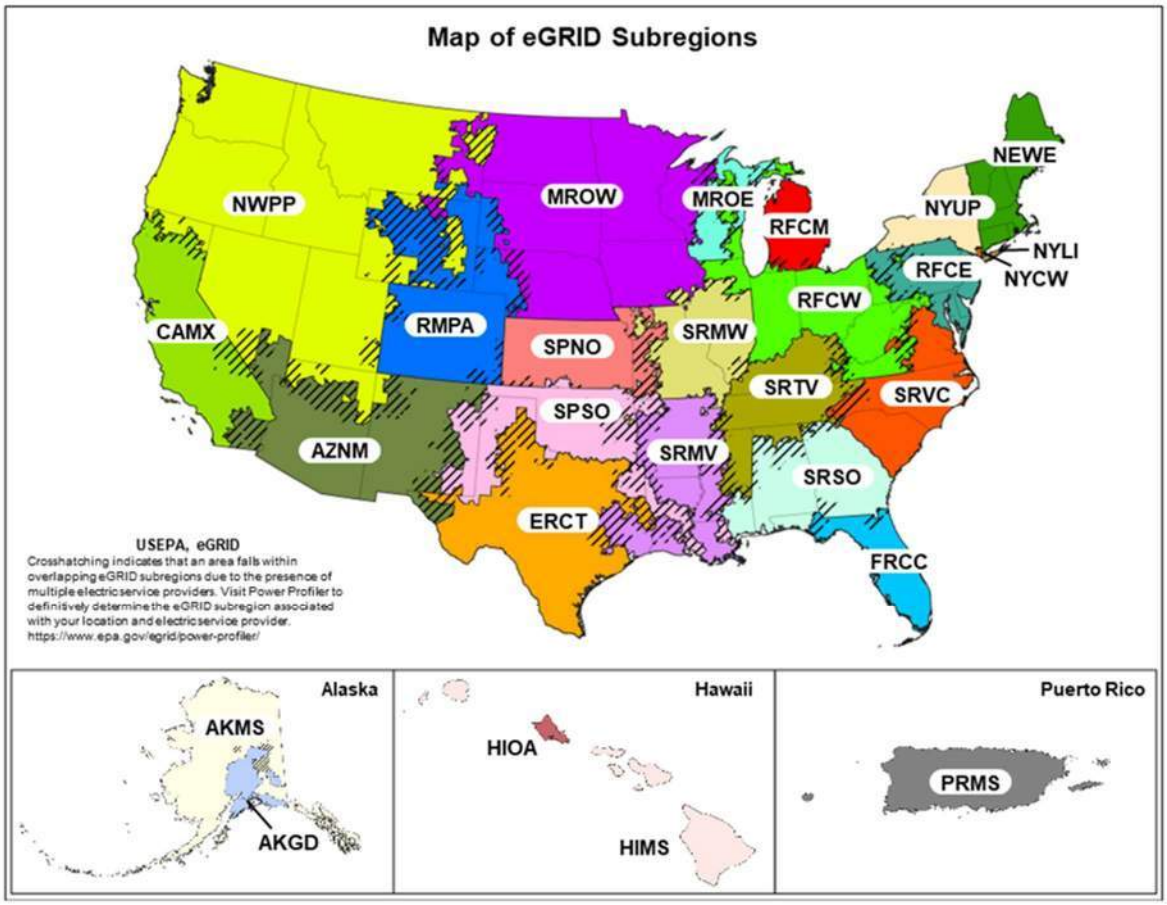
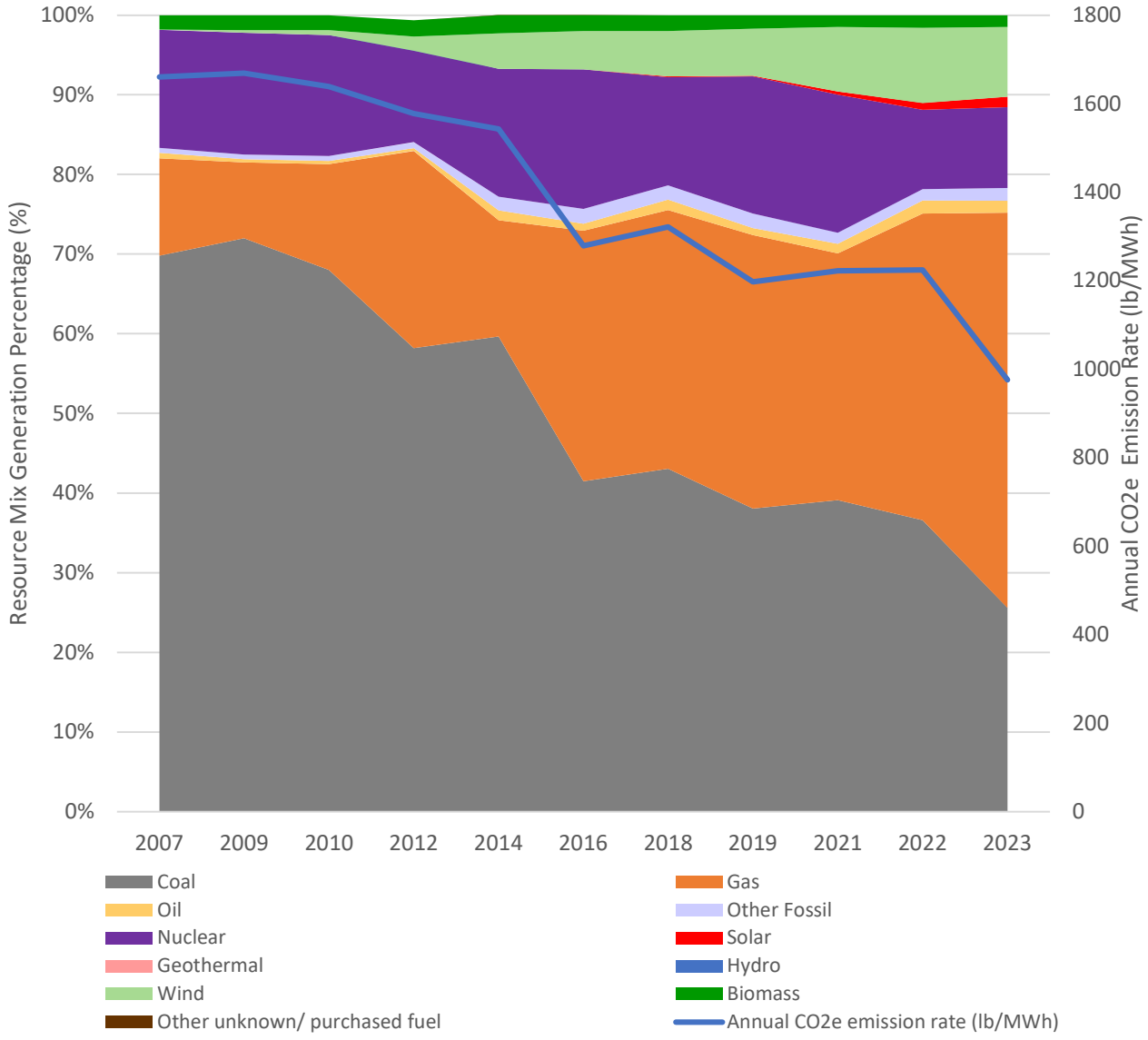


Figure 5 displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Building portfolio Scope 1 emissions include the emissions generated from on-site combustion, and Scope 2 emissions are based on the emissions factor of imported electricity. Approximately 67% of carbon emissions are attributed to steam and 33% associated with electricity. Steam combustion for space heating and imported electricity resulted in 145 tCO2e (Scope 1) and 93 tCO2e (Scope 2) emissions, respectively, for a total of 238 tCO2e emissions. Oakland County does not currently purchase RECs or EACs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend how energy-efficient a building is per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBtu) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and steam for Admin Annex II are converted to kBtus units, summed, and divided by the total square footage.

Table 8: Annual Utility Summary (2024)

Building:	Central Garage					**Electric EUI:**	22	kBtu/SF/yr
GFA:	32,838	SF				**Steam EUI:**	51	kBtu/SF/yr
eGRID Subregion:	RFCM					**Current EUI**	73	kBtu/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	210,370	kWh	3.412	718	0.0004427	93	$23,140	62%
Steam	1,402	klbs	1194	1,674	0.1190000	167	$14,018	38%
		Totals		2,392		**260**	$37,159	100%

According to the US EPA, the average site EUI is 71.9 kbtu/SF/yr for a vehicle dealership, 51.4 kbtu/SF/yr for a retail store, and 52.9 kbtu/SF/yr for an office. Given that the Central Garage is 80% garage, 15% office space, and 5% retail, the average site EUI is approximately 68.0 kbtu/SF/yr. The total EUI for the existing condition of the building is calculated as 73 kBtu/SF/yr, which is higher than the national benchmark. There are opportunities to optimize existing systems to reduce energy consumption and improve the efficiency of the facility.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient
Retail	Convenience Store*	Convenience Store with Gas Station	883.5	350.9	Industry Survey
		Convenience Store without Gas Station			
	Mall	Enclosed Mall	170.7	65.7	CBECS - Enclosed Mall
		Lifestyle Center	228.8	103.5	CBECS - Strip Shopping Mall
		Strip Mall			
		Other - Mall	225.3	101.6	CBECS - Enclosed Mall and Strip Shopping Mall
	Retail Store*		120.0	51.4	CBECS - Retail Store
	Supermarket/Grocery Store*		444.0	196.0	CBECS - Grocery Store/Food Market
	Vehicle Dealership*		138.2	71.9	Industry Survey

3.8 End Use Breakdown

The table below shows the estimated energy usage breakdown as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based on an annual hot water usage estimation by factoring in the water heater efficiency and number of employees. Table 9 and Figure 6 and Figure 7 below show the full estimated breakdown of each end use and their contribution to site energy consumption, EUI, and GHG emissions.

Table 9: Existing Energy Use per Category

End Use Breakdown (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (klbs)**	**Site Energy Total (kBtu)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	0	1,385	1,654,077	50.4	164.9
Space Cooling	44,662	0	0	152,386	4.6	19.8
Fans	67,636	0	0	230,775	7.0	29.9
Pumps	2,736	0	0	9,334	0.3	1.2
SHW/DHW	0	0	16	19,657	0.6	2.0
Conveyance	0	0	0	0	0.0	0.0
Lighting	85,028	0	0	290,115	8.8	37.6
Plug Loads	10,309	0	0	35,173	1.1	4.6
Process Loads	0	0	0	0	0.0	0.0
Refrigeration	0	0	0	0	0.0	0.0
Cooking	0	0	0	0	0.0	0.0
Information Technology	0	0	0	0	0.0	0.0
TOTAL	**210,370**	**0**	**1,402**	**2,391,516**	**73**	**260**
Historical Billing	210,370	0	1,402			
Percent of Actual	100%	0%	100%			
per sqft	6.41	0.00	0.04			

Figure 7: Existing Electricity End Use Allocation

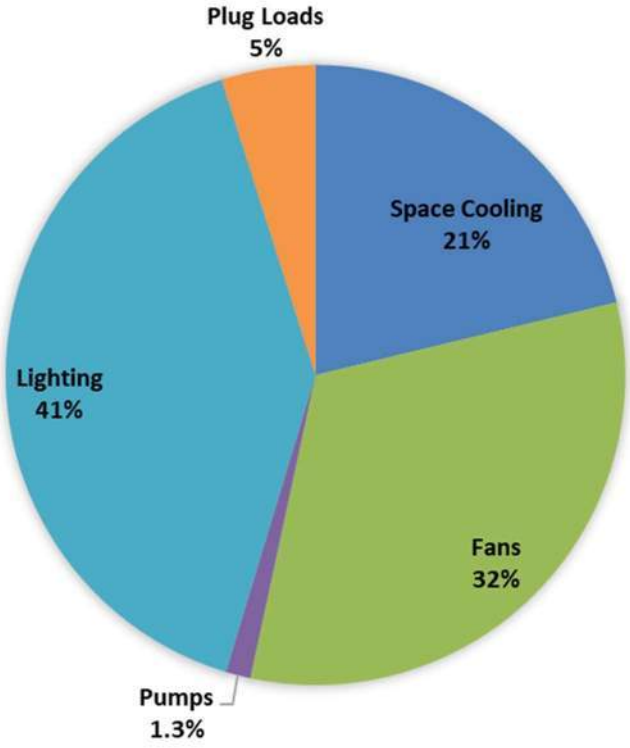
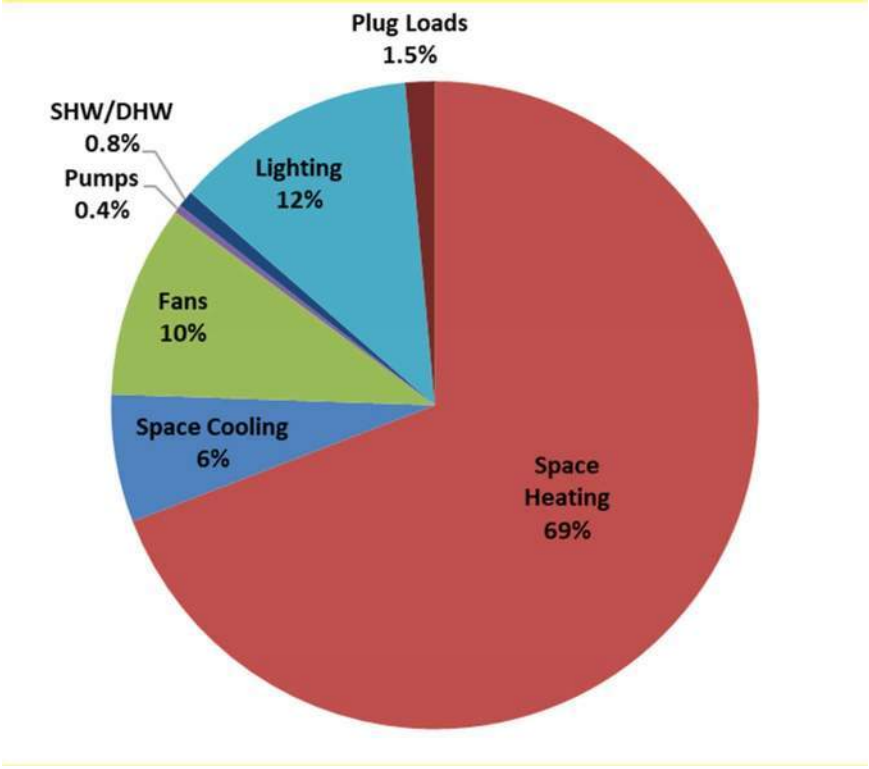


Figure 8: Existing Energy End Use Allocation



4 Energy Conservation Measures

The projects discussed in this section are economically viable but are not intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures. These measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure, but it reveals their potential impact on the economic and energy standpoint. The main goal of these measures is to provide options for facility management and set the baseline for proceeding with the implementation of selected projects. On the other hand, some of these measures may interact with capital improvement projects. In this case, the project selection and planning for implementation must be meticulously considered the future projects to avoid double dipping, emphasizing the need for caution and attention to detail in decision-making.

The cost estimates are rough orders of magnitude (ROM) numbers that show an estimated price for each measure. Once the project enters the design phase, more precise cost estimates may be created. The cost estimates used information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – LED Lighting Upgrade

This measure proposes upgrading all remaining fluorescent lighting to Light-emitting diode (LED) lightbulbs with motion sensors and dimming functionality where appropriate to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements. Incorporating lighting controls allows for better management and customization of lighting systems, leading to reduced energy consumption, and increased overall efficiency by limiting the time lighting is on to only when necessary. For indoor lighting, lighting controls consist of occupancy, daylighting, timers, scheduling, and dimming features to optimize light levels based on external lighting availability and usage of a space. For outdoor lighting, the lighting controls consist of motion sensors, photocells, and timers to turn the lighting ON/OFF. The current lighting in the Central Garage is approximately 59% LED and 41% fluorescent and the estimated wattage is approximately 0.59 W/ft². See Section 2.1.3 for the lighting counts used to estimate energy consumption.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.



Figure 9: Example Fixture with Integrated Occupancy Controls

Assumptions:

- This measure assumes lighting savings of approximately 0.28 W/ft².
- Lights are assumed to be turned on 17 hours per day for 256 days of the year, and exit signs are assumed to be turned on 24 hours per day.
- LED upgrades cost $215/fixture, which include integrated controls, and will be on approximately 355 fixtures.
- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- O&M savings assume an average cost of $3.81/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, the subsequent steps would involve conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. Following this assessment, a controls contractor can be engaged to install the lighting controls and assist building engineers in configuring the schedule to optimize lighting usage. Provided below are the rebate opportunities for LED lighting upgrades and lighting controls from DTE. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 10. ECM 1 Savings and ROM Cost

Savings Summary								
ECM	District Steam Savings (klbs)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
LED Lighting	0	45,402	154	20	$1,429	$4,994	$30,960	4.8
Overall % Reduction	0%	21.6%	6.5%	7.7%		13.4%		

4.2 ECM 2 – BAS Controls Integration and Retro-Commissioning

This combined measure involves installing a building automation system (BAS) and completing retro commissioning (RCx) once the BAS is operational. Together, these steps enable centralized control, improve system coordination, and ensure building operations are optimized for efficiency and reliability.

BAS Integration

BAS integration refers to connecting and coordinating various building systems and components through a centralized control platform. The goal is to enhance the overall efficiency, functionality, and manageability of building operations. While BAS installation does not directly yield energy savings, it enables the optimization of other measures. Central Garage currently has no centralized controls. BAS integration would allow centralized monitoring and optimization of the current AHU and potential heat pump replacement, the steam-to-hot-water heat exchanger and glycol loop, unit heaters and any electric resistance heaters serving localized zones, and the RTU-1 that conditions the office/radio shop. Trend logs, alarms, and schedules will be established for all tied-in points. Particular focus will be placed on correcting the mixing plenum operation, which currently draws from the steam tunnel or OA with an unknown damper position, and coordinating ventilation with garage operating hours and door positions.

Commissioning

With BAS installed, Annex II will have centralized visibility and control of major HVAC systems. Commissioning is a critical follow-on activity to ensure the BAS is properly configured, sequences of operation are optimized, and long-standing inefficiencies are resolved. Commissioning includes systematically evaluating and fine-tuning HVAC, controls, and other energy-consuming systems to restore them to design intent and reduce energy waste.

The following list represents commissioning opportunities that should be evaluated to validate operation, repair if discrepancies identified or implement if not active and feasible for major HVAC systems. This effort will proactively improve building system operation and optimize energy usage.

- Optimize HVAC scheduling in non 24/7 occupied spaces
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling

- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water and chilled water supply reset
- Discharge air setpoint reset
- Outside air temperature lockouts

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing a BAS will have no change to existing controls capabilities and will increase customization of equipment.
- Commissioning will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 15% reduction in estimated heating and cooling end use energy consumption.
- Project cost is estimated at $2 per square foot of building area.
- This measure supports electrification readiness indirectly by ensuring electric systems are optimized and operating efficiently.
- O&M Savings assume 1hr/week average reduction in maintenance issues due to better equipment monitoring and remote access to space controls.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Identify equipment to be connected to the central control system and engage a building controls integration company to plan and cost the system integration. Coordinate with planned capital upgrades and renovations where possible to optimize benefits. This measure is recommended for implementation.

ECM Savings and ROM Cost

Table 11. ECM 2 Savings and ROM Cost

Savings Summary								
ECM	District Steam Savings (klbs)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
RCx	208	17,255	307	32	$3,380	$3,976	$65,676	8.9
Overall % Reduction	14.8%	8.2%	12.8%	12.5%		10.7%		

4.3 ECM 3 – New Window AC Units

This measure proposes replacing the two existing window-mounted air conditioning (AC) units in the Radio Shop with new, high-efficiency models. The replacement units are specified as GE AWCS18WWL, 18,600 BTU (1.55 tons) each, with an Energy Efficiency Ratio (EER) of 11.3, which is significantly higher than the performance of the existing equipment. Window AC units

serve as dedicated spot-cooling for the Radio Shop, where cooling is required during occupied hours to maintain comfort for staff and equipment. By replacing these units with higher-efficiency models, the building will reduce cooling energy consumption and electricity costs while maintaining the same level of occupant comfort. Minisplits were considered but not selected due to higher first cost, more complex installation, and limited runtime of this small, localized load. High-efficiency window AC units provide a simpler, lower-cost like-for-like replacement.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Baseline units are assumed to have an EER of 9.0 (typical of older window AC units), compared against the new units with EER 11.3. Electricity savings are calculated based on the improvement in EER.
- Project cost is estimated at $2,000 per unit installed, for a total ROM cost of $4,000.
- This measure supports electrification readiness indirectly by ensuring efficient cooling equipment is in place, though it does not directly reduce fossil fuel use.
- No O&M savings are associated with this measure.
- A Microsoft Excel™ spreadsheet was used to determine energy savings based upon 2024 utility costs.

Next Steps: Procure and install two new window AC units with ≥11.3 EER in the Radio Shop. Verify electrical circuits for compatibility and schedule installation to minimize disruption to Radio Shop operations. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 12. ECM 3 Savings and ROM Cost

Savings Summary							
ECM	District Steam Savings (klbs)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Replace Window AC Units	0	2,487	8	1	$274	$4,000	15
Overall % Reduction	0%	1.2%	0.4%	0.4%	0.7%	--	--

4.4 ECM 4 – Steam Pipe Insulation

This measure proposes insulating approximately 500 linear feet of exposed 6-inch diameter steam piping observed during the site visit. Uninsulated or poorly insulated steam lines result in significant heat loss, increasing the demand on the central steam plant and raising operating costs. Adding insulation improves thermal resistance, reduces energy losses, and lowers the steam load required to meet building heating needs. The proposed improvement assumes pipe insulation will increase the effective R-value from R-1 to R-3.5. This ECM is recommended due

to its low implementation cost, short payback potential, and direct reduction of unnecessary steam losses.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- The pipe diameter is 6 inches; the length of pipe to be insulated is 500 linear feet.
- The baseline R-value is R-1. The insulated R-value is R-3.5.
- Heat loss savings are calculated based on the change in thermal resistance, pipe surface area, temperature difference between steam and ambient conditions, and annual operating hours.
- Total project cost is estimated at $10 per linear foot for a total ROM cost of $5,000.
- This measure supports electrification readiness indirectly by ensuring efficient cooling equipment is in place, though it does not directly reduce fossil fuel use.
- No O&M Savings are associated with this measure.
- A Microsoft Excel™ spreadsheet was used to determine energy savings based upon 2024 utility costs.

Next Steps: Conduct a detailed field survey to verify lengths, diameters, and surface conditions of the piping. Select insulation type (e.g., fiberglass, calcium silicate, or aerogel wrap) with appropriate jacketing for durability and moisture protection. Coordinate installation during off-peak heating periods to minimize operational disruption. This measure is recommended for implementation

ECM Savings and ROM Cost:

Table 13. ECM 4 Savings and ROM Cost

Savings Summary							
ECM	District Steam Savings (klbs)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Steam Pipe Insulation	332	0	397	40	3,321	$5,000	2
Overall % Reduction	23.7%	0.0%	16.6%	15.2%	8.9%	--	--

5 Measures Requiring Additional Consideration

This section provides additional information about projects that have been evaluated but are not currently recommended for implementation due to poor economics, feasibility issues, conflicts with other projects already recommended, or requirements for additional study that may impact feasibility. Equipment electrification projects, which have longer paybacks, may be listed here but will be expanded upon in the final Electrification Plan for each building. All electrification projects that are required for campus electrification are not included in the energy audit reports. This report includes one measure that is included in the Not Recommend Category. The measure summaries are given below:

5.1 Electric Infrared Heaters

Table 14: Proposed Energy Savings Summary

Savings Summary								
ECM	District Steam Savings (klbs)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Electric Infrared Heaters	190	-361,745	-1,007	-137	$0	-$37,889	$230,914	NA

ECM 5 – Electric Infrared Heaters: This measure suggests electrifying the garage heaters with infrared units. This measure has a very high cost to both operate and install and is not recommended at this time. Additional options will be investigated in the electrification report. excluded. ECM 5 and ECM 6 are mutually exclusive. This measure is not recommended currently due to the low overall demand of IT systems.

6 Appendix A

Table 15: Monthly Utility Data (2023 to 2024)

Month	Steam Consumption (klbs)	Steam Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	-	-	18,362	$2,020	25	33	1,050.9	0
Feb-23	-	-	19,298	$2,123	29	36	954.6	0
Mar-23	-	-	19,377	$2,131	26	42	918.4	0
Apr-23	-	-	18,622	$2,048	26	42	525.3	28.1
May-23	-	-	17,354	$1,909	23	38	283.4	76.3
Jun-23	-	-	17,093	$1,880	24	37	86.3	139.1
Jul-23	-	-	19,954	$2,195	27	37	11.3	226.9
Aug-23	-	-	21,935	$2,413	29	44	48.3	140.6
Sep-23	-	-	17,407	$1,915	24	39	112.5	84.9
Oct-23	-	-	19,768	$2,174	27	42	414.5	31.1
Nov-23	-	-	18,577	$2,043	26	43	779.2	0
Dec-23	-	-	17,781	$1,956	24	30	834.1	0
Jan-24	246	$2,456	22,442	$2,469	30	40	1,193.6	0
Feb-24	138	$1,381	19,292	$2,122	29	36	873.9	1
Mar-24	171	$1,708	19,788	$2,177	27	43	771.2	2.1
Apr-24	138	$1,383	18,154	$1,997	25	41	437.1	20.9
May-24	59	$589	17,055	$1,876	23	38	148.4	98
Jun-24	72	$724	15,143	$1,666	21	33	51.4	206.7
Jul-24	19	$188	17,854	$1,964	24	33	18.4	250.9
Aug-24	26	$259	16,132	$1,775	22	32	36.6	215.4
Sep-24	50	$504	16,611	$1,827	23	38	84	112.3
Oct-24	92	$922	15,757	$1,733	21	34	356	30.7
Nov-24	144	$1,442	14,702	$1,617	20	34	606.9	4.2
Dec-24	246	$2,459	17,440	$1,918	23	30	1,036.80	0
2023 Sum	-	-	225,528	$24,808			6,019	727
2024 Sum	1,402	$14,018	210,370	$23,141			5,614	942

**Steam costs estimated using $10/klb*

7 Appendix B

Table 16: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Efficiency	Capacity 2	Capacity 3	Approx Year Installed	Condition
AHU-1	1	Exhaust fans	Whole building	Buffalo (exhaust fan)	Vane Axial size 24 MB, model M-8665						Very poor
RTU 1	1	Packaged rooftop unit (Dx, most likely electric heating)	Office & Radio Shop (~6000 sqft)	Trane	Illegible	7.5 TON					Good
	1	Domestic water heater		Lochnivar	KMA050KD	4.5 kW		50 Gal		2018	New
HHWUH -1 to 4	4	Heating hot water unit heaters, associated pumps		Dayton	1EBC4	226 MBH		23.5 GPM	0.5 HP		
HHWDC -1	1	Duct hot water heating coil	Office area	Trane	D5WB18040	125.26 MBH					
EF-1,2	2	Exhaust fans	Vehicle modification and radio shop areas	Greenheck	GB-180-15	4000 CFM		1.5 HP			
EF-3,4	2	Exhaust fans	Toilet and J.C.	Greenheck	SP-A125	100 CFM		0.053 kW			
	2	Window AC Units				1.5 TON	9.5 EER				

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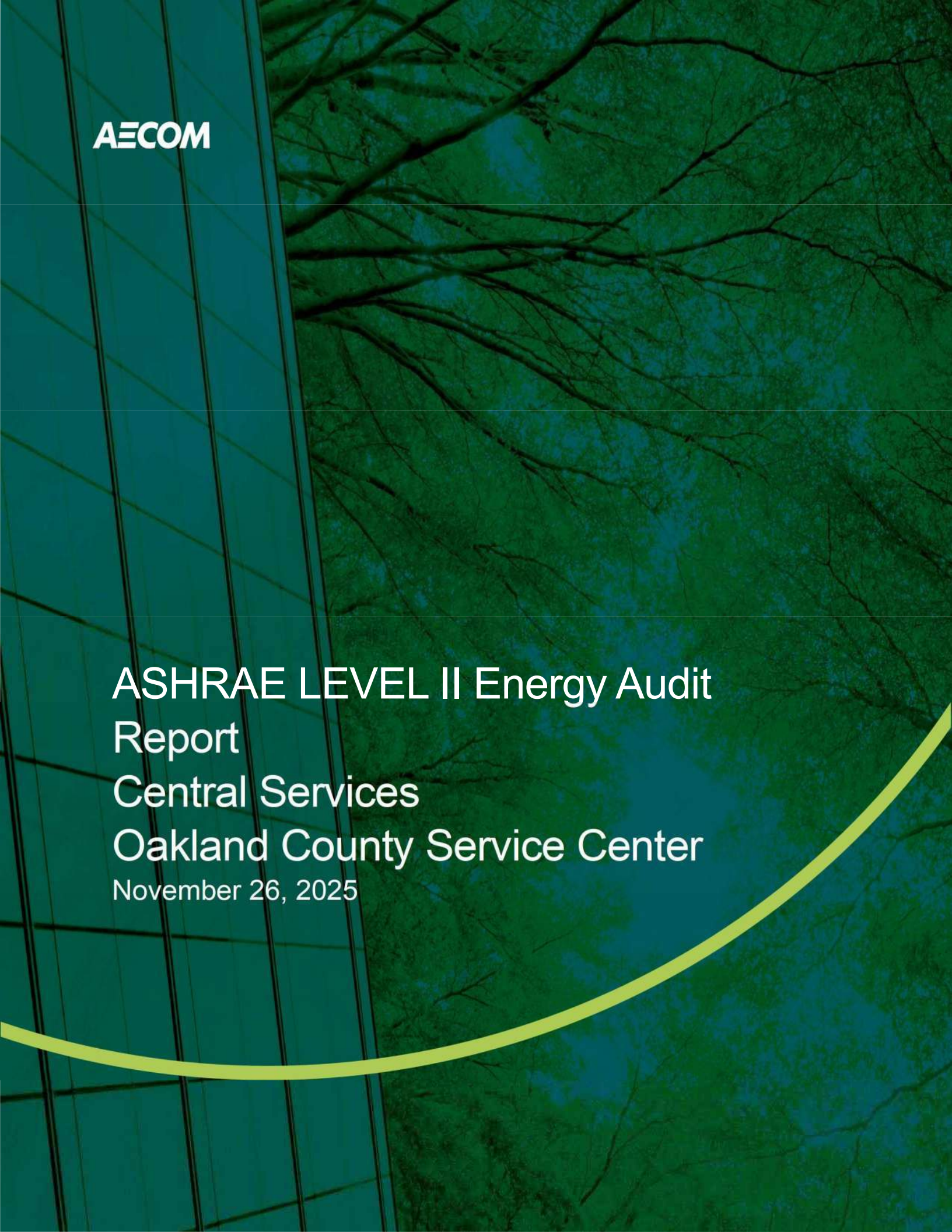

AECOM

ASHRAE LEVEL II Energy Audit Report
Central Services
Oakland County Service Center

November 26, 2025

Quality information

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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Central Services in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

Oakland County Central Services is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Monday April 7, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates six Energy Conservation Measures (ECMs) for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The 4 recommended ECMs listed represent a projected 46% annual energy cost savings with an aggregate simple payback of 9.2 years. The remaining two measures are not recommended for implementation at this time. This building requires significant HVAC retrofits to electrify, which are likely not economically beneficial at this time due to low overall energy consumption and electricity vs. natural gas fuel rates. Additional information will be provided in the final Electrification Plan.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Central Services Proposed Energy Savings Summary

Energy Conservation Measures												
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**District Steam Savings**	**Total Energy Saved**	**Green House Gas Savings**	**O&M Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	klbs/y	MMBTU	tCO2e	MTCO2e	$/yr	$	Years
1	Building RCx	Med	R	1,857	0	42	57	5.9	$0	$629	$14,265	22.7
2a	LED Lighting	Med	R	13,404	3	0	45.7	5.9	$549	$2,258	$25,155	9
3	Setback Temp	High	R	0	0	81	96.2	9.6	$0	$806	$1,500	1.9
4	Repair steam pipe insulation	High	R	0	0	86	102.7	10.2	$0	$860	$5,500	6.4
			Sum	**22,384**	**3**	**209**	**326**	**35**	**$549**	**$4,533**	**$46,420**	**9.2**
			Total Percentage	**40%**	**38%**	**44%**	**43%**	**39%**		**42%**		
Measures Requiring Additional Consideration												
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**District Steam Savings**	**Total Energy Saved**	**Green House Gas Savings**	**O&M Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
5	Install New Window AC Units	Low	RS	1,026	0	0	3.5	0.5	0.5	$113	$6,000	53.1
6	Install Electric Infrared Heaters to Replace Steam Fin Tube Baseboard Radiators	Low	NR	-182,884	0	425	-117.0	-30.4	0.0	-$15,871	$52,800	NA

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
*Where demand reduction varies with load, the peak reduction is listed
**N/A indicates a negative payback period which results from negative cost savings due to the higher cost of electricity relative to the cost of natural gas, common for electrification measures

2 Existing Conditions and Observations

The Central Services Building, constructed in the 1920s, serves multiple functions, including office space, off-storage, groundskeeper spaces, general storage, and equipment maintenance areas. Despite its age, the building is still in use, though it has not undergone any recent renovations. The building is heated through steam radiant baseboard units with a steam-to-hot-water heat exchanger. No active cooling system is installed; cooling is provided only by window air conditioning (AC) units in select areas. The building's structure features brick walls and single-pane windows, contributing to energy inefficiencies and temperature control challenges. The facility is 19,020 ft^2.

The building is located in a region with an average outdoor temperature of around 35°F, which directly impacts its heating requirements. The facility is fully heated and partially air-conditioned, covering approximately 10-15% of the building. The spaces within the building are occupied for varying amounts of time, primarily during business hours and some areas are used only sporadically.

The building is utilized as a mixed-use facility with varying levels of occupancy across different areas. The East Ground Off Storage / Groundskeeper area is used between 6:00 AM and 2:00 PM Monday through Friday, with the heating, ventilation, and air conditioning (HVAC) system operating 24/7 to maintain a steady temperature of 75°F for both occupied and unoccupied conditions. Other areas such as the Basement, General Storage, and E Grounds Equipment are occupied 24/7, with the HVAC system running continuously. These areas are also maintained at a temperature of 75°F, regardless of occupancy. The building’s HVAC system generally operates 24/7, ensuring that all conditioned spaces are kept at a constant temperature even when they are not in use.

2.1 Building Systems

2.1.1 Building Envelope

The Central Services building appears to be built from a single layer of block with no insulation or gypsum board in most of the building. Some offices have gypsum board finish, but it is not clear if the exterior walls are insulated between block and gypsum board.

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Brick	Unknown
Roof	Unknown	Unknown
Glazing	Single-paned	Poor

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The window air conditioners are Direct Expansion (DX) cooling systems used to provide localized cooling in specific office and storage areas. These units, manufactured by Friedrich (Office 1), Kenmore (Plantings Storage Area), and Frigidaire (Office 2), are approximately 15–25 years old and are in fair condition. There are about 16 units distributed throughout the building, each with an estimated cooling capacity of 5 MBH. The units are controlled manually and are not connected to the Building Automation System (BAS). Cooling is typically operated during business hours (6:00 AM - 5:00 PM). There are no automated setpoints, meaning temperature adjustments are done by occupants. The cooling performance of these units may have declined due to their age, which could impact their efficiency.

The building is equipped with exhaust fans that provide ventilation to specific areas, including toilet room and cool rooms. These fans include a tube axial fan (model Dayton 4C661), with an 18” diameter and a 1 horsepower (HP) motor. The fan is rated at 13.6 A, operating at 115 V and 1-phase power. The Dayton 4C661 fan operates in conjunction with dampers and is set to operate based on temperature. The system is in good condition, with no signs of damage or wear.

The piston-type air compressor, manufactured by Worthington and installed in 1973 is used for providing pneumatic power for tools and control systems throughout the building. The compressor model is EU 3506 A, with a size specification of 6/3.5 x 2.75. It was installed in 1973.

The cooling unit was originally used for cooling the cool room but has been abandoned and is no longer operational.

Hot water baseboard heaters (FTR) run along the entire perimeter of the building, providing consistent heat. These units are part of the original system installed during the building’s construction. While the system operates year-round to meet heating demands, many of the baseboard units are missing covers, which can reduce the system's efficiency and increase heat loss. The heaters are primarily manually controlled and rely on temperature-dependent setpoints. The condition of the system is generally fair, with the baseboard heaters functioning, but some units may require maintenance or replacement of missing covers to improve their effectiveness.

Large tube radiators are installed around 10% of the building’s perimeter and in the brine tank room, and use hot water for heat distribution. These radiators, while effective, are part of the original system and remain in fair condition. The radiators provide additional heating, but their efficiency could be impacted by corrosion or other age-related issues. Like the baseboard heaters, the radiators operate year-round based on heating demand. The radiators are controlled manually or based on temperature fluctuations.

Currently, the overhead door in the brine tank room is open, which could reduce the effectiveness of the heating system. Additionally, the air intake damper at the roof is interlocked with the exhaust fan but is stuck open, further compromising the heating efficiency by allowing heat to escape through the open damper.

The steam pressure transmitter is manufactured by Kobold and measures the pressure within the steam system, typically set at 120 pounds per square inch (PSI). Currently, there is a slight

discrepancy between the electronic readings from the transmitter at 1.7 WC and the manual pressure gauge at 20.5 PSI, indicating a potential calibration issue. The transmitter's pressure readings should be monitored and recalibrated to ensure accurate steam pressure management. The steam pressure to Admin Annex is also located in this building (ABB 600T series).

The steam-to-hot-water heat exchangers are used to distribute heat across the entire building. These heat exchangers are in good condition, with the insulation on the steam supply and return piping remaining intact. The heat exchangers operate year-round, and they convert steam into hot water that is distributed throughout the building. The steam pressure setpoint is 120 PSI. This system is critical for the building's heating needs and continues to operate without significant issues.

The building is served by B&G circulator pumps that distribute hot water throughout the building. These pumps are constant-speed and operate year-round to maintain hot water circulation. The pumps are rated at 0.8 HP and operate with 115V, 1-phase power.

2.1.2.2 Plumbing

Submersible sump pumps are installed to manage water levels in low-lying areas of the building, ensuring that water does not accumulate.

2.1.2.3 Building Controls

The Central Services building does not use a building automation system to manage its operations. Instead, local dial-type thermostats are located across the facility to control the steam heat systems and local controls are used for the window AC units.

2.1.3 Lighting Systems

Based on the site visit, the fixtures are installed as recessed, ceiling-mounted, or suspended, based on the installation needs and the space layout. The fluorescent fixtures are rated at 42W, while the light emitting diode (LED) fixtures are rated at 14W.

The lighting fixture quantities mentioned below apply to the North section of the building. There are approximately 101 total light fixtures with a total wattage of 8,324 watts.

Table 3: North Lighting Summary

Lighting	North Section	
	Total Fixtures	Lamps per Fixture
Fluorescent Lights	50	2 lamps
Fluorescent Lights	15	4 lamps
Exit LED	6	-
Incandescent Lights	13	1 lamp
LED CAN Lights	17	1 lamp

The following light fixture quantities are for the South area of the building. There are approximately 77 total light fixtures. The approximate total wattage is 7,020 watts.

Table 4: South Lighting Summary

Lighting	South Section	
	Total Fixtures	Lamps per Fixture
Fluorescent Lights	37	2 lamps
Exit LED	11	-
Incandescent Lights	2	1 lamp
Fluorescent Lights	20	4 lamps
Fluorescent Lights	5	1 lamp
Fluorescent Lights	2	3 lamps

The approximate total wattage of the building is 15,344 watts. The approximate area per drawing is 19,020 ft^2. The lighting density is approximately 0.8 W/ft^2.

2.1.4 Electrical Infrastructure

The building is divided into two main sections: North and South. The North area is served by Power Distribution Panel No. 1, rated at 400A, 250V, along with a Lighting Panel (LP) rated at 225A, 120/240V. The South area includes its own Main Distribution Panel and a separate meter that supplies power to the remaining portion of the building. The entire facility is powered by a 150 KVA transformer located outside the building. The primary meter number is 700X37G1, and the service operates at 120/240V, 3-phase. The specific amperage rating of the service and the availability of a single line diagram were not provided. The building includes backup power, supported by a 240/120V generator, with an external generator connection point.

2.1.5 Electrical Infrastructure

The roof vents are currently stuck open, causing heat loss when the heating system is active. This may result in inefficiency and higher energy usage as warm air escapes the building.

3 Utility Billing Analysis

3.1 Utility Type and Usage

Central Services receives electric service and is connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

Steam usage is metered and billed to the building based on the cost to generate the utility. Steam is the primary heating source for the building.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Steam:** Oakland County Internal Tracking

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 5: Total Energy Usage and GHG Emissions (2024)

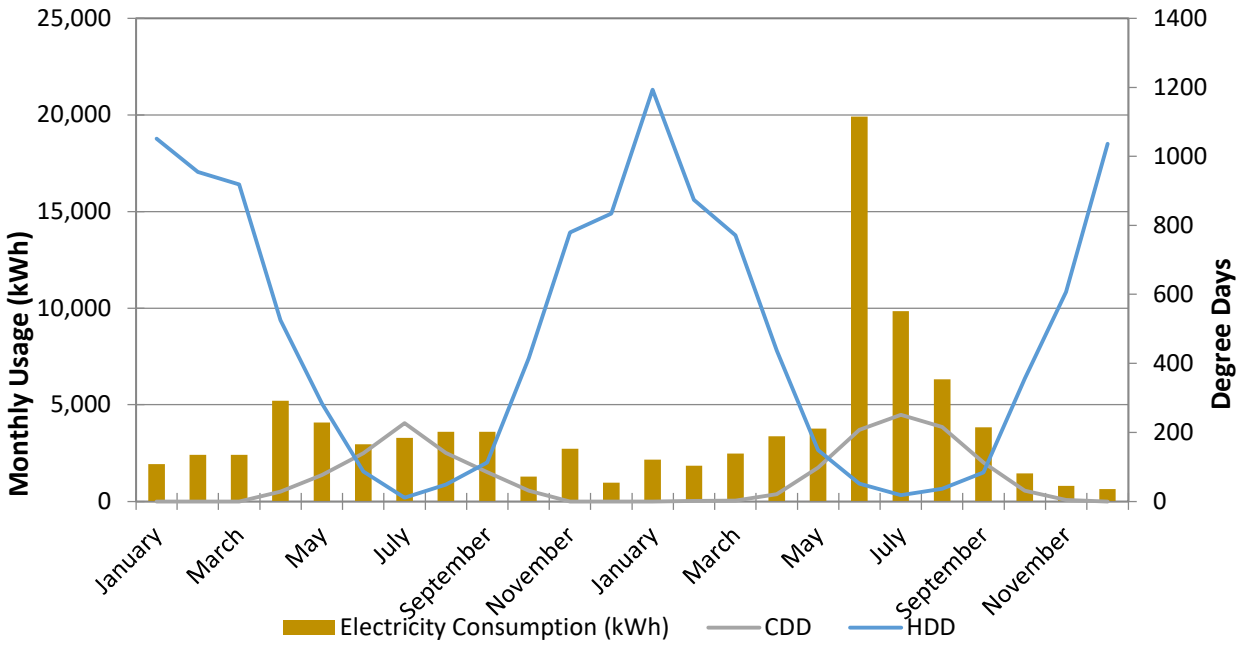
Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	56.400 kWh	192	$6,204	$0.11/kWh	0.0004427	33
Steam	472 klbs	563	$4,716	$10/klbs	0.119	56
Total	**--**	**755**	**$10,920**	**--**	**--**	89

**Steam (1 kBTU = 1,194 klbs); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Central Services does not have central cooling and instead cools select spaces with three window AC units. This low cooling load is illustrated in Figure 3 as electricity usage does not show a strong correlation to weather data, particularly in 2023, indicating the majority of electricity usage consists of baseload usage. This usage does not vary much from month to month and includes loads such as lighting, fans, and pump loads. The annual usage for the baseline 12-month period from January to December 2024 is 56,400 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

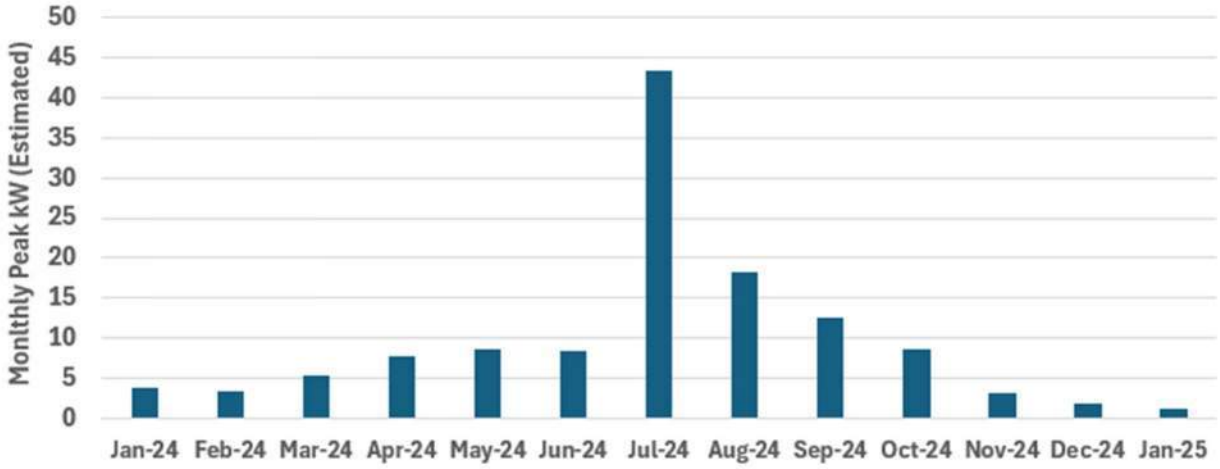
The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 6: Electrical Capacity Analysis

Maximum Building Capacity at Service Transformer	150 kW
Maximum Capacity at Switchgear (A*V*Ph)	96 kW
Estimated Peak Demand	41 kW (from meter)
Remaining Capacity	**55 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge:	**$0.057/kWh**
DTE Electric Demand Charge:	**$6.15/kW/Month**
Average Dollar per kWh Used in Calculations:	**$0.11/kWh**

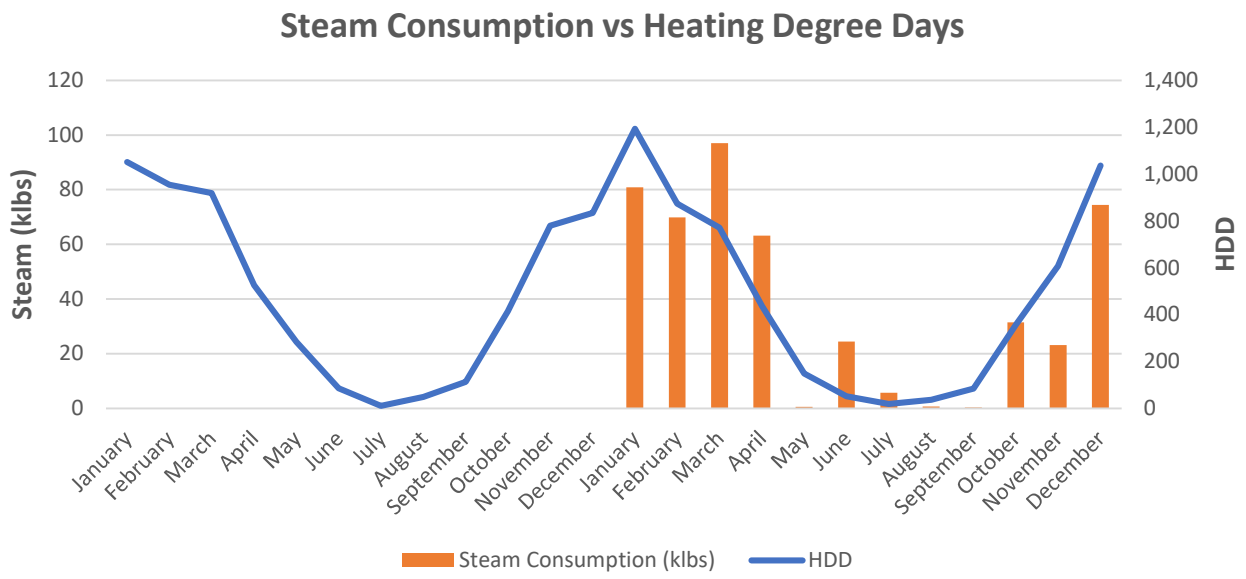
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Steam Usage Profile

Figure 3 shows the monthly steam usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Steam usage shows a correlation to weather data, as steam is primarily used for space heating. However, there is baseload summer usage due to domestic hot water usage for bathrooms and year-round hot water demand from baseboard heaters. The annual usage for the baseline 12-month period from January to December 2024 is 472 klbs. Detailed monthly steam usage and costs are in Appendix A.

Figure 3: Steam Usage Profile (January 2023 to December 2024)



3.4.1 Steam Rate Structure

Unlike electricity and natural gas, which are billed directly by external utilities, steam is an internal utility produced on campus. The cost allocation for steam is derived from the total natural gas cost at the central steam plant, as well as costs to operate the plant. Each steam-served building is billed proportionally based on its metered steam usage relative to the campus total. As a result, there are no separate delivery, demand, or third-party charges; the unit cost of steam reflects the cost of natural gas, plant operating cost and efficiency, and distribution system performance.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings.

Average Dollar per klb Used in Calculations: $10.00/thousand lbs

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 7 below.

Table 7: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$6,204
Natural Gas	$4,716
Total	$10,920
ECI $/yr/sf	$0.57

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

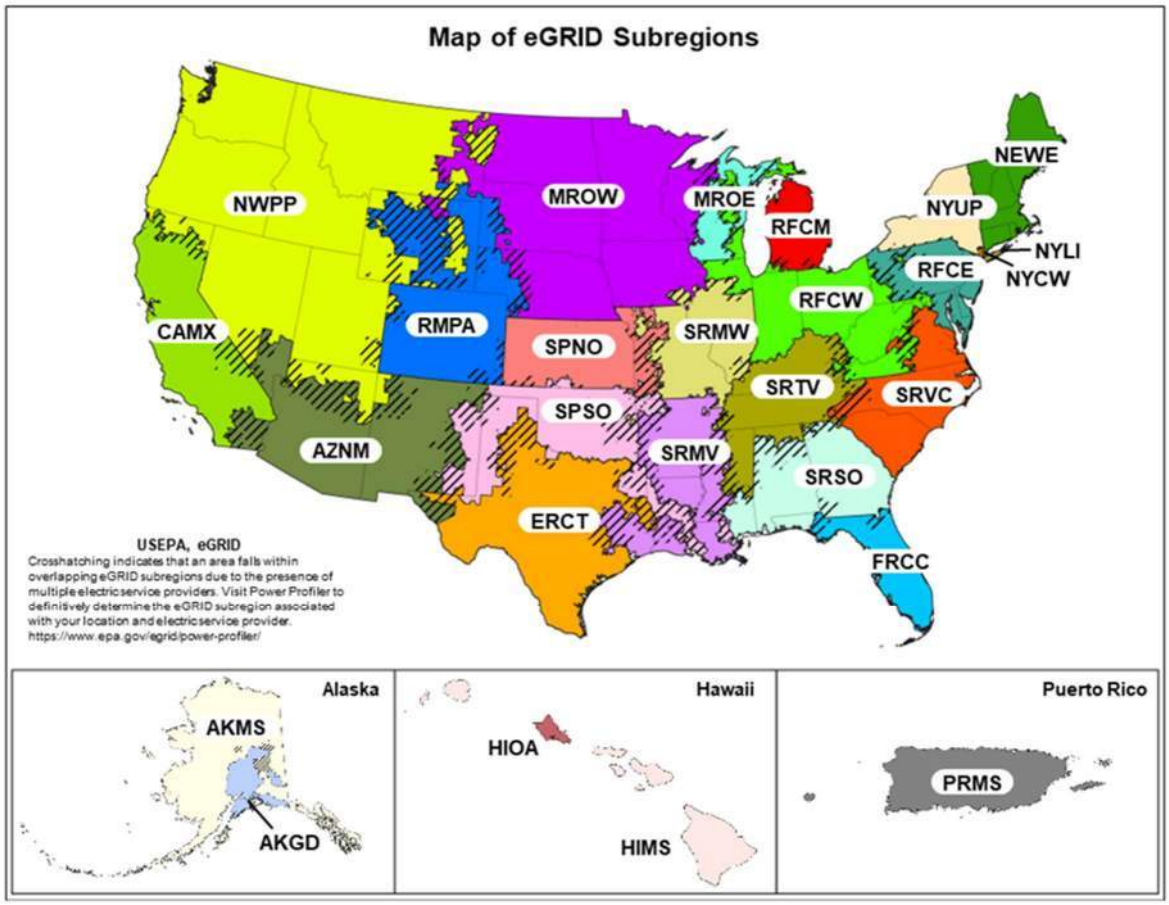
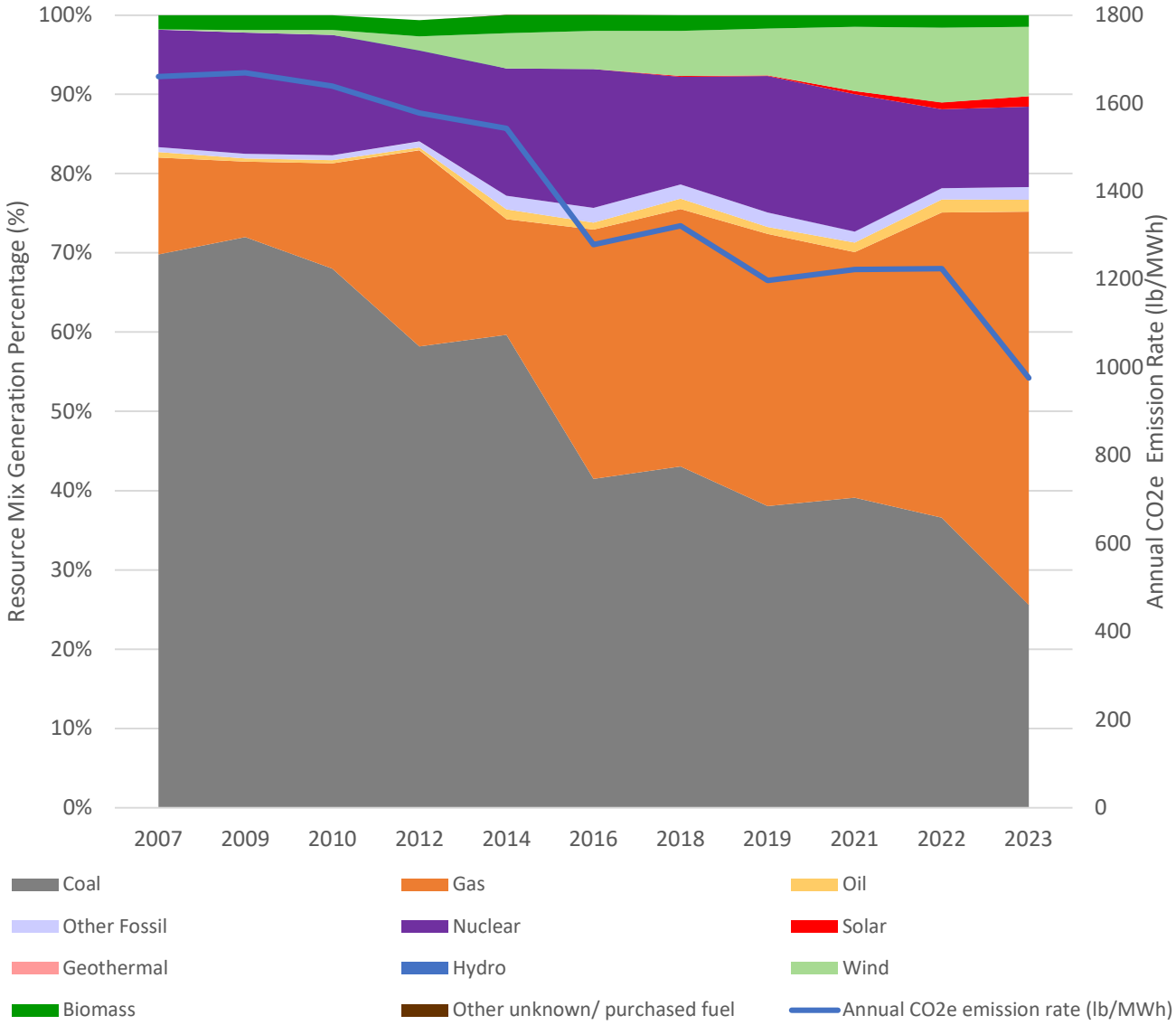


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO_2e emissions factor for the RFCM sub-region is 976 lb. CO_2e/MWh, which is significantly higher than national average of 767.2 lb. CO_2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 60 percent of carbon emissions are attributed to steam and 40 percent are associated with electricity. Steam combustion and imported electricity resulted in 49 tCO2e (campus-level Scope 1) and 33 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 82 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for Central Services are converted to kBTUs units, summed, and divided by the total square footage.

Table 8: Annual Utility Summary (2024)

Building:	Central Services				**Electric EUI:**		10	kBTU/SF/yr
GFA:	19,020	SF			**Steam EUI:**		30	kBTU/SF/yr
eGRID Subregion:	RFCM				**Current EUI**		40	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	56,400	kWh	3.412	192	0.0004427	33	$6,204	57%
Steam	472	klbs	1194	563	0.119	56	$4,716	43%
		Totals		**755**		**89**	**$10,920**	**100%**

According to the US EPA, the average site energy use intensity for a mixed-use facility is 40.1 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 40 kBTU/SF, which is approximately equal to the national benchmark. Nevertheless, there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient

3.8 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees and visitors. Table 9, Figure 7 and

Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 9: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (klbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	0	425	507,000	26.7	50.5
Space Cooling	16,277	0	0	55,536	2.9	9.5
Fans	1,100	0	0	3,754	0.2	0.6
Pumps	1,190	0	0	4,061	0.2	0.7
SHW/DHW	0	0	47	56,014	2.9	5.6
Conveyance	0	0	0	0	0.0	0.0
Lighting	30,292	0	0	103,358	5.4	17.6
Plug Loads	8,246	0	0	28,137	1.5	4.8
Process Loads	0	0	0	0	0.0	0.0
Refrigeration	0	0	0	0	0.0	0.0
Cooking	0	0	0	0	0.0	0.0
Information Technology	0	0	0	0	0.0	0.0
TOTAL	**56,724**	**0**	**472**	**757,859**	**40**	**89**
Historical Billing	**56,400**	**0**	**472**			
Percent of Actual	101%	0%	100%			
per sqft	**2.97**	**0.00**	**0.02**			

Figure 7: Existing Electricity End Use Distribution

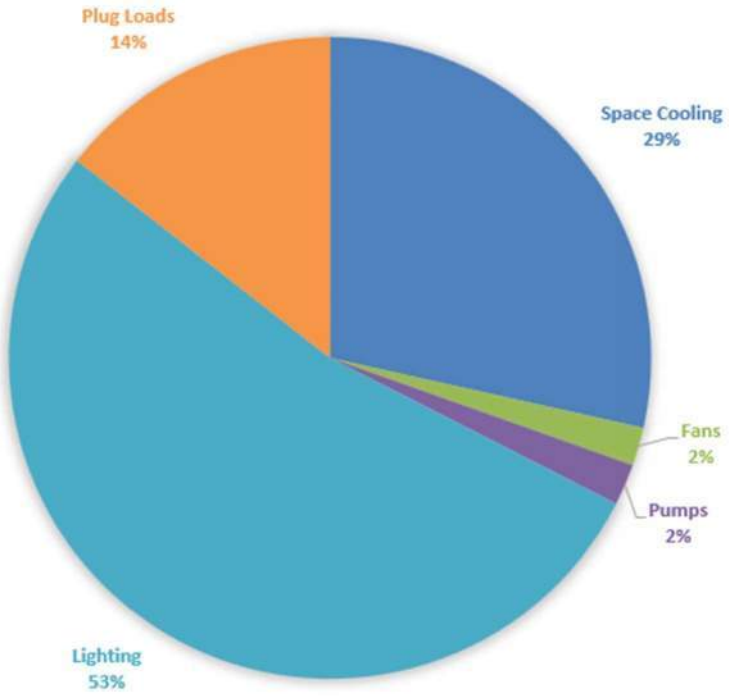
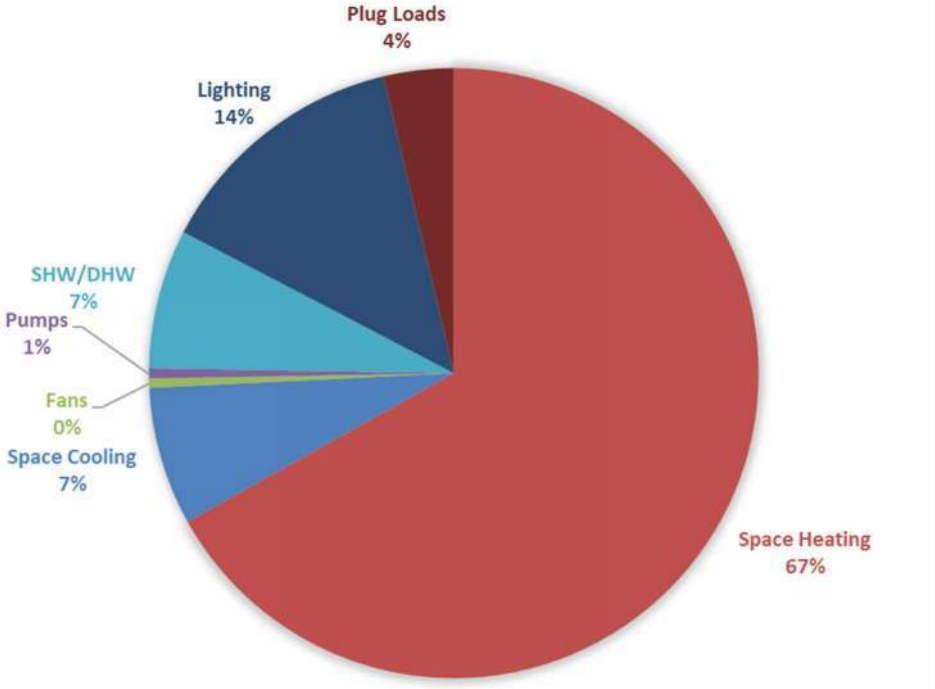


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – Retro-Commissioning

This combined measure involves completing retro-commissioning (RCx) at the building. While no BAS exists in the building, there are HVAC and lighting systems that can be optimized through low-cost local controls and existing equipment repairs. There is also the option to install a Building Automation System, which comes at a greater cost, but given the scale of retrofits required to electrify this building it is recommended to hold off on centralizing the controls until a new design is determined.

The following list represents commissioning opportunities that should be evaluated to validate operation, repair if discrepancies identified or implement if not active and feasible for major HVAC systems. This effort will proactively improve building system operation and optimize energy usage, while also collecting additional information that can inform the final design for building electrification.

Specific to the building:

- Optimize air compressor.
- Install fin tube radiators (FTR) covers where missing.
- Steam Trap Repairs
- Valve and actuator adjustments
- Filter replacements
- System Maintenance

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Commissioning will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 10% reduction in estimated heating energy consumption, and 10% reduction was estimated for cooling as potential setback savings are accounted for in ECM 3, Implement Temperature Setbacks.
- Project cost is estimated at $0.75 per square foot of building area.

- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Engage with RCx contractor to survey building and identify opportunities for system optimization and repair.

ECM Savings and ROM Cost:

Table 10. ECM 1 Savings and ROM Cost

Savings Summary							
ECM	Steam Savings (klbs)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
RCx + Install BAS	42	1,857	57	5.9	$629	$14,265	22.7
Overall % Reduction	**9%**	**3%**	**8%**	**7%**	**6%**	**--**	**--**

4.2 ECM 2 – LED Lighting and Controls

This measure proposes upgrading all fluorescent lighting to Light-emitting diode (LED) lightbulbs with sensors to reduce energy consumption and electrical demand. LEDs are highly energy efficient as most of the electrical energy supplied to the fixture is converted into light – 80% or more depending upon the LED lamp. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements.

Incorporating lighting controls allows for better management and customization of lighting systems, leading to reduced energy consumption, and increased overall efficiency by limiting the time lighting is on to only when necessary. For indoor lighting, lighting controls consist of occupancy, daylighting, timers, scheduling, and dimming features to optimize light levels based on external lighting availability and usage of a space. For outdoor lighting, the lighting controls consist of motion sensors, photocells, and timers to turn the lighting ON/OFF. The lighting in Central Services includes a mix of fluorescent fixtures rated at 42 W and light emitting diode (LED) fixtures rated at 14 W across the north and south sections of the building. See Section 2.1.3 for the lighting counts used to estimate energy consumption. The fluorescent fixtures are rated at 42W, while the light emitting diode (LED) fixtures are rated at 14W.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.



Figure 9: Example Fixture with Integrated Occupancy Controls

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture.
- Lights operate 8 hours per day for 252 business days per year based on office operation hours.
- O&M savings assume an average cost of $3.81/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- This measure assumes a 30% reduction in interior lighting energy (kWh).
- LED upgrades cost $215/fixture, which include integrated control sensors and no additional wiring and control circuits. Low-cost fixtures and external controls can be used as an alternative to this implementation method. This measure assumes all fluorescent lamps are converted to LEDs, estimated at 144 total fixtures.
- This measure indirectly supports electrification readiness by realizing a potential kW demand reduction that can be deployed elsewhere for new electric loads.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, subsequent steps include conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. Following this assessment, a controls contractor can be engaged to install the lighting controls and assist

building engineers in configuring the schedule to optimize lighting usage. Provided below are the rebate opportunities for LED lighting upgrades and lighting controls from DTE.

ECM Savings and ROM Cost:

Table 11. ECM 2 Savings and ROM Cost

	Savings Summary							
ECM	Steam Savings (klbs)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost ($)	Simple Payback (Yrs)
LED Upgrade	0	20,527	70	9.1	$549	$2,258	$25,155	9.0
Overall % Reduction	**0%**	**36%**	**9%**	**10%**	**--**	**21%**	**--**	**--**

4.3 ECM 3 – Implement Temperature Setbacks for HVAC Systems

Implementing standardized setpoints and occupancy schedules for the HVAC system can reduce energy consumption to enhance energy efficiency in areas with regular weekly occupancy. By establishing consistent temperature setpoints and aligning HVAC schedules with actual occupancy patterns, the system avoids unnecessary heating or cooling during unoccupied hours such as evenings, weekends, and holidays. This can be done by enabling seasonal occupied and unoccupied setpoints and schedules on programmable thermostats or enabling these controls in a centralized BAS where only authorized individuals can adjust as needed. This allows the HVAC system to “coast” toward unoccupied setpoints when the spaces are unoccupied and minimizes the need for the HVAC system to run. Central Services is heated with a steam to heating hot water (HHW) heat exchanger that pumps the HHW to a system of fin and tube radiators --baseboard heating – throughout the building. The current system maintains a constant temperature of 75°F. Given that the building does not currently have a BAS, the units run 24/7. However, the building only operates during typical business hours, offering an opportunity to reduce the total HVAC operation time with setbacks to reduce energy consumption. There are potential additional savings by reducing the occupied setpoint during the winter months, so the system does not need to consume as much energy to reach the desired setpoint. This can be achieved through the installation of local thermostats and timers for radiant systems. This is presented as an alternative to BAS installation, which should be considered if new HVAC infrastructure is designed and implemented.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- This measure assumes heating season energy savings due to reduced HVAC operation hours. Cooling season savings are omitted due to Michigan’s climate.
- The existing HHW distribution system runs 24/7 to maintain an occupied setpoint of 75°F due to the current scheduling. The current heat exchanger has an assumed heating capacity of 300 MBH.

- The occupied setpoint was lowered 3 degrees to 72°F while the unoccupied setback temperature was assumed to be 55°F for freeze protection.
- $1500 was used to estimate the installation programmable thermostats to control system operation.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: The first consideration for this building should be the timeline for removal of the steam heating system. If that process is expected to begin in less than 5 years, consider planning the design of the new systems and not implementing upgrades to the current HVAC. If the implementation plan is greater than 5 years in the future, proceed with this measure. Conduct a survey of existing control functionalities to determine any necessary upgrades and then establish seasonal setpoints (generally targeting 68-74°F when occupied and 55-60°F/80-85°F when unoccupied) and HVAC schedules that align with building occupancy patterns. Install thermostats in areas that reflect Verify and monitor to ensure the system is operating as intended and adjust as needed. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 12. ECM 3 Savings and ROM Cost

Savings Summary								
ECM	Steam Savings (klbs)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
HVAC Setbacks	81	0	96.2	9.6	$0	$806	$1,500	1.9
Overall % Reduction	**17%**	**0%**	**13%**	**11%**	**--**	**7%**	**--**	**--**

4.4 ECM 4 – Repair Steam Pipe Insulation

As a heat transfer medium like steam or hot water moves throughout a pipe, heat is lost to the environment through the pipe wall, particularly along stretches of a distribution network. This means more energy is used to heat the liquid to the required end-use temperature to attempt to recover this loss. Installing and repairing pipe insulation greatly reduces this heat loss and therefore reduces the energy input into the system. Central Services has some p

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- It was assumed that the replacement costs would roughly total $10 per linear foot of pipe.
- This measure calculates that 20% of the heating energy is lost though the jacket of the steam piping.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Identify locations with damaged insulation or bare pipe and evaluate the feasibility of repairing or installing insulation on each section. Purchase new insulation and make the necessary repairs or installations.

ECM Savings and ROM Cost:

Table 13. ECM 4 Savings and ROM Cost

Savings Summary							
ECM	**Steam Savings (klbs)**	**Electric Savings (kWh)**	**Energy Savings (MMBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
Repair Pipe Insulation	86	0	103	10.2	$860	$5,500	6.4
Overall % Reduction	**18%**	**0%**	14%	12%	8%	--	--

5 Measure Requiring Additional Consideration

This section provides details on measures that were analyzed but are not recommended for immediate implementation at this time. This includes measures that require further study, such as capital-intensive replacements of existing equipment, but are not justified through energy savings alone. This section may also include measures that conflict with building electrification plans, or projects that are simply not recommended due to being financially impractical or not being technically feasible.

5.1 ECM 5 – Install New Window AC Units

Upgrading outdated HVAC systems is a highly effective energy conservation measure as newer systems can offer higher efficiencies and reduced maintenance requirements. This upgrade also improves indoor air quality and thermal comfort for occupants. Central Servies has three Dx window AC units – Friedrich, Kenmore, and Frigidaire for Office 1, Office 2, and plantings storage area respectively. Since these units are 15 to 25 years old and are in fair condition, they should be replaced as they approach the end of useful life (EUL) with newer, more efficient units to reduce energy use. Implementing this measure as part of a routine capital upgrade ensures the integration of modern energy-efficient equipment into the facility's infrastructure, maximizing the overall benefit and lifecycle performance of the new systems.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- HVAC equipment identified is due for routine end-of-life replacement.
- This measure assumes energy savings resulting from an improved efficiency rating of 13.3 EER for the new units as compared to the assumed 10.5 EER for the existing units. The current units were assumed to have a cooling capacity of 5 MBH each.
- It was assumed that the replacement costs would roughly total $2,000 per unit.
- This measure indirectly supports electrification readiness by realizing a potential kW demand reduction that can be deployed elsewhere for new electric loads.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Detailed planning and design should be undertaken to ensure the new units are appropriately sized and configured to meet the specific needs of the space. This process should be integrated into the facility's routine capital upgrade schedule to optimize the benefits of the new equipment and ensure seamless implementation along with other county priorities.

ECM Savings and ROM Cost:

Table 14. ECM 5 Savings and ROM Cost

Savings Summary							
ECM	Steam Savings (klbs)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Install New Window AC Units	0	1,026	3.5	0.5	$113	$6,000	53.1
Overall % Reduction	**0%**	**2%**	**0.5%**	**1%**	**1%**	**--**	**--**

5.2 ECM 6 – Replace FTR Baseboard Heating with Electric Infrared Heaters

Upgrading outdated HVAC systems is a highly effective energy conservation measure as newer systems can offer higher efficiencies and reduced maintenance requirements. Additionally, replacing fossil-fuel based equipment with alternatives serves electrification and decarbonization goals. Central Servies is heated via a system of fin and tube radiators (FTR) serving as 90% of the perimeter baseboard heating and large tube radiators serving the brine tank room and 10% of the perimeter. The system is fed heating hot water (HHW) from the central water tube heat exchanger. Many of the FTRs are without covers and are in fair condition, indicating an opportunity to upgrade to a more efficient system. Also, as the heat exchanger requires steam to produce hot water, it is recommended to replace the system with electric infrared heaters to eliminate the need for steam in support of the county's electrification goals. Implementing this measure as part of a routine capital upgrade ensures the integration of modern energy-efficient equipment into the facility's infrastructure, maximizing the overall benefit and lifecycle performance of the new systems.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- HVAC equipment identified is due for routine end-of-life replacement.
- This measure assumes energy savings resulting from eliminating the steam needed for heating, though
- The current heat exchanger has an assumed heating capacity of 300 MBH.
- It was assumed that the replacement costs would roughly total $600 per kW of the new electric resistance system.
- This measure supports electrification readiness as the proposed equipment would directly use electricity to heat, unlike the current equipment.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Detailed planning and design should be undertaken to ensure the new units are appropriately sized and configured to meet the specific needs of the space. This process should be integrated into the facility's routine capital upgrade schedule to optimize the benefits of the new equipment and ensure seamless implementation along with other county priorities.

ECM Savings and ROM Cost:

Table 15. ECM 6 Savings and ROM Cost

Savings Summary							
ECM	Steam Savings (klbs)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)*
Install New Window AC Units	425	-182,884	-117.0	-36.1	-$15,871	$52,800	NA
Overall % Reduction	**90%**	**-324%**	**-15%**	**-34%**	**-145%**	**--**	**--**

**N/A indicates a negative payback period which results from negative cost savings due to the higher cost of electricity relative to the cost of natural gas, common for electrification measures.

6 Appendix A

Table 16: Monthly Utility Data (2023 to 2024)

Month	Steam Consumption (klbs)	Steam Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	-	-	1,920	$211	3	3	1,051	0
Feb-23	-	-	2,400	$264	4	4	955	0
Mar-23	-	-	2,400	$264	3	5	918	0
Apr-23	-	-	5,200	$572	7	12	525	28
May-23	-	-	4,080	$449	5	9	283	76
Jun-23	-	-	2,960	$326	4	6	86	139
Jul-23	-	-	3,280	$361	4	6	11	227
Aug-23	-	-	3,600	$396	5	7	48	141
Sep-23	-	-	3,600	$396	5	8	113	85
Oct-23	-	-	1,280	$141	2	3	415	31
Nov-23	-	-	2,720	$299	4	6	779	0
Dec-23	-	-	960	$106	1	2	834	0
Jan-24	81	$966,077	2,160	$238	3	4	1,194	0
Feb-24	70	$99,898	1,840	$202	3	3	874	1
Mar-24	97	$138,727	2,480	$273	3	5	771	2
Apr-24	63	$90,313	3,360	$370	5	9	437	21
May-24	0.5	$718	3,760	$414	5	8	148	98
Jun-24	24	$34,956	19,920	$2,191	28	43	51	207
Jul-24	6	$8,090	9,840	$1,082	13	18	18	251
Aug-24	0.7	$1,031	6,320	$695	8	13	37	215
Sep-24	0.3	$369	3,840	$422	5	9	84	112
Oct-24	31	$44,915	1,440	$158	2	3	356	31
Nov-24	23	$33,153	800	$88	1	2	607	4
Dec-24	74	$106,471	640	$70	1	1	1,037	0
2023 Sum	-	0	34,400	$3,784			6,019	727
2024 Sum	472	$1,524,718	56,400	$6,204			5,614	942

7 Appendix B

Table 17: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Capacity 2	Condition
	1	Window AC (Dx)	Office 1	Friedrich		5 MBH	15-25 years old	Fair
	1	Window AC (Dx)	Office 2	Kenmore		5 MBH		Fair
	1	Window AC (Dx)	Plantings storage area	Frigidaire		5 MBH		Fair
CU	1	Condensor Unit (Dx)	Cool room					Abandoned
	1	Water tube heat exchanger	Whole building		Approx. 38” long x 6” diameter			
		Large tube radiators (HW)	Brine tank room					Fair
		Large tube radiators (HW)	~10% of perimeter				1973	Fair
		Baseboard FTR (HW)	Whole building					Most of perimeter has FTR, much without covers
	1	Air compressor (piston type)	Filling Tires	Worthington	EU 3506 A, SIZE 6/3.5X2.75	30 HP (est)		
CRT	1	Condensate return tank and in-line pump						
		Submersible sump pump						
		Hot water circulator pump	Whole building	B&G Circulator	NBF-22 103252LF 1J01			
	1	Tube axial exhaust fan		Dayton	4C661 – 18”D	1 HP		
	1	Axial exhaust fan	Cool room					
	2	Axial exhaust fan	Toilet Room					
	1	In-line exhaust fan	Office 1					
		Roof vent	Brine tank room					
		Steam pressure transmitter		Kobold				

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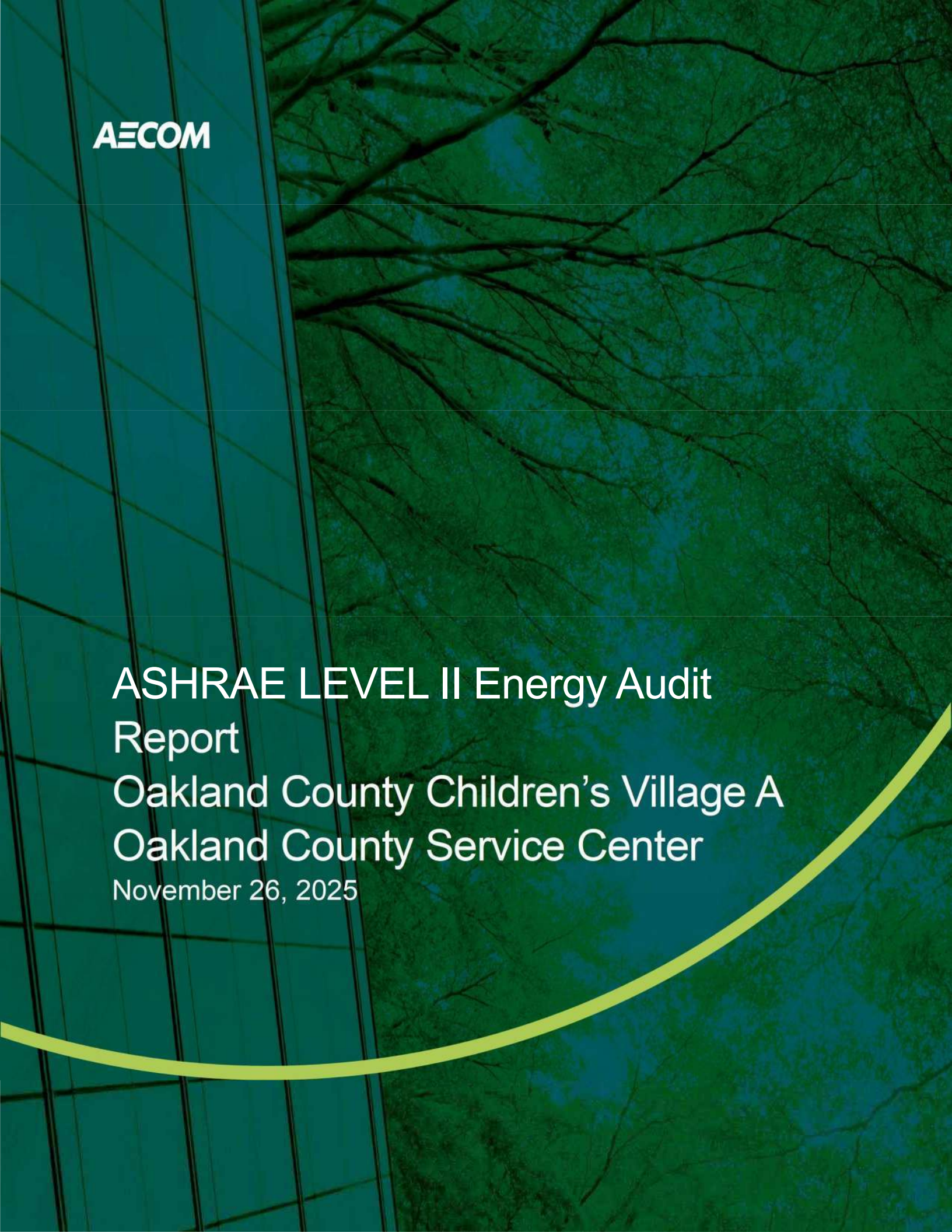

AECOM

ASHRAE LEVEL II Energy Audit Report
Oakland County Children's Village A
Oakland County Service Center

November 26, 2025

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

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OAKLAND COUNTY, MI Government

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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Children's Village A Building in accordance with ASHRAE Standard 211-2018. Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County Children's Village is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Wednesday April 16, 2025 was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates one Energy Conservation Measures (ECMs) for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The recommended listed measure represent a projected 19% annual energy cost savings with a simple payback of 1 year. This report does not specify additional capital measures because the building future is not currently known. The site visit team noted that the building may be demolished, which would limit any investment that should be made into the facility.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Children's Village Building A Proposed Energy Savings Summary

Energy Conservation Measures												
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	MTCO2e	$/yr	$	Years
1	HVAC Setback	H	R	22,049	0	224	0	308	22.1	$3,541	$3,720	1.05
Sum of Recommended Measures				22,049	0	2,324	0	308	22	3,541	3,720	1.05
Overall % Reduction				19%	0%	20%	0%	20%	20%	19%	-	-
	Retro-Commissioning	Not evaluated further since building has been vacant since 2021										
	Building Envelope Improvements											
	Upgrade Pneumatic Controls to DDC											

Notes
Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Children's Village, a detention facility, functions as a residential center for juvenile residents, offering a structured environment that supports their education during rehabilitation. Building A, a residential treatment facility with one wing for boys and one wing for girls, was built in 1974. The concrete masonry unit (CMU) building features a beige brick veneer and is two stories tall, with a roofing system that includes an attic.

This building was closed in 2021 and has remained vacant with the HVAC systems operational since closure. The current plan is to demolish this building in the upcoming years as the Children's Village is modernized. Details remain unclear as the Children's Village Master Plan is still underway.

2.1 Building Systems

2.1.1 Building Envelope

The building has two above-grade and one below-grade floor. The window/wall ratio is estimated to be about 25%. The windows appear to be in good condition; however, they are single-pane windows and are assumed to be original to the building.

The walls are CMU structures with brick veneer on the exterior. There is no insulation on the interior side behind the drywall. The attic was not accessible, and the insulation levels are not known at this stage.

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	CMU with brick veneer	Good
Roof	Attic	Good
Glazing	Single-pane, aluminum frame, tinted windows are original, 25% window/wall ratio	Fair

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The building has a hot water boiler for heating and two direct expansion (DX) split-AC condenser units paired with two constant volume multi-zone AHUs. The boiler, condenser units, and AHUs are assumed to be over 20 years old and in fair to poor operating condition. The building does not have any perimeter baseboard heating. Although the building is vacant, these systems are still operating at normal conditions and appear to be overheating, resulting in unnecessary energy use.

2.1.3 Plumbing

The domestic hot water is provided by a 1995 Lochinvar boiler with an input capacity of 399 MBH and storage tank with 119 gallon capacity.

2.1.4 Building Controls

The building systems are controlled by pneumatic damper actuators and a 2 HP air compressor is located in the boiler room. All pumps and fans are equipped with constant-speed motors. The lighting systems are manually controlled.

2.1.5 Lighting Systems

All lighting fixtures have recently been upgraded to LED. The fixtures are a mix of recessed, ceiling-mounted, and suspended types, depending on the area. The typical LED lamp is approximately 12 watts.

Table 3: Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
LED Lights	73	2 lamp
LED Lights	31	1 lamp

The total approximate quantity of light fixtures is 104. The approximate total wattage is 2,124 watts. The approximate area per drawing is 18,602 ft².., with an approximate lighting density of 0.114 W/ft².

2.1.6 Electrical Infrastructure

The main electrical service for the facility is fed from a 300 kVA transformer located outside the building. The service is rated at 208/120 volts, 3-phase, 4-wire, with a capacity of 1200 amperes. The Main Distribution Panel (MDP) is located in the mechanical room in the basement. The utility meter number is IQDP-4000. As of 7:30 AM on June 5, 2025, the meter displayed an accumulated total of 755,897 kWh. There is no generator on site.

3 Utility Billing Analysis

3.1 Utility Type and Usage

Children's Village Building A receives electric service and natural gas service and is not on the central steam system. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

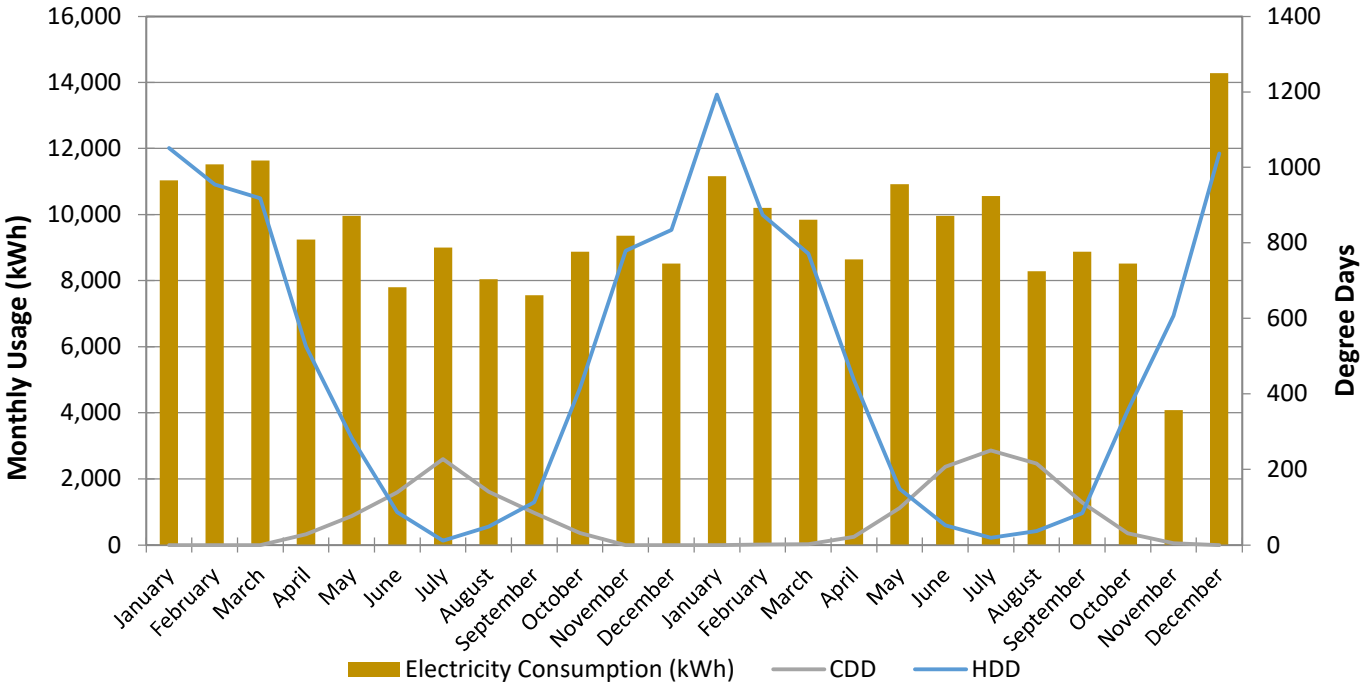
Utility	Annual Usage	Annual Usage (MMBtu)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	115,320 kWh	393	$12,685	$0.11	0.0004427	51
Natural Gas	1,119 MCF	1,162	$5,577	$4.98	0.05249	61
Total	--	1,555	$18,262	--	--	113

**Natural Gas (1 MCF = 1,038,000 Btu); Electricity (1 kWh = 3412 Btu)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*
****Natural gas annual usage is 3-year average due to significant data fluctuations*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage does not show a correlation to weather data, and electricity is slightly higher in the winter months than the summer. Due to the site observations of the system overheating, this may indicate there is some simultaneous heating and cooling occurring during the winter months as lighting loads are minimal since the building is vacant and operates mostly with minimal security lighting. The most prominent electricity load in this building are the constant volume fans on the two AHUs, which are operating normally although the building is vacant. The annual usage for the baseline 12-month period from January to December 2024 is 115,320 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

An electrical capacity analysis was not conducted for this building as it is vacant and planned for demolition.

3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.

- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy, and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. This arrangement accurately distributes the cost of electricity consumption, but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand but high usage are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: $0.057/kWh

DTE Electric Demand Charge: $6.15/kW/Month

Average Dollar per kWh Used in Calculations: $0.11/kWh

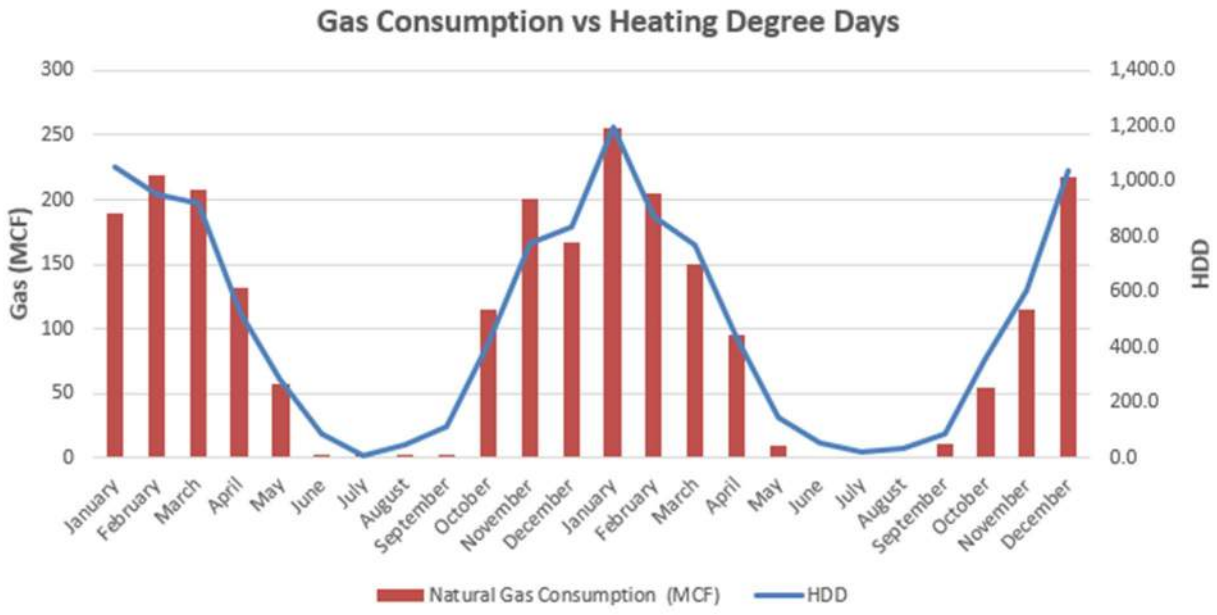
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows a direct correlation to weather data, as natural gas is primarily used for space heating and the boiler and HVAC systems are operating as normal although the building is vacant. The annual usage for the baseline 12-month period is 1,119 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 2: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electric, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): $3.48/dTh (decatherm, or 1M BTU)

Constellation NG Usage Charge (Day Gas): $5.29/dTh (decatherm, or 1M BTU)

Average Dollar per MCF Used in Calculations: $4.98/MCF

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided by an annual purchase request statement for 2024 of the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 5 below.

Table 5: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$12,685
Natural Gas	$5,577
Total	$18,262
ECI $/yr/sf	$0.98

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 3 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 3: Map of eGRID Subregions

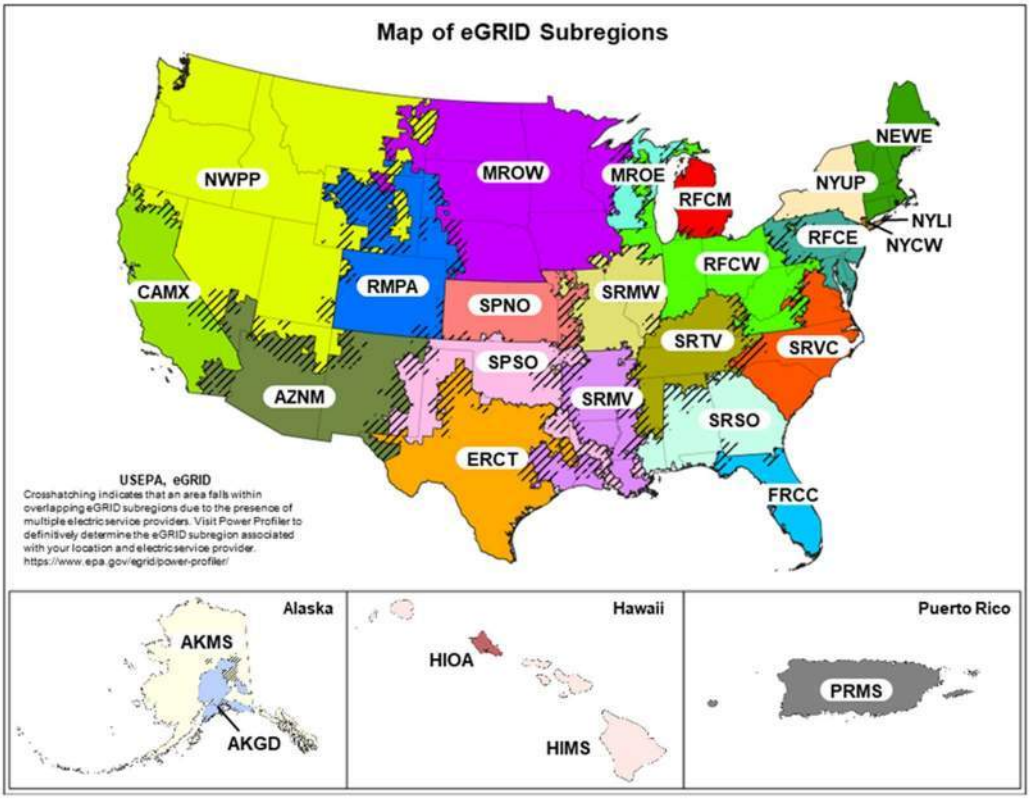
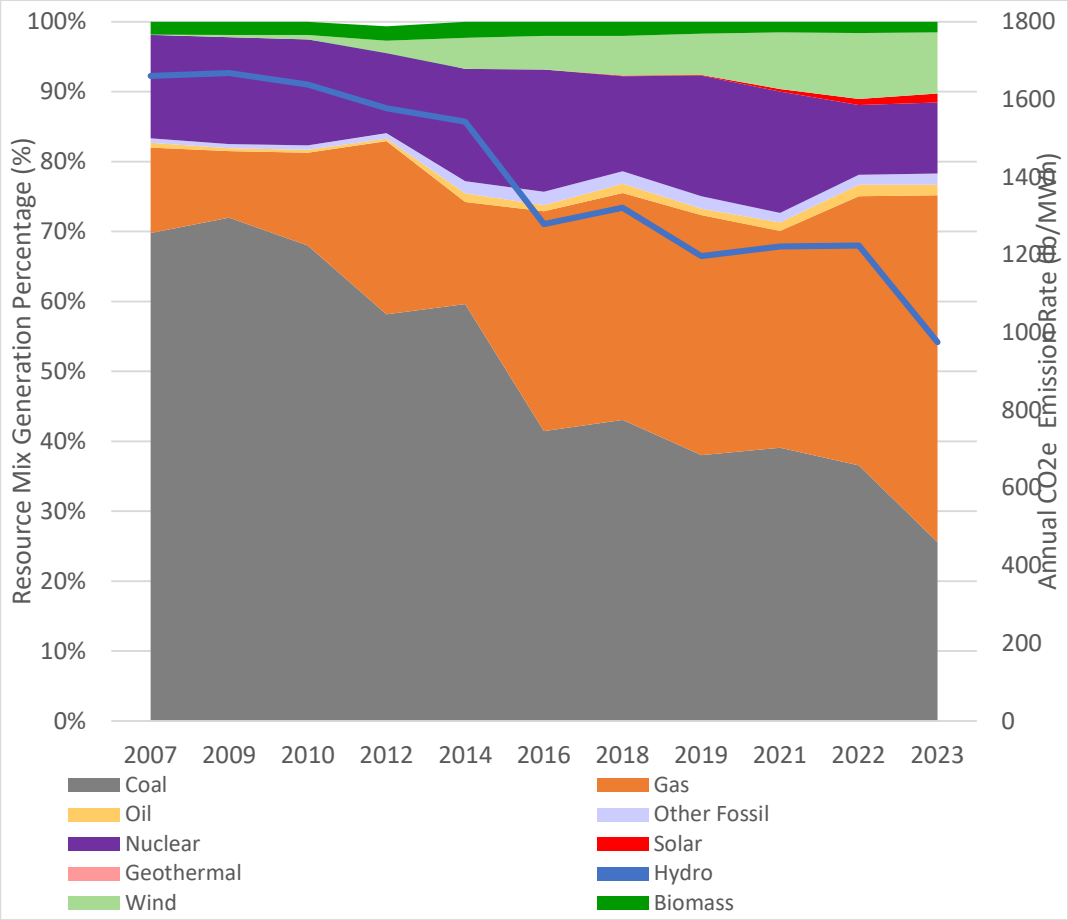


Figure 4 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal

and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 4: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 55 percent of carbon emissions are attributed to natural gas and 45 percent associated with electricity. Natural gas combustion for space heating and imported electricity resulted in 61 tCO2e (Scope 1) and 51 tCO2e (Scope 2) emissions, respectively, for a total of 113 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficient per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBtu) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for Children's Village A, are converted to kBtus units, summed, and divided by the total square footage.

Table 6: Annual Utility Summary (2024)

Building:	Children's Village A					**Electric EUI:**	21	kBtu/SF/yr
GFA:	18,602	SF				**Gas EUI:**	62	kBtu/SF/yr
eGRID Subregion:	RFCM					**Current EUI**	84	kBtu/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	115,320	kWh	3.412	393	0.0004427	51	$12,685	69%
Natural Gas	1,119	MCF	1.038	1,162	0.05249	61	$5,577	31%
Totals				1,555		113	$18,262	100%

According to the US EPA, the average site energy use intensity for residence hall is 57.9 kbtu/SF/yr. The total EUI for the existing condition of the building is calculated as 84 kBtu/SF, which is higher than the national benchmark. It's important to note the national benchmark does not factor in the variance for weather conditions whereas Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison and site observations indicate there is a significant opportunity to setback HVAC systems to reduce unnecessary energy consumption while the building is vacant and awaiting demolition.

Figure 5: Average EUI per Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient

3.8 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. Domestic hot water usage and plug loads are assumed to be zero as the building is vacant. Table 7 and Figure 6 and Figure 7 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 7: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBtu)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	1,119	0	1,161,870	62	61
Space Cooling	30,625	0	0	104,493	6	14
Fans	75,988	0	0	259,271	14	34
Pumps	3,631	0	0	12,387	1	2
SHW/DHW	0	0	0	0	0	0
Conveyance	0	0	0	0	0	0
Lighting	3,096	0	0	10,564	1	1
Plug Loads	0	0	0	0	0	0
Process Loads	1,980	0	0	6,757	0	1
Refrigeration	0	0	0	0	0	0
Cooking	0	0	0	0	0	0
Information Technology	0	0	0	0	0	0
TOTAL	115,320	1,119	0	1,555,342	84	113
Historical Billing	115,320	1,119	0			
Percent of Actual	100%	100%	0%			
per sqft	6.2	0.6	0			

Figure 6: Existing Electricity End Use Distribution

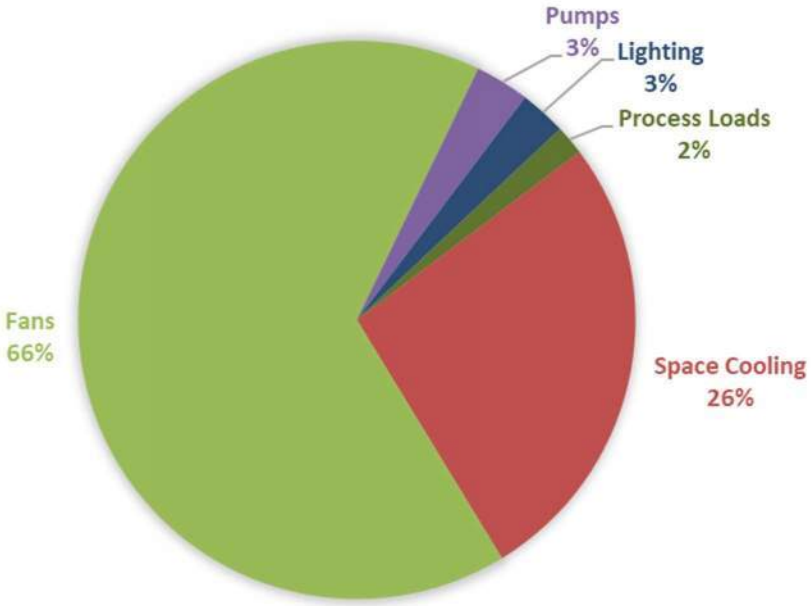
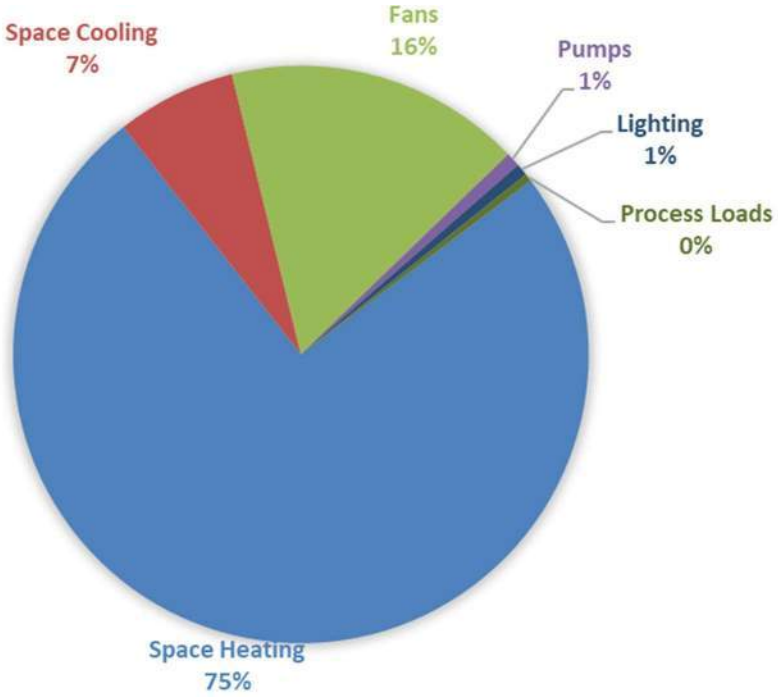


Figure 7: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure, but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – HVAC Setback

Implementing standardized setpoints and occupancy schedules for the HVAC system can reduce energy consumption to enhance energy efficiency in areas with regular weekly occupancy. By establishing consistent temperature setpoints and aligning HVAC schedules with actual occupancy patterns, the system avoids unnecessary heating or cooling during unoccupied hours such as evenings, weekends, and holidays. This can be done by enabling seasonal occupied and unoccupied setpoints and schedules on programmable thermostats or enabling these controls in a centralized BAS where only authorized individuals can adjust as needed. This allows the HVAC system to “coast” toward unoccupied setpoints when the spaces are unoccupied and minimizes the need for the HVAC system to run. Children’s Village Building A has been vacant since 2021 but the HVAC systems remain fully operational at normal occupied setpoints, even to the point of overheating. This is resulting in unnecessary energy use to heat, cool, and ventilate a vacant building. This presents an opportunity to evaluate the existing pneumatic controls, make necessary repairs where needed to restore functionality, and adjust HVAC system setpoints to unoccupied setpoints.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Existing systems are running 24/7 to maintain occupied setpoints while the building is vacant.
- This measure assumes energy savings due to reduced HVAC operation hours by maintaining unoccupied setpoints. Unoccupied setpoints can be set to very low levels, with the goal of preventing damage from freezing on the equipment. This could conservatively mean an indoor setpoint of 50F for heating, and to turn the equipment OFF in summer months for cooling. This measure assumes a 20% reduction in energy use for the building, but much higher potential savings are possible with more aggressive controls.

- Assumes minor costs associated with evaluating and repairing some of the existing controls to restore functionality.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Conduct a survey of existing control functionalities to determine any necessary repairs to restore functionality and then establish setpoints (generally targeting 68-74°F when occupied and 50-60°F/80-90°F when unoccupied) and HVAC schedules that align with building occupancy patterns. Following these steps, programmable thermostats or a centralized BAS HVAC schedules should be configured accordingly. Verify and monitor to ensure the system is operating as intended and adjust as needed. This measure is recommended for immediate implementation.

ECM Savings and ROM Cost:

Table 8: ECM 1 Savings and ROM Cost

Savings Summary							
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
HVAC Setback	224	22,049	308	22	$3,541	$3,720	1
Overall % Reduction	20%	19%	20%	20%	19%	--	--

5 Measure Requiring Additional Consideration

This section provides details on measures that were analyzed but are not recommended for immediate implementation at this time. This includes measures that require further study, such as capital-intensive replacements of existing equipment, but are not justified through energy savings alone. This section may also include measures that conflict with building electrification plans, or projects that are simply not recommended due to being financially impractical or not being technically feasible.

For Children's Village Building A, additional analysis was not provided due to the unoccupied nature of the building. If ECM 1 is implemented, there are no additional measures that are necessary until the long-term strategy for the building is determined. Once the use and long-term plan for the building are determined, capital investment is required to bring the building up to modern standards, which can include the electrification measures that are provided in the Final Electrification Report.

5.1 Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent. Building A currently has old pneumatic controls. Since the building is vacant and planned to be demolished, its recommended to do the minimum necessary to setback the HVAC systems rather than a full retro-commissioning to optimize system operation.

5.2 Building Envelope Improvements

Effective insulation and a well-sealed building envelope are critical for managing the transfer of heat between the exterior and interior environments. In Michigan, where seasonal temperature variations can be significant, improving building envelope integrity not only reduces energy consumption for heating and cooling but also helps maintain a consistent and comfortable indoor environment for staff, residents, and visitors. In addition to insulation, proper vapor sealing prevents moisture intrusion and minimizes indoor air quality issues related to high humidity. As building energy codes and insulation standards have evolved, older buildings can greatly benefit from upgrades that align with modern requirements, enhancing their energy efficiency. This measure includes building envelope improvements such as sealing air gaps around points of infiltration, adding insulation into the attic, and upgrading windows to double-pane windows. These steps not only reduce energy usage and associated emissions but also lower heating capacity requirements, making them an essential precursor to any major HVAC system upgrades. While this measure is beneficial to reduce the energy load and minimize infiltration, it has a poor payback as a standalone project and is not recommended since the building is currently vacant and planned to be demolished.

5.3 Upgrade Pneumatic Controls to DDC

Pneumatic controls upgrades refer to the process of upgrading antiquated pneumatic control systems and components to direct digital controls (DDC) and integrating it with a centralized control system. Pneumatic controls use compressed air to operate valves and dampers and are prone to operational and maintenance issues. Upgrading these antiquated controls to DDC will enhance the overall efficiency, functionality, and manageability of HVAC system operation. This measure directly produces electricity savings by eliminating the need for a compressed air system, but also indirectly contributes additional energy savings by enabling better control and functionality such as scheduling and optimization. Building A has two dual-duct AHUs with pneumatic controls for all components. A 2HP air compressor provides compressed air to the system to control the AHUs. This measure is not recommended as the building is vacant. However, there are likely issues with the current pneumatic controls which should be minimally repaired to restore functionality and allow the HVAC systems to setback (ECM 1).

6 Appendix A

Table 9: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	190	$1,164	11,040	$1,185	15	20	1,051	0
Feb-23	219	$1,281	11,520	$1,085	17	21	955	0
Mar-23	207	$631	11,640	$1,044	16	25	918	0
Apr-23	131	$455	9,240	$813	13	21	525	28
May-23	57	$171	9,960	$785	13	22	283	76
Jun-23	2	$5	7,800	$584	11	17	86	139
Jul-23	2	$8	9,000	$728	12	17	11	227
Aug-23	2	$6	8,040	$639	11	16	48	141
Sep-23	2	$6	7,560	$696	11	17	113	85
Oct-23	115	$333	8,880	$723	12	19	415	31
Nov-23	201	$750	9,360	$719	13	22	779	0
Dec-23	167	$822	8,520	$605	11	15	834	0
Jan-24	255	$1,125	11,160	$258	15	20	1,194	0
Feb-24	205	$1,117	10,200	$1,043	15	19	874	1
Mar-24	150	$849	9,840	$794	13	21	771	2
Apr-24	96	$200	8,640	$758	15	25	437	21
May-24	9	$19	10,920	$842	15	24	148	98
Jun-24	2	$6	9,960	$915	14	22	51	207
Jul-24	2	$5	10,560	$941	14	20	18	251
Aug-24	2	$3	8,280	$761	11	16	37	215
Sep-24	11	$26	8,880	$712	12	20	84	112
Oct-24	55	$147	8,520	$809	11	18	356	31
Nov-24	116	$400	4,080	$440	6	10	607	4
Dec-24	218	$484	14,280	$1,201	19	24	1,037	0
2023 Sum	1,295	$5,632	112,560	$9,606			6,019	727
2024 Sum	1,119	4,381	115,320	$9,474			5,614	942

7 Appendix B

Table 10: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Efficiency	Capacity 2	Approx Year Installed
	1	AHU	Girls Wing			6300			
	1	AHU	Boys Wing			6200			
	1	Boiler							
	1	DHW Boiler		Lochinvar		399			1995
	1	DHW Storage Tank				119			
	1	Air Compressor				2			
	1	HW Pump				0.5			
	1	Exhaust Fans				0.99			

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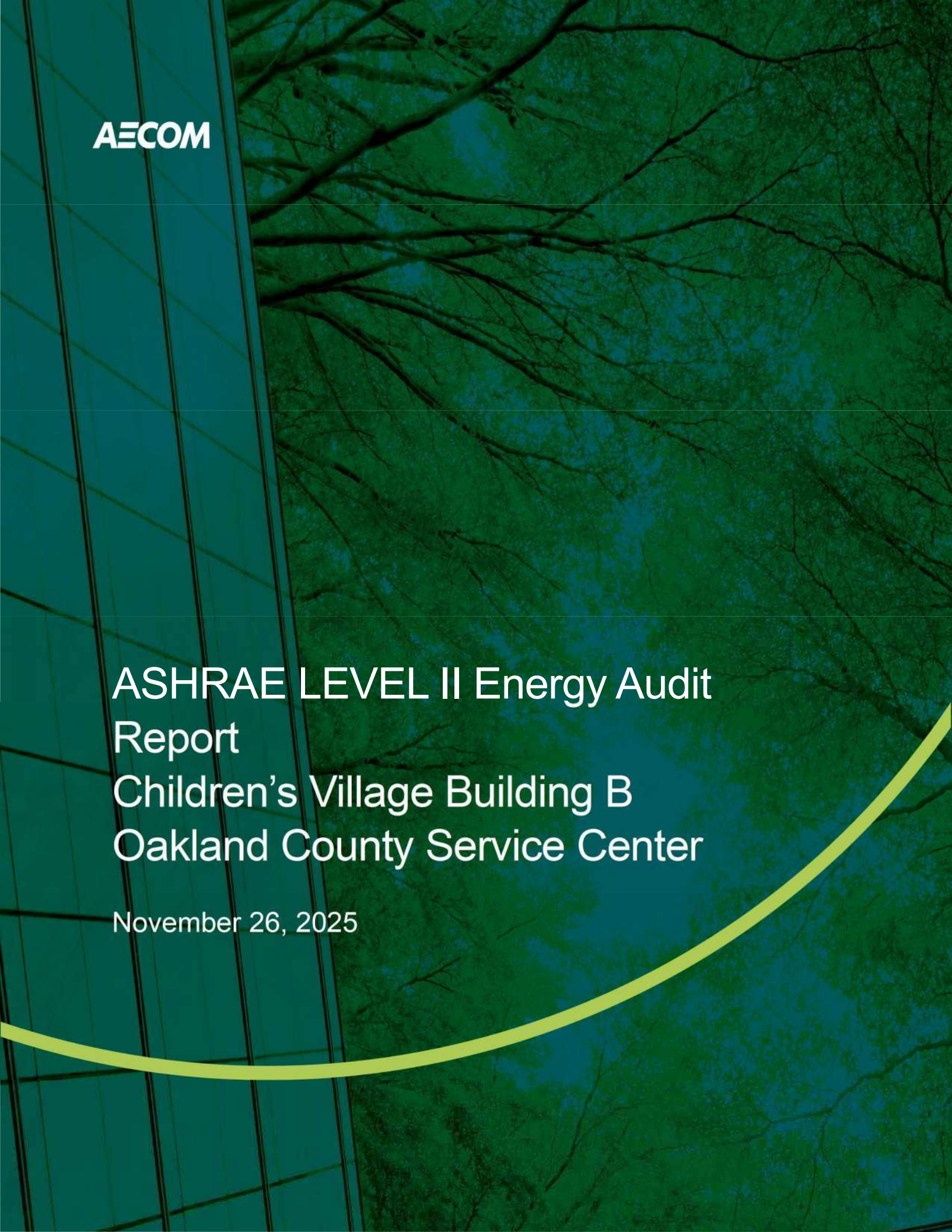

AECOM

ASHRAE LEVEL II Energy Audit Report
Children's Village Building B
Oakland County Service Center

November 26, 2025

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

Prepared for:
OAKLAND COUNTY, MI Government

Prepared by:
AECOM

Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Children's Village B Building in accordance with ASHRAE Standard 211-2018. Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County Children's Village is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Wednesday April 16, 2025 was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates 3 Energy Conservation Measures (ECMs) for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The recommended listed measures represent a projected 51% annual energy cost savings with an aggregate simple payback of 9 years. ECM 2 is a comprehensive measure which includes HVAC equipment retrofits, optimization, and controls upgrades and can be bundled with future electrification work or implemented to help prepare the building for future electrification.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Children's Village Building B Proposed Energy Savings Summary

Energy Conservation Measures												
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M Saving**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	MMBTU	tCO2e	$/yr	$/yr	$	Years
1	LED Lighting Upgrade	H	R	18,400	4	0	63	8	$686	$2024	$19,135	7
2	HVAC Upgrades + Controls	H	RS	38,089	12	118	253	23	$3,380	$4,781	$78,437	10
Sum of Recommended Measures				**$56,489**	**16**	**118**	**316**	**307**	**$4,066**	**$6,805**	**$97,572**	**9**
Overall % Reduction				**61%**	**32%**	**18%**	**32%**	**41%**	**40%**	**48%**	**-**	**-**
Measures with Additional Consideration Required												
3	Building Envelope Improvements	N/A	NR	2,953	0	60	34	3	$0	$622	$40,200	65

Notes
Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed
**N/A indicates a negative payback period which results from negative cost savings due to the higher cost of electricity relative to the cost of natural gas, common for electrification measures

2 Existing Conditions and Observations

The Children's Village, a detention facility, functions as a residential center for juvenile residents, offering a structured environment that supports their education during rehabilitation. Building B, a residential treatment facility, was built in 1974. The concrete masonry unit (CMU) building features a beige brick veneer and is two stories tall, with a roofing system that includes an attic.

The facility can accommodate up to 10 children who can receive treatment for approximately six to nine months. The children in these residential units have completed their initial treatment and no longer require detention. The building includes sleeping units, a playroom, and a kitchen that prepares them to reintegrate into social life seamlessly.

2.1 Building Systems

2.1.1 Building Envelope

The building has two above-grade and one below-grade floor. The window/wall ratio is estimated to be about 25%. The windows appear to be in good condition; however, they are single-pane windows and are assumed to be original to the building.

The walls are CMU structures with brick veneer on the exterior. There is no insulation on the interior side behind the drywall. The attic was not accessible, and the insulation levels are not known at this stage.

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	CMU with brick veneer	Good
Roof	Attic	Good
Glazing	Single-pane, aluminum frame, tinted windows are original, 25% window/wall ratio	Fair

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The boiler in Building C supplies steam to Building B's heating system. The steam is converted to hot water by heat exchangers, and the heating hot water is distributed to the perimeter baseboards and air handling unit (AHU) hot deck.

A carrier made 12.5-ton split AC supplies cooling to the AHU via a direct expansion (DX) cooling coil.

The constant volume air distribution system is a dual duct system with one being a hot duct and the other a cold deck with two zones. The AHU is original to the building, and it is at the end of its useful life. It is recommended to convert the dual duct air distribution system to a single duct with a multi-zone variable air volume system.

2.1.3 Plumbing

The domestic hot water is provided by instantaneous heat exchangers (HX) fed by the boiler located in the C building. There is no recirculation pump and the hot water is circulated by the city pressure whenever hot water is needed. The HX appears to be in good operating condition.

2.1.4 Building Controls

The building systems are controlled by pneumatic damper actuators. All pumps and fans are equipped with constant-speed motors. The lighting systems are manually controlled. The compressor for pneumatic controls is located in Building C.

2.1.5 Lighting Systems

During the site visit, lighting fixtures were observed to vary based on room layout. Fixtures were either recessed, ceiling-mounted, or suspended. The mechanical rooms have 12W light emitting diode (LED) fixtures, while the remaining areas use 32W fluorescent fixtures.

Table 3. Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
Fluorescent Lights	89	2 lamp
LED Light	2	1 lamp

The total approximate quantity of light fixtures is 91, with an approximate total wattage of 5,720 watts. The approximate area per drawing is 8,599 ft², and the calculated lighting density is approximately 0.66 W/ft².

Building B is similar in layout and lighting configuration to Building C. The total approximate number of light fixtures in Building B is 91 and calculated lighting density is approximately 0.66 W/ft².

2.1.6 Electrical Infrastructure

The facility is powered by a 150 kVA transformer located outside the building. The main electrical service, shared by both Buildings B and C, is rated at 600 amps, 120/208 volts, 3-phase, and is associated with meter number 7850298. Backup power is provided by a 180 kW KOHLER generator.

3 Utility Billing Analysis

3.1 Utility Type and Usage

Children's Village Building B receives electric service and natural gas service. Metering is shared between Building B and C. Therefore, usage is distributed evenly as the square footage, usage, and building systems are the same. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

Steam usage is still tracked but appears under electricity, which reflects the energy needed to power steam boilers, and natural gas at the central heating plant.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

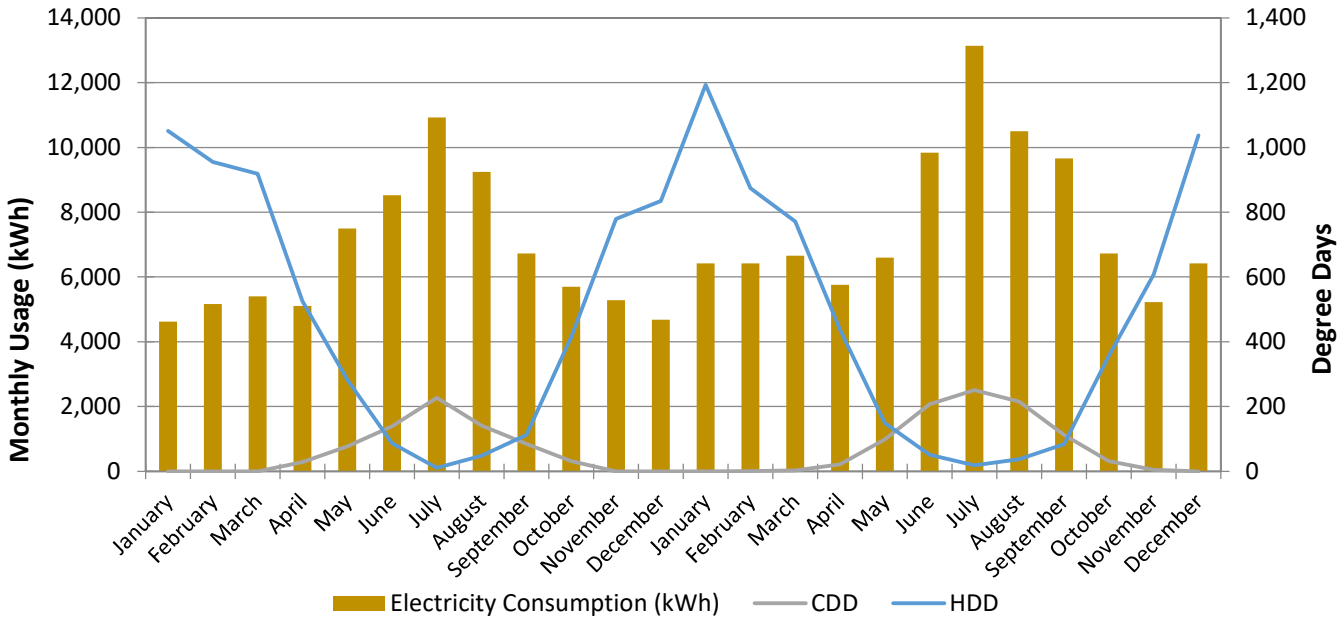
Utility	Annual Usage	Annual Usage (MMBtu)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	93,360 kWh	319	$10,270	$0.11	0.0004427	41
Natural Gas	642 MCF	667	$3,201	$4.98	0.0549206	35
Total	**--**	**985**	**$13,470**	**--**	**--**	**77**

**Natural Gas (1 MCF = 1,038,000 Btu); Electricity (1 kWh = 3413 Btu)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*
****Natural gas annual usage is 3-year average due to significant data fluctuations*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a correlation to CDD, representing seasonal loads associated with cooling in the summer months. The electricity usage for the remainder of the year is relatively stable due to baseload usage such as lighting and fan loads which are consistent throughout the year. The annual usage for the baseline 12-month period from January to December 2024 is 93,360 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



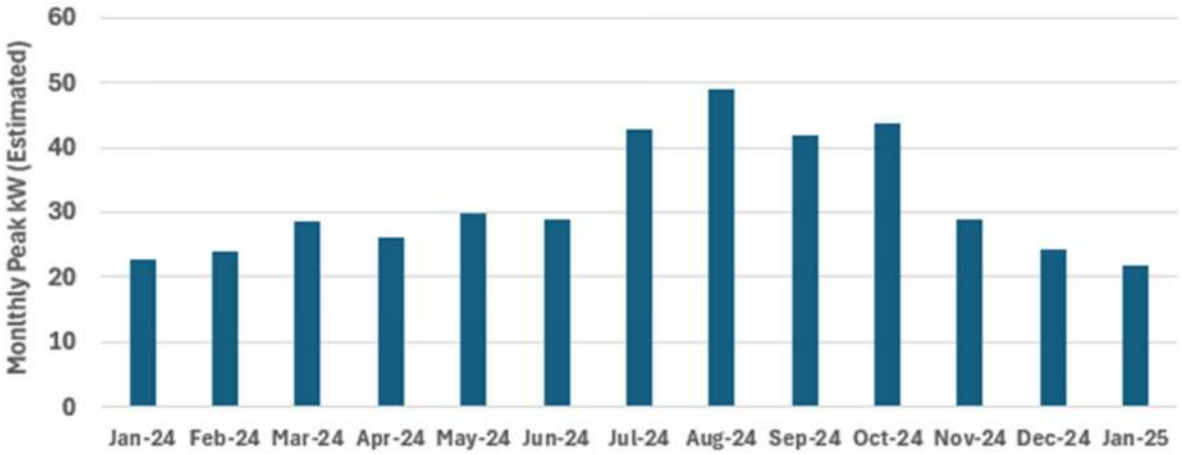
3.3 Building Electrical Capacity Analysis

AECOM has developed a methodology to estimate the peak demand of the building which uses the metered consumption of the building, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below. The service for this building is shared with Building C, which electric capacity appears sufficient to support.

Table 5. Electric Capacity Results

Maximum Building Capacity at Service Transformer	150 kW
Maximum Capacity at Switchgear (A*V*Ph)	216 kW
Estimated Peak Demand	49 kW (estimated)
Remaining Capacity	**101 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge:	**$0.057/kWh**
DTE Electric Demand Charge:	**$6.15/kW/Month**
Average Dollar per kWh Used in Calculations:	**$0.11/kWh**

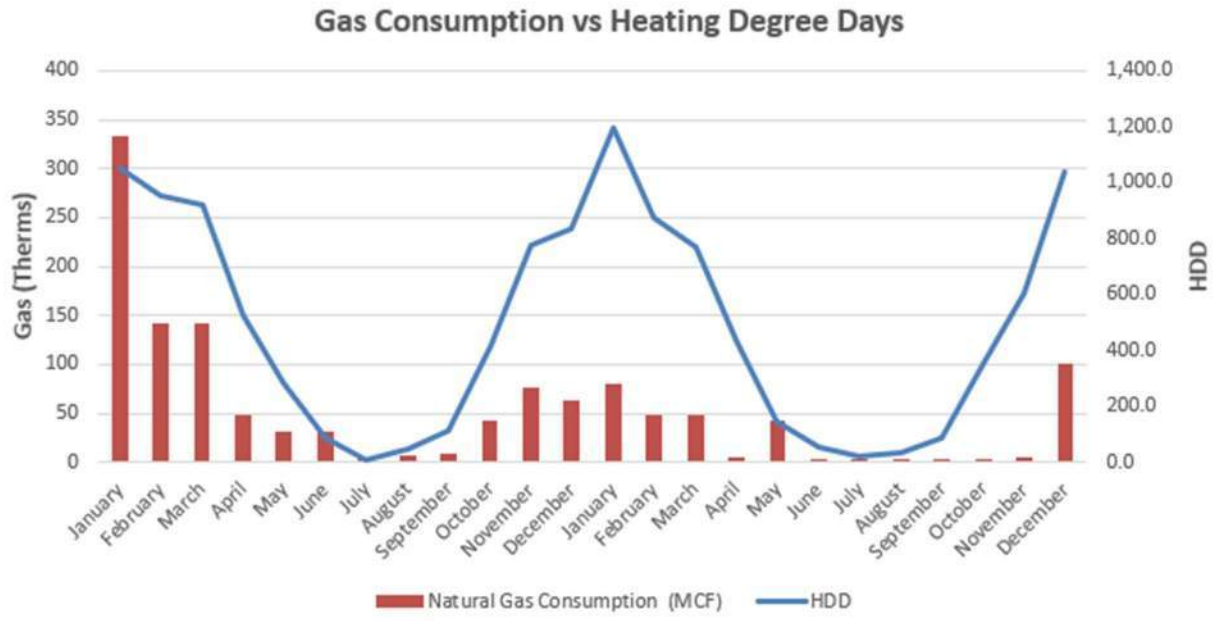
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. An analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. The profile shows a significant fluctuation in usage between 2023. It's unclear whether this is due to operational changes, billing or metering issues. Therefore, a 3-year average baseline was developed using 2022 to 2024 billed gas data. Natural gas usage shows a direct correlation to weather data, as natural gas is primarily used for space heating. However, since this is a 24/7 occupied juvenile detention facility there is a small baseload summer usage due to domestic hot water usage for bathrooms and showers. The 3-year average annual usage for the baseline 12-month period is 642 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the

year. Gas is billed with a similar structure to electric, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: **$1.33/MCF (1000 cubic feet)**

Constellation NG Usage Charge (fixed Fee): **$3.48/dTh (decatherm, or 1M BTU)**

Constellation NG Usage Charge (Day Gas): **$5.29/dTh (decatherm, or 1M BTU)**

Average Dollar per MCF Used in Calculations: **$4.98/MCF**

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided by an annual purchase request statement for 2024 of the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$10,270
Natural Gas	$3,201
Total	$13,470
ECI $/yr/sf	$1.57

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb

CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

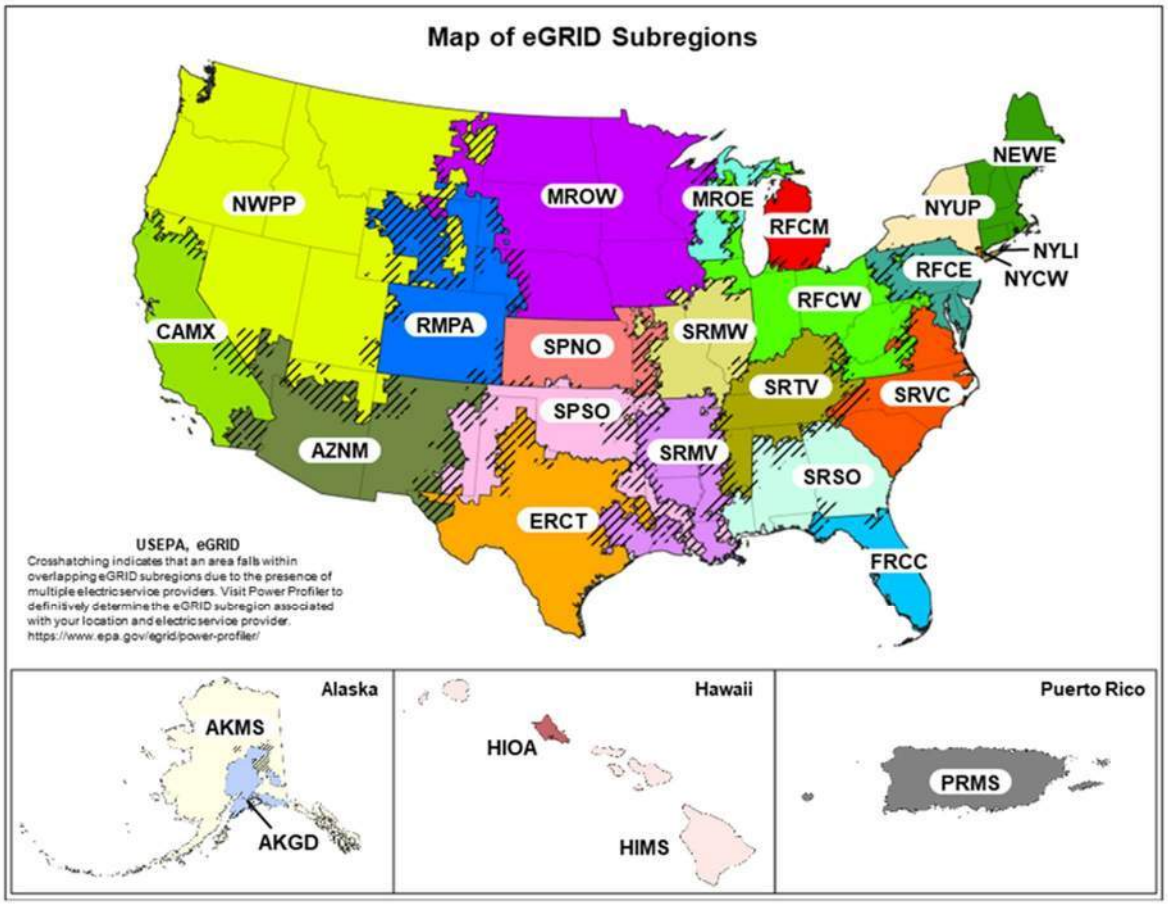
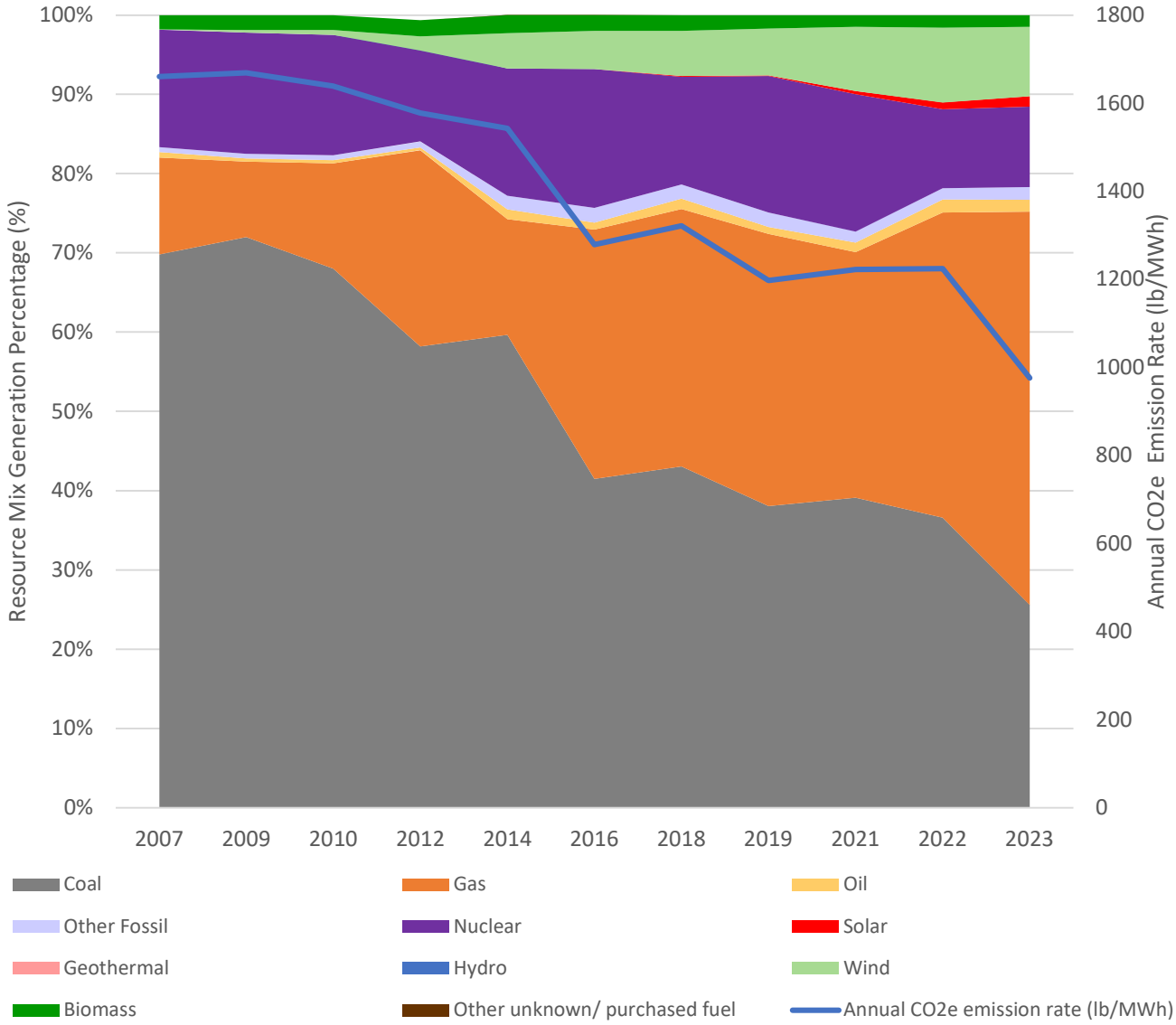


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 46 percent of carbon emissions are attributed to natural gas and 54 percent associated with electricity. Natural gas combustion for space heating and imported electricity resulted in 35 tCO2e (Scope 1) and 41 tCO2e (Scope 2) emissions, respectively, for a total of 77 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficient per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBtu) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for Children's Village B, are converted to kBtus units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Children's Village B					**Electric EUI:**	37	kBtu/SF/yr
GFA:	8,599	SF				**Gas EUI:**	78	kBtu/SF/yr
eGRID Subregion:	RFCM					**Current EUI**	115	kBtu/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	93,360	kWh	3.412	319	0.0004427	41	$10,270	76%
Natural Gas	642	MCF	1.038	667	0.05249	35	$3,201	24%
		Totals		**985**		**77**	**$13,470**	**100%**

According to the US EPA, the average site energy use intensity for residence hall is 57.9 kbtu/SF/yr. kbtu/SF/yr. The total EUI for the existing condition of the building is calculated as 115 kBtu/SF, which is significantly higher than the national benchmark. It's important to note the national benchmark does not factor in the variance for weather conditions whereas Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison indicates there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient

3.8 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees and residents. Table 8 and Figure 7 and Figure 7 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (klbs)**	**Site Energy Total (kBtu)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	582	0	604,126	70	32
Space Cooling	29,530	0	0	100,755	12	13
Fans	31,685	0	0	108,108	13	14
Pumps	0	0	0	0	0	0
SHW/DHW	0	60	0	62,655	7	3
Conveyance	0	0	0	0	0	0
Lighting	24,858	0	0	84,815	10	11
Plug Loads	4,367	0	0	14,902	2	2
Process Loads	2,420	0	0	8,258	1	1
Refrigeration	500	0	0	1,706	0	0
Cooking	0	0	0	0	0	0
Information Technology	0	0	0	0	0	0
TOTAL	**93,360**	**642**	**0**	**985,325**	**115**	**77**
Historical Billing	93,360	6,42	0			
Percent of Actual	100%	100%	0%			
per sqft	10.9	0.8	0			

Figure 7: Existing Electricity End Use Distribution

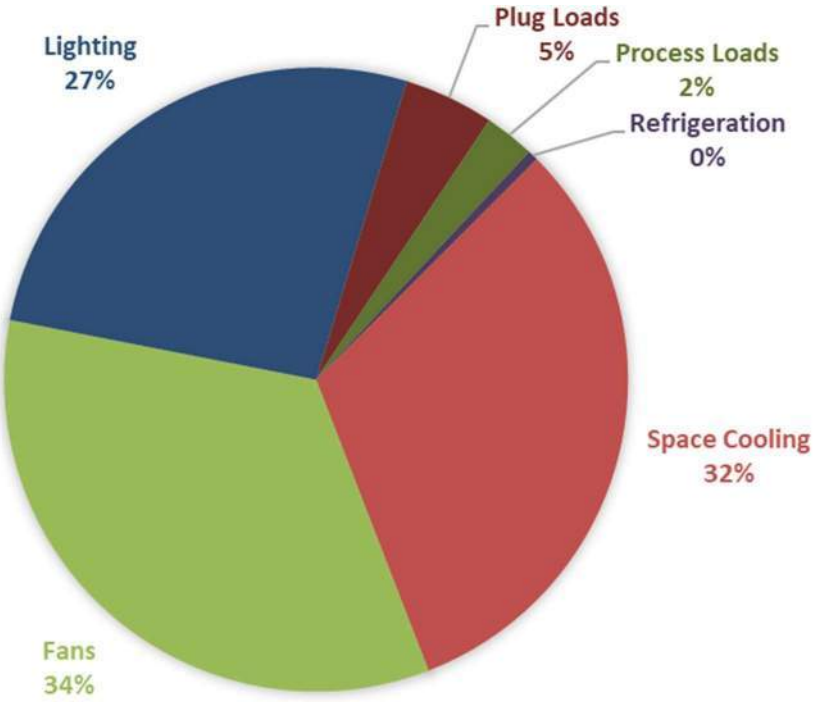
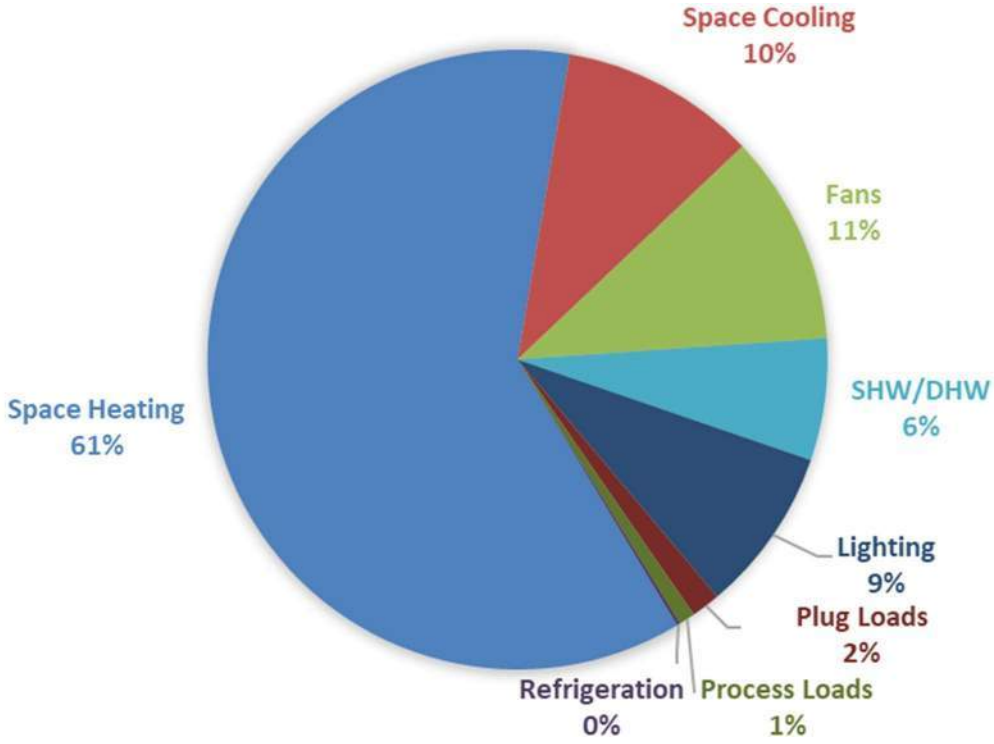


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – LED Lighting

This measure proposes upgrading all remaining fluorescent lighting to light-emitting diode (LED) lightbulbs with motion sensors and dimming functionality where appropriate to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements. The current lighting in Children's Village Building B is primarily fluorescent and the estimated wattage is approximately 0.66 W/ft^2.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Because the controls are integrated into the proposed fixture, this measure provides savings for fixture replacement and controls as one combined project. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.



Figure 9: Example Fixture with Integrated Occupancy Controls

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- This measure assumes lighting savings of approximately 0.36 W/ft² and 20% reduction in lighting energy through implementation of controls.
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture. Lighting controls that include dimming will likely require full fixture replacement, which drive up the total cost of implementation for the measure.
- Interior lights operate 18 hours per day for 252 business days per year, which averages the different occupancy schedules for different parts of the building (24/7 and normal business hours).
- O&M savings assume an average cost of $3.81/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- LED upgrades cost $215/fixture, applied to 89 fixtures. This assumes integrated control sensors and no additional wiring and control circuits. Low-cost fixtures and external controls can be used as an alternative to this implementation method. The costs have been split out between the fixtures and controls in the summary table below.
- This measure indirectly supports electrification readiness by realizing a potential kW demand reduction that can be deployed elsewhere for new electric loads.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For

lighting controls, if integrated controls are not included in each fixture, subsequent steps are required that may consist of conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. This measure is recommended for implementation.

Table 9. ECM 1 Savings and ROM Cost

	Savings Summary							
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Annual O&M Savings ($)	Est Project Cost ($)	Simple Payback (Yrs)
LED Upgrade	0	18,400	63	8.1	$2,024	$686	$19,135	7
Overall % Reduction	**0%**	**18%**	**5%**	**10%**	**14%**	**--**	**--**	**--**

4.2 ECM 2 - HVAC Upgrades

Upgrading outdated HVAC systems, such as constant volume multi-zone and dual-duct systems, to modern single-duct variable air volume (VAV) systems is a highly effective energy conservation measure. VAV systems dynamically adjust airflow and temperature based on real-time demand, significantly reducing energy consumption compared to older, less efficient systems that operate at constant output levels. This upgrade not only enhances energy efficiency but also improves indoor air quality and thermal comfort for occupants. Implementing this measure as part of a routine capital upgrade ensures the integration of modern energy-efficient equipment into the facility's infrastructure, maximizing the overall benefit and lifecycle performance of the new systems.

The single dual-duct AHU, 12.5-ton split-AC condensing unit, and its pneumatic controls are outdated and beyond its expected useful life. The steam boiler which converts to hot water for heating for both Building B and C is also extremely old and inefficient. These are due for a routine capital upgrade. A single-duct VAV AHU system with modern DDC controls should be installed to optimize energy use and comfort. It can be paired with a dual fuel heat pump condensing unit or a high-efficiency split-AC condensing unit (2b). This ECM includes upgrading controls and equipment optimization strategies that will be combined with the design of the new system. Optimization strategies include the following:

- Optimize HVAC scheduling in non 24/7 occupied spaces
- Optimize HVAC occupied and unoccupied setpoints
- Repair or replace leaking steam traps
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors and actuators
- Discharge air setpoint reset
- Outside air temperature lockouts
- Outside air damper control
- Duct static pressure reset

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- HVAC equipment identified is due for routine end-of-life replacement.
- This measure assumes energy savings due to the adjustment of constant volume 100% fan speed to an average of 75% fan speed and assumes cooling savings from modern high efficiency condensing unit. The savings assume the current heating system is maintained in the building, which accounts for approximately 18% of the total heating savings.
- This measure should be considered as part of the electrification project across the campus, which would include converting the gas boiler to a heat pump style heater. Cost savings would be reduced under this scenario due to current utility rates.
- Cost to implement this measure assume $6/CFM and $1,500/ton to install new equipment, ducting, and zone controls. Additionally there is a cost of $3.40/sqft for control upgrades and optimization.
- O&M Costs are assumed to be a reduction in system maintenance of an average of 1hr per week.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Conduct a thorough assessment of the existing HVAC systems to determine the scope of upgrades required. Following this, detailed planning and design should be undertaken to ensure the new systems are appropriately sized and configured to meet the building's specific needs. This should include ensuring the new system is "electrification-ready" such that it either uses hot water for heating and/or is a dual-fuel heat pump that can use either source as the RFCM grid emissions improve or Oakland County renewable energy procurement makes it more favorable to use electricity over gas for heating to meet decarbonization goals. This process should be integrated into the facility's routine capital upgrade schedule to optimize the benefits of the new equipment and ensure seamless implementation along with other county priorities.

Table 10. ECM 2 Savings and ROM Cost

Savings Summary								
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**Annual O&M Savings ($)**	**Est Project Cost ($)**	**Simple Payback (Yrs)**
HVAC Upgrade + Controls	118	38,089	253	23	$4,781	$3,380	$78,437	10
Overall % Reduction	**18%**	**41%**	**26%**	**31%**	**35%**	**--**	**--**	**--**

5 Measure Requiring Additional Consideration

This section provides details on measures that were analyzed but are not recommended for immediate implementation at this time. This includes measures that require further study, such as capital-intensive replacements of existing equipment, but are not justified through energy savings alone. This section may also include measures that conflict with building electrification plans, or projects that are simply not recommended due to being financially impractical or not being technically feasible.

5.1 Building Envelope Improvements

Effective insulation and a well-sealed building envelope are critical for managing the transfer of heat between the exterior and interior environments. In Michigan, where seasonal temperature variations can be significant, improving building envelope integrity not only reduces energy consumption for heating and cooling but also helps maintain a consistent and comfortable indoor environment for staff, residents, and visitors. In addition to insulation, proper vapor sealing prevents moisture intrusion and minimizes indoor air quality issues related to high humidity. As building energy codes and insulation standards have evolved, older buildings can greatly benefit from upgrades that align with modern requirements, enhancing their energy efficiency. This measure includes building envelope improvements such as sealing air gaps around points of infiltration, adding insulation into the attic, and upgrading windows to double-pane windows. These steps not only reduce energy usage and associated emissions but also lower heating capacity requirements, making them an essential precursor to any major HVAC system upgrades. While this measure is beneficial to reduce the energy load and minimize infiltration, it has a poor payback as a standalone project. These envelope improvements should be considered as part of a comprehensive building renovation project.

Table 11. ECM 3 Savings and ROM Cost

Savings Summary								
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**Annual O&M Savings ($)**	**Est Project Cost ($)**	**Simple Payback (Yrs)**
Building Envelope Upgrades	60	2,953	63	3	$622	$0	$40,200	65
Overall % Reduction	**9%**	**3%**	**7%**	**6%**	**5%**	**--**	**--**	**--**

6 Appendix A

Table 12: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	334	$2,049	4,620	$496	12	16	1,051	0
Feb-23	142	$830	5,160	$486	15	19	955	0
Mar-23	142	$433	5,400	$485	15	23	918	0
Apr-23	49	$169	5,100	$449	14	23	525	28
May-23	31	$94	7,500	$592	20	33	283	76
Jun-23	31	$77	8,520	$638	24	37	86	139
Jul-23	3	$13	10,920	$884	29	41	11	227
Aug-23	6	$18	9,240	$734	25	37	48	141
Sep-23	9	$25	6,720	$619	19	30	113	85
Oct-23	42	$122	5,700	$464	15	24	415	31
Nov-23	76	$283	5,280	$406	15	25	779	0
Dec-23	63	$312	4,680	$332	13	16	834	0
Jan-24	80	$354	6,420	$148	17	23	1,194	0
Feb-24	48	$263	6,420	$657	19	24	874	1
Mar-24	48	$273	6,660	$538	18	29	771	2
Apr-24	5	$10	5,760	$505	18	30	437	21
May-24	43	$88	6,600	$749	18	29	148	98
Jun-24	2	$8	9,840	$904	27	43	51	207
Jul-24	3	$9	13,140	$1,171	35	49	18	251
Aug-24	3	$6	10,500	$966	28	42	37	215
Sep-24	3	$7	9,660	$775	27	44	84	112
Oct-24	3	$8	6,720	$639	18	29	356	31
Nov-24	4	$16	5,220	$563	15	24	607	4
Dec-24	101	$224	6,420	$540	17	22	1,037	0
2023 Sum	928	4,422	78,840	$6,583			6,019	727
2024 Sum	344	1,264	93,360	$8,152			5,614	942

7 Appendix B

Table 13. Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Efficiency	Capacity 2	Approx Year Installed
AHU	1	Air handling unit				146			
	1	Split AC, Dx	AHU	Carrier	38AKS016	12.5			
		Steam to HHW heat exchanger							

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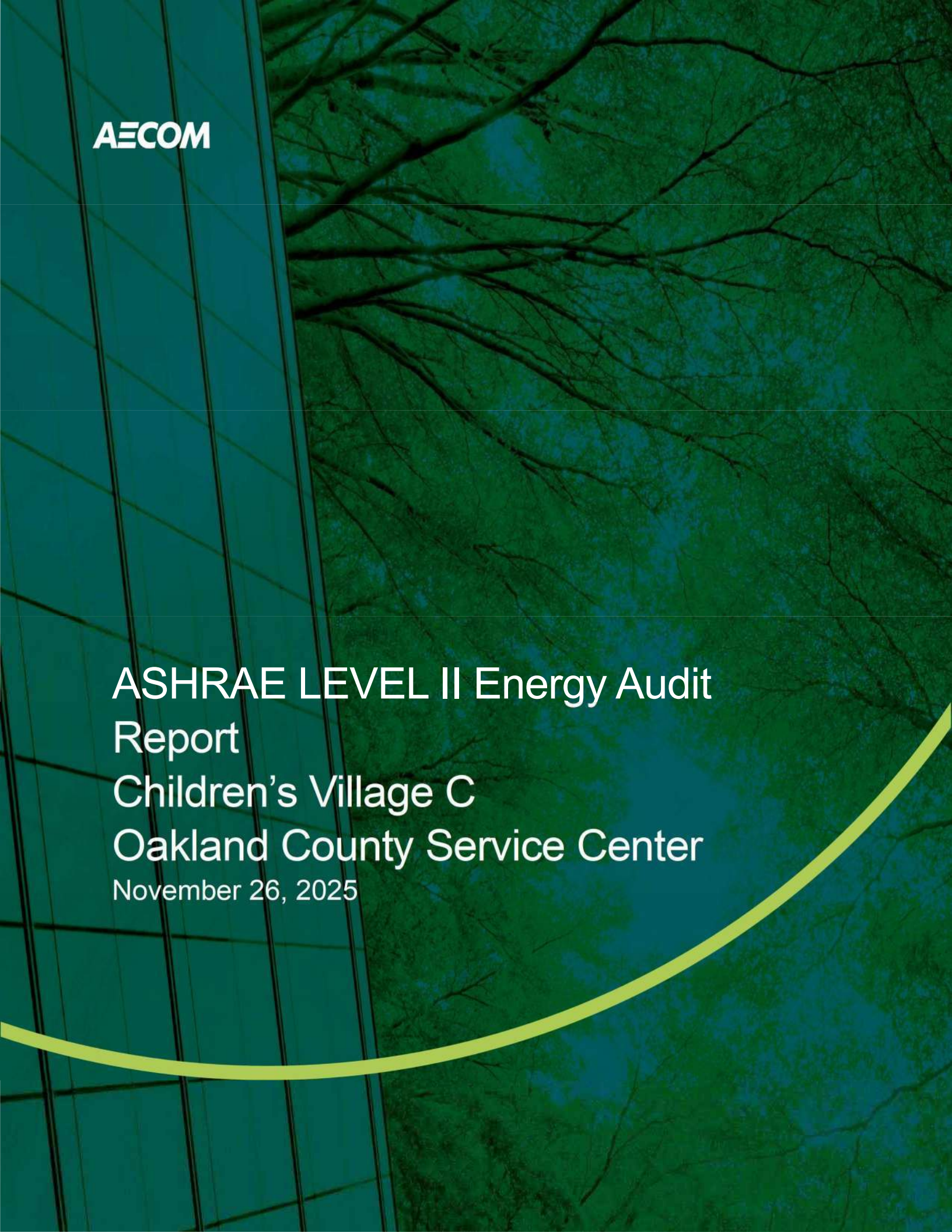

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ASHRAE LEVEL II Energy Audit Report
Children's Village C
Oakland County Service Center

November 26, 2025

Quality information

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Revision	Revision date	Details	Authorized	Name	Position

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OAKLAND COUNTY, MI Government

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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Children's Village C Building in accordance with ASHRAE Standard 211-2018. Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County Children's Village is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Wednesday April 16, 2025 was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates five ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The recommended listed measures represent a projected 31% annual energy cost savings with an aggregate simple payback of 13.8 years.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in the Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Children's Village Building C Proposed Energy Savings Summary

Energy Conservation Measures												
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	MMBTU	tCO2e	$/yr	$/yr	$	Years
1	LED Lighting Upgrade	H	R	15,819	3	0	54	7	$530	$2,270	$19,135	8.4
2	HVAC Upgrades (VAV AHU + RCx + controls + AC)	H	RS	38,089	2	119	253	23	$0	$4,781	$78,437	16
Sum of Recommended Measures				53,908	5	119	307	30	$530	$7,051	$95,572	13.8
Overall % Reduction				58%	10%	18%	31%	40%	--	31%	-	-
Measures Considered but Not Recommended												
3	Building Envelope Improvements	N/A	NR	431	0	60	63	3	$0	$344	$40,200	117

Notes
Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed
**N/A indicates a negative payback period which results from negative cost savings due to the higher cost of electricity relative to the cost of natural gas, common for electrification measures

2 Existing Conditions and Observations

The Children's Village, a detention facility, functions as a residential center for juvenile residents, offering a structured environment that supports their education during rehabilitation. Building C, a residential treatment facility, was built in 1974. The concrete masonry unit (CMU) building features a beige brick veneer and is two stories tall, with a roofing system that includes an attic.

The facility can accommodate up to 10 children who can receive treatment for approximately six to nine months. The children in these residential units have completed their initial treatment and no longer require detention. The building includes sleeping units, a playroom, and a kitchen that prepares them to reintegrate into social life seamlessly.

2.1 Building Systems

2.1.1 Building Envelope

The building has two above-grade and one below-grade floor. The window/wall ratio is estimated to be about 25%. The windows appear to be in good condition; however, they are single-pane windows and are assumed to be original to the building.

The walls are CMU structures with brick veneer on the exterior. There is no insulation on the interior side behind the drywall. The attic was not accessible, and the insulation levels are not known at this stage.

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	CMU with brick veneer	Good
Roof	Attic	Good
Glazing	Single-pane, aluminum frame, tinted windows are original, 25% window/wall ratio	Good

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The heating is supplied by a Weill McLain LGB-9 steam boiler, which serves both B and C buildings. The boiler's heating input ranges between 520 - 1000 thousand British thermal units per hour (MBH), with an expected combustion efficiency of at maximum 83%. The steam pressure is set to 10 pounds per square inch (PSI), which is high for the steam heating coil. The system should maintain this pressure for the heat exchangers.

A 16-ton Carrier split air-conditioning (AC) unit supplies direct expansion (DX) cooling to the cooling coil inside the air handling unit (AHU). The constant volume air distribution system is a dual duct system with one being a hot duct and the other a cold deck with two zones. The AHU

is original to the building, and it is at the end of its useful life. It is recommended to convert the dual duct air distribution system to a single duct with a multi-zone variable air volume system.

2.1.3 Plumbing

An indirect water heater provides domestic hot water. A condensing boiler heats water, and it enters a storage tank with a heating coil. The hot water storage tank heats the domestic water. A circulation pump constantly circulates hot water within the domestic hot water distribution infrastructure. The unit was installed in 2019 and appears in good condition.

The water temperature in the tank was observed to be about 125°F. The storage temperature should be increased to 140°F to prevent legionella bacteria growth in the tank and provide a buffer during peak times. It's highly recommended to install a mixing valve on the supply side of the hot water tank and increase the water storage temperature to 160°F.

2.1.4 Building Controls

The building systems are controlled by pneumatic damper actuators. All pumps and fans are equipped with constant-speed motors. The lighting systems are manually controlled. The compressor for pneumatic control is located in this building, serving both B and C buildings.

2.1.5 Lighting Systems

During the site visit, lighting fixtures were observed to vary based on room layout. Fixtures were either recessed, ceiling-mounted, or suspended. The mechanical rooms have 12W light emitting diode (LED) fixtures, while the remaining areas use 32W fluorescent fixtures.

Table 3: Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
Fluorescent Lights	89	2 lamps
LED Light	2	1 lamp

The total approximate quantity of light fixtures is 91, with an approximate total wattage of 5,720 watts. The approximate area per drawing is 8,599 ft², and the calculated lighting density is approximately 0.66 W/ft².

Building C is similar in layout and lighting configuration to Building B. The total approximate number of light fixtures in Building C is 91and calculated lighting density is approximately 0.66 W/ft².

2.1.6 Electrical Infrastructure

The facility is powered by a 150 kVA transformer located outside the building. The main electrical service, shared by both Buildings B and C, is rated at 600 amps, 120/208 volts, 3-phase, and is associated with meter number 7850298. Backup power is provided by a 180 kW KOHLER generator.

3 Utility Billing Analysis

3.1 Utility Type and Usage

Children's Village Building C receives electric service and natural gas service, and is not connected to the steam network. Metering is shared between Building B and C. Therefore, usage is distributed evenly as the square footage, usage, and building systems are the same. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

Utility	Annual Usage	Annual Usage (MMBtu)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	93,360 kWh	319	$10,270	$0.11/kWh	0.0004427	41
Natural Gas	642 MCF	667	$3,199	$4.98/MCF	0.0549206	35
Total	**--**	**985**	**$13,469**	**--**	**--**	**77**

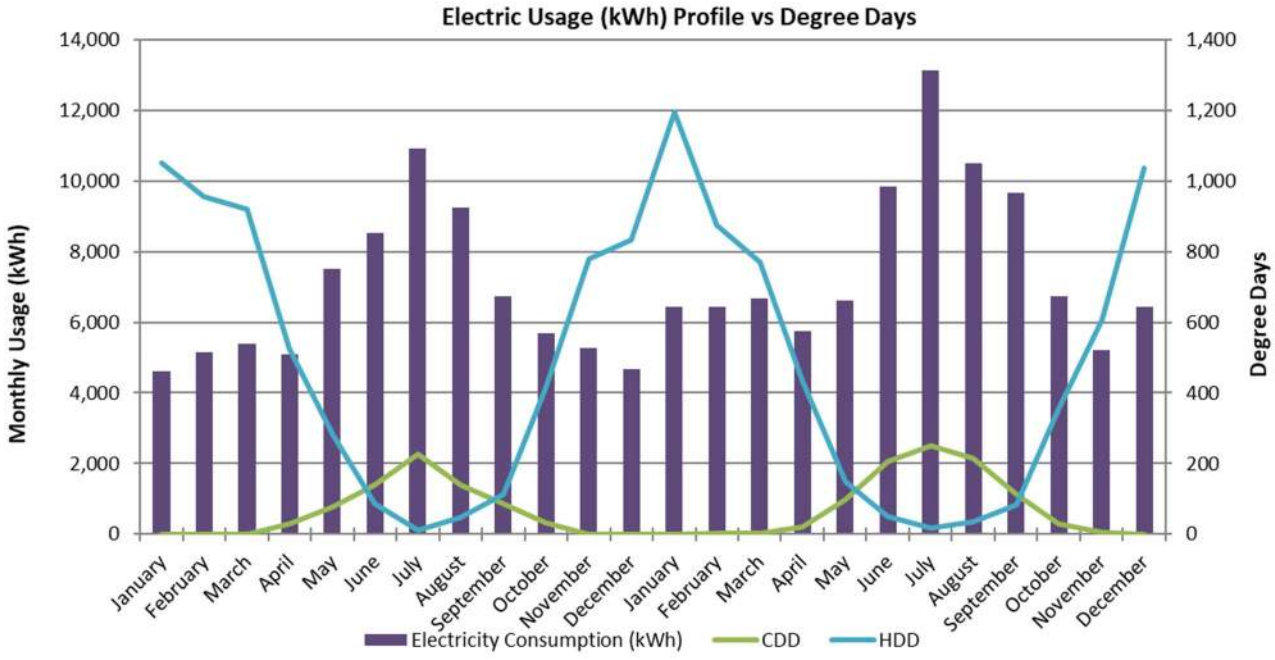
**Natural Gas (1 MCF = 1,038,000 Btu); Electricity (1 kWh = 3413 Btu)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*
****Natural gas annual usage is 3-year average due to significant data fluctuations*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a correlation to CDD, representing seasonal loads associated with cooling in the summer months. The electricity usage for the remainder of the year is relatively stable due to baseload usage such as lighting and fan loads which are consistent throughout

the year. The annual usage for the baseline 12-month period from January to December 2024 is 93,360 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



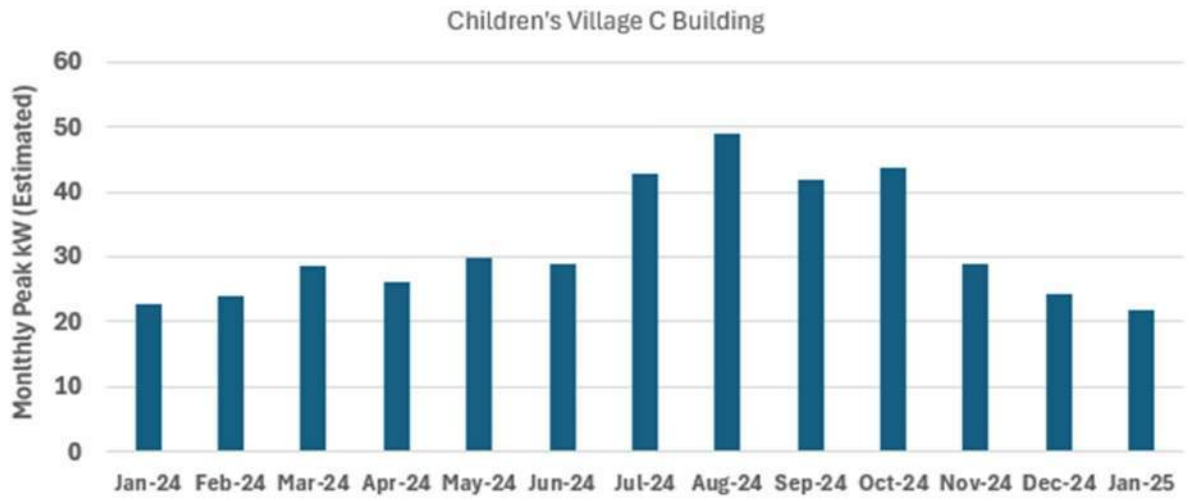
3.3 Building Electrical Capacity Analysis

AECOM has developed a methodology to estimate the peak demand of the building which uses the metered consumption of the building, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below. The service for this building is shared with Building B, which electric capacity appears sufficient to support.

Table 5: Electric Capacity Results

Maximum Building Capacity at Service Transformer	150 kW
Maximum Capacity at Switchgear (A*V*Ph)	216 kW
Estimated Peak Demand	49 kW (estimated)
Remaining Capacity	**101 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy, and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. This arrangement accurately distributes the cost of electricity consumption, but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand but high usage are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge: **$6.15/kW/Month**

Average Dollar per kWh Used in Calculations: **$0.11/kWh**

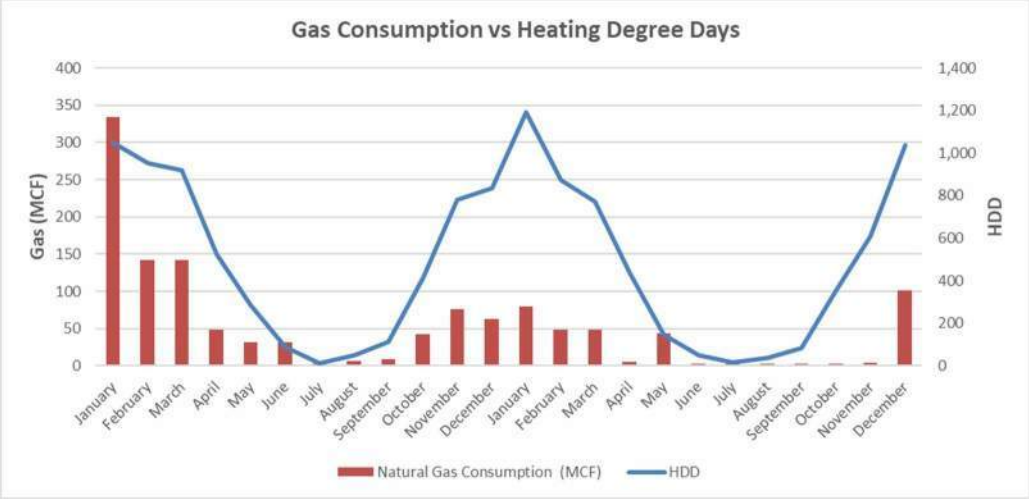
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. The profile shows a significant fluctuation in usage between 2023. It's unclear whether this is due to operational changes, billing or metering issues. Therefore, a 3-year average baseline was developed using 2022 to 2024 billed gas data. Natural gas usage shows a direct correlation to weather data, as natural gas is primarily used for space heating. However, since this is a 24/7 occupied juvenile detention facility there is a small baseload summer usage due to domestic hot water usage for bathrooms and showers. The 3-year average annual usage for the baseline 12-month period is 642 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electric, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): $3.48/dTh (decatherm, or 1.038MCF)

Constellation NG Usage Charge (Day Gas): $5.29/dTh (decatherm, or 1.038MCF)

Average Dollar per MCF Used in Calculations: $4.98/MCF

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided by the County for 2024 of the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$10,270
Natural Gas	$3,201
Total	$13,470
ECI $/yr/sf	$1.57

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO_2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

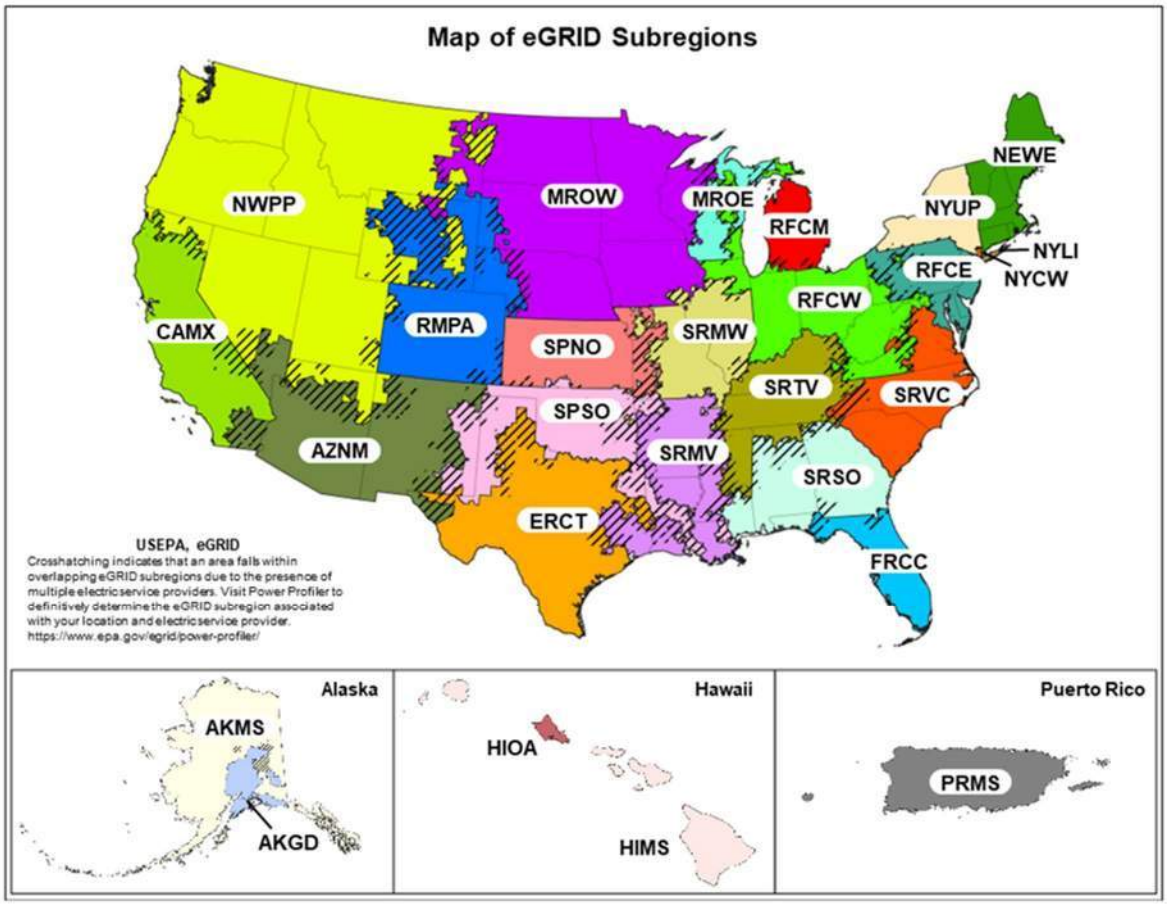
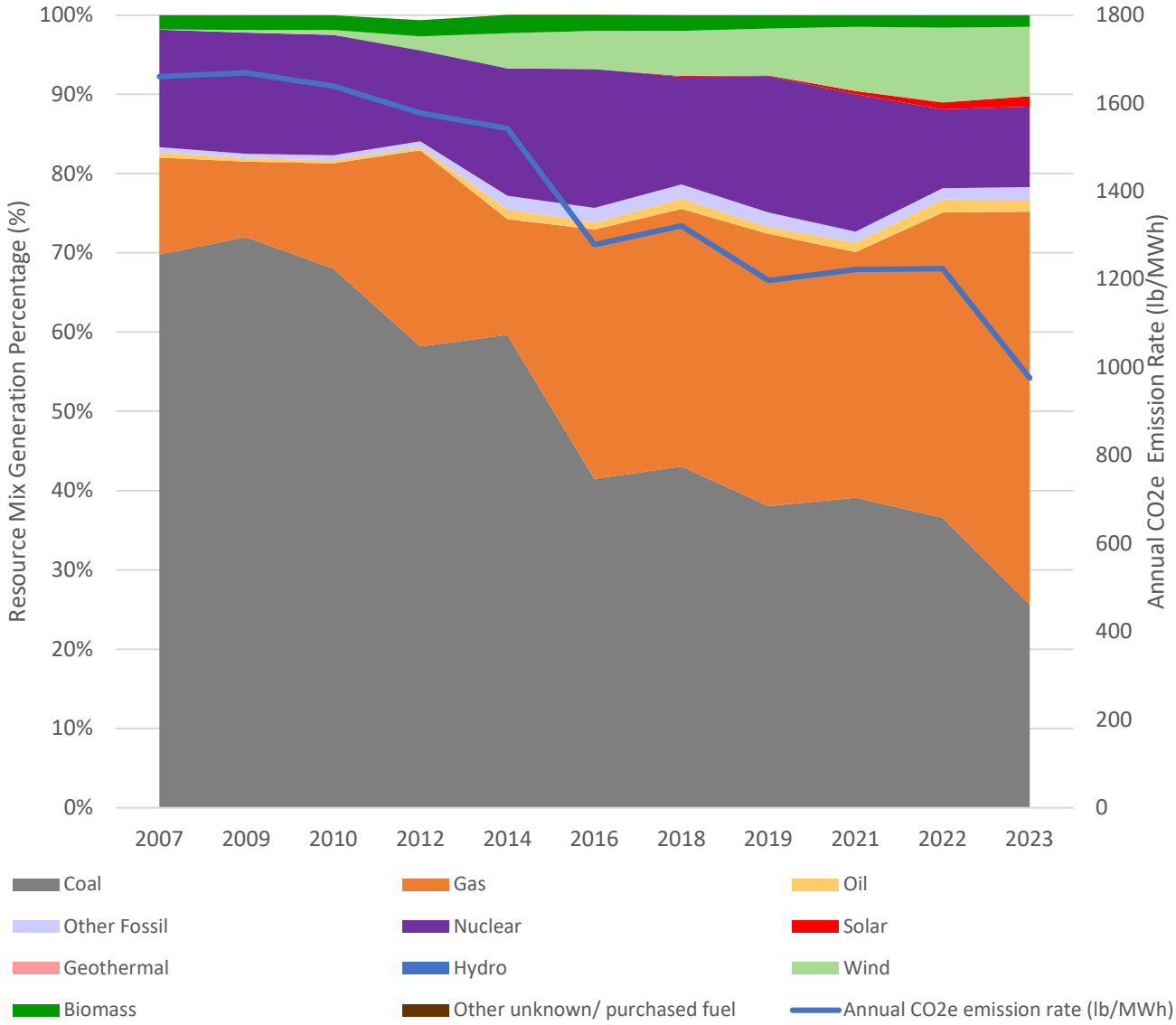


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 46 percent of carbon emissions are attributed to natural gas and 54 percent associated with electricity. Natural gas combustion for space heating and imported electricity resulted in 35 tCO2e (Scope 1) and 41 tCO2e (Scope 2) emissions, respectively, for a total of 77 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficient per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBtu) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for Children's Village C, are converted to kBTU units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Children's Village C					**Electric EUI:**	37	kBtu/SF/yr
GFA:	8,599	SF				**Gas EUI:**	78	kBtu/SF/yr
eGRID Subregion:	RFCM					**Current EUI**	115	kBtu/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	93,360	kWh	3.412	319	0.0004427	41	$10,270	76%
Natural Gas	642	MCF	1.038	667	0.0549206	35	$3,199	24%
Totals				985		77	$13,469	100%

According to the US EPA, the average site energy use intensity for residence hall is 57.9 kbtu/SF/yr. The total EUI for the existing condition of the building is calculated as 115 kBtu/SF, which is significantly higher than the national benchmark. It's important to note the national benchmark does not factor in the variance for weather conditions whereas Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison indicates there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient

3.8 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees and residents. Table 8 and Figure 7 and Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBtu)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	582	0	604,126	70	32
Space Cooling	29,530	0	0	100,755	12	13
Fans	31,685	0	0	108,108	13	14
Pumps	0	0	0	0	0	0
DHW	0	60	0	62,655	7	3
Conveyance	0	0	0	0	0	0
Lighting	24,858	0	0	84,815	10	11
Plug Loads	4,367	0	0	14,902	2	2
Process Loads	2,420	0	0	8,258	1	1
Refrigeration	500	0	0	1,706	0	0
Cooking	0	0	0	0	0	0
Information Technology	0	0	0	0	0	0
TOTAL	93,360	642	0	985,325	115	77
Historical Billing	93,360	**642**	0			
Percent of Actual	100%	100%	0%			
per sqft	10.9	**0.07**	0			

Figure 7: Existing Electricity End Use Distribution

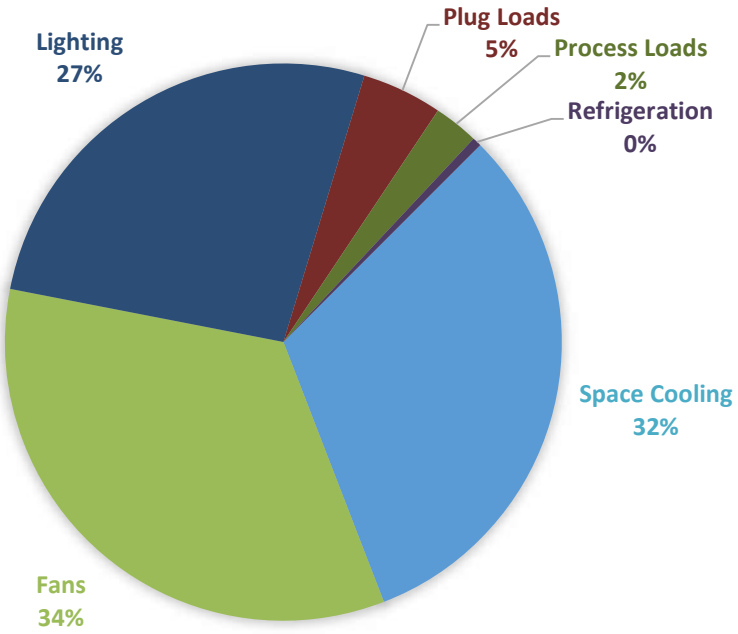
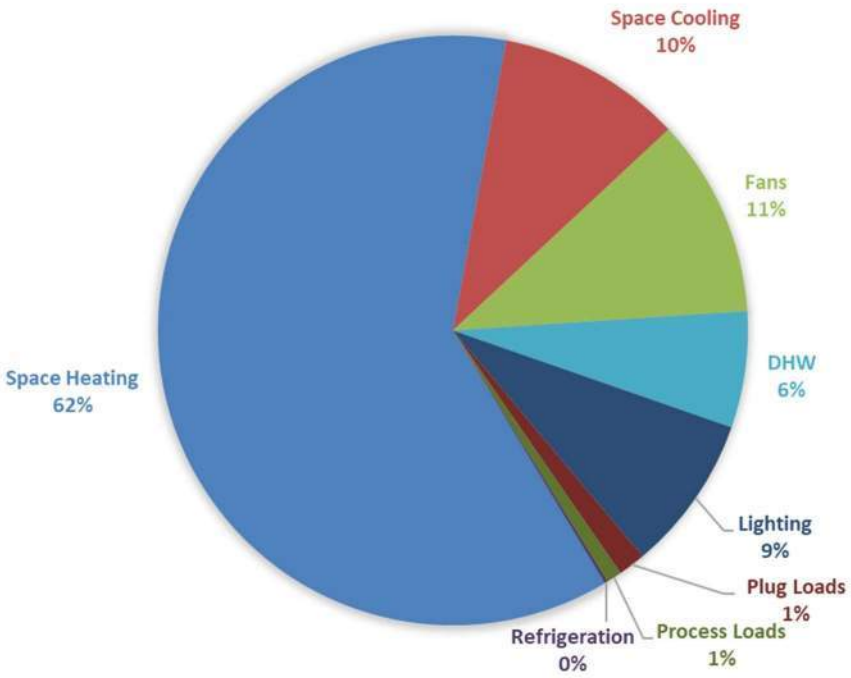


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – LED Lighting

This measure proposes upgrading all remaining fluorescent lighting to light-emitting diode (LED) lightbulbs with motion sensors and dimming functionality where appropriate to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements. The current lighting in Children's Village Building C is primarily fluorescent and the estimated wattage is approximately 0.66 W/ft².

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.

Figure 9: Example Fixture with Integrated Occupancy Controls



Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- This measure assumes lighting savings of approximately 0.36 W/ft² and 20% reduction in lighting energy through implementation of controls.
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture. Lighting controls that include dimming will likely require full fixture replacement, which drive up the total cost of implementation for the measure.
- Interior lights operate 18 hours per day for 252 business days per year, which averages the different occupancy schedules for different parts of the building (24/7 and normal business hours).
- O&M savings assume an average cost of $2.94/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- LED upgrades cost $215/fixture, applied to 89 fixtures. This assumes integrated control sensors and no additional wiring and control circuits. Low-cost fixtures and external controls can be used as an alternative to this implementation method. The costs have been split out between the fixtures and controls in the summary table below.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, if integrated controls are not included in each fixture, subsequent steps are required that may consist of conducting a thorough examination of the lighting infrastructure to

determine the feasibility of installing and implementing controls within the current system. This measure is recommended for implementation.

Table 9: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Annual O&M Savings ($)	Est Project Cost	Simple Payback (Yrs)
LED Upgrade	0	15,819	54	7	$1,740	$530	$19,135	8.4
Overall % Reduction	0%	17%	5%	9%	13%	--	--	--

4.2 ECM 2 - HVAC Upgrades

Upgrading outdated HVAC systems, such as constant volume multi-zone and dual-duct systems, to modern single-duct variable air volume (VAV) systems is a highly effective energy conservation measure. VAV systems dynamically adjust airflow and temperature based on real-time demand, significantly reducing energy consumption compared to older, less efficient systems that operate at constant output levels. This upgrade not only enhances energy efficiency but also improves indoor air quality and thermal comfort for occupants. Implementing this measure as part of a routine capital upgrade ensures the integration of modern energy-efficient equipment into the facility's infrastructure, maximizing the overall benefit and lifecycle performance of the new systems.

The single dual-duct AHU, 13-ton split-AC condensing unit, and its pneumatic controls are outdated and beyond its expected useful life. The steam boiler which converts to hot water for heating for both Building B and C is also extremely old and inefficient. These are due for a routine capital upgrade. A single-duct VAV AHU system with modern DDC controls should be installed to optimize energy use and comfort. It can be paired with a dual fuel heat pump condensing unit or a high-efficiency split-AC condensing unit. This ECM includes upgrading controls and retro-commissioning.

Additionally, this measure assumes both controls upgrades from pneumatic to DDC and optimization of existing equipment control sequences to further improve energy performance. Pneumatic controls upgrades refers to the process of upgrading antiquated pneumatic control systems and components to direct digital controls (DDC) and integrating it with a centralized control system. Pneumatic controls use compressed air to operate valves and dampers and are prone to operational and maintenance issues. Upgrading these antiquated controls to DDC will enhance the overall efficiency, functionality, and manageability of HVAC system operation. This measure directly produces electricity savings by eliminating the need for a compressed air system, but also indirectly contributes additional energy savings by enabling better control and functionality such as scheduling and optimization. Building B has one dual-duct AHU which is original to the building and has pneumatic controls for all components. A 5 HP air compressor provides compressed air to the system to control the AHUs in Buildings B and C. This measure is not recommended as a standalone measure due to the age and condition of the dual-duct AHU and need for a routine upgrade. Finally, the following opportunities should be included in control sequence analysis:

- Optimize HVAC scheduling in non 24/7 occupied spaces
- Optimize HVAC occupied and unoccupied setpoints
- Repair or replace leaking steam traps
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors and actuators
- Discharge air setpoint reset
- Outside air temperature lockouts
- Outside air damper control
- Duct static pressure reset
- Upgrade pneumatic controls to direct-digital controls (DDC) and integrate with BAS

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- HVAC equipment identified is due for routine end-of-life replacement.
- This measure assumes energy savings due to the adjustment of constant volume 100% fan speed to an average of 75% fan speed and assumes cooling savings from modern high efficiency condensing unit.
- Implementation costs assume $6/CFM, $1500/Ton, and $3/sqft for controls work.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Conduct a thorough assessment of the existing HVAC systems to determine the scope of upgrades required. Following this, detailed planning and design should be undertaken to ensure the new systems are appropriately sized and configured to meet the building's specific needs. This should include ensuring the new system is "electrification-ready" such that it either uses hot water for heating and/or is a dual-fuel heat pump that can use either source as the RFCM grid emissions improve or Oakland County renewable energy procurement makes it more favorable to use electricity over gas for heating to meet decarbonization goals. This process should be integrated into the facility's routine capital upgrade schedule to optimize the benefits of the new equipment and ensure seamless implementation along with other county priorities.

Table 10: ECM 2 Savings and ROM Cost

Savings Summary (2a – VAV AHU + HE AC + Controls + RCx)								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Annual O&M Savings ($)	Est Project Cost	Simple Payback (Yrs)
HVAC Upgrades (VAV AHU + AC + controls + RCx)	1,232	38,089	253	23	$4,781	$0	$78,437	16
Overall % Reduction	18%	41%	26%	31%	35%		--	--

5 Measure Requiring Additional Consideration

This section provides details on measures that were analyzed but are not recommended for immediate implementation at this time. This includes measures that require further study, such as capital-intensive replacements of existing equipment, but are not justified through energy savings alone. This section may also include measures that conflict with building electrification plans, or projects that are simply not recommended due to being financially impractical or not being technically feasible.

5.1 Building Envelope Improvements

Effective insulation and a well-sealed building envelope are critical for managing the transfer of heat between the exterior and interior environments. In Michigan, where seasonal temperature variations can be significant, improving building envelope integrity not only reduces energy consumption for heating and cooling but also helps maintain a consistent and comfortable indoor environment for staff, residents, and visitors. In addition to insulation, proper vapor sealing prevents moisture intrusion and minimizes indoor air quality issues related to high humidity. As building energy codes and insulation standards have evolved, older buildings can greatly benefit from upgrades that align with modern requirements, enhancing their energy efficiency. This measure includes building envelope improvements such as sealing air gaps around points of infiltration, adding insulation into the attic, and upgrading windows to double-pane windows. These steps not only reduce energy usage and associated emissions but also lower heating capacity requirements, making them an essential precursor to any major HVAC system upgrades. While this measure is beneficial to reduce the energy load and minimize infiltration, it has a poor payback as a standalone project. These envelope improvements should be considered as part of a comprehensive building renovation project.

Table 11: ECM 3 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Annual O&M Savings ($)	Est Project Cost	Simple Payback (Yrs)
Building Envelope Upgrades	60	431	63	3	$344	$0	$40,200	117

6 Appendix A

Table 12: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	334	$2,049	4,620	$496	12	16	1,051	0
Feb-23	142	$830	5,160	$486	15	19	955	0
Mar-23	142	$433	5,400	$485	15	23	918	0
Apr-23	49	$169	5,100	$449	14	23	525	28
May-23	31	$94	7,500	$592	20	33	283	76
Jun-23	31	$77	8,520	$638	24	37	86	139
Jul-23	3	$13	10,920	$884	29	41	11	227
Aug-23	6	$18	9,240	$734	25	37	48	141
Sep-23	9	$25	6,720	$619	19	30	113	85
Oct-23	42	$122	5,700	$464	15	24	415	31
Nov-23	76	$283	5,280	$406	15	25	779	0
Dec-23	63	$312	4,680	$332	13	16	834	0
Jan-24	80	$354	6,420	$148	17	23	1,194	0
Feb-24	48	$263	6,420	$657	19	24	874	1
Mar-24	48	$273	6,660	$538	18	29	771	2
Apr-24	5	$10	5,760	$505	18	30	437	21
May-24	43	$88	6,600	$749	18	29	148	98
Jun-24	2	$8	9,840	$904	27	43	51	207
Jul-24	3	$9	13,140	$1,171	35	49	18	251
Aug-24	3	$6	10,500	$966	28	42	37	215
Sep-24	3	$7	9,660	$775	27	44	84	112
Oct-24	3	$8	6,720	$639	18	29	356	31
Nov-24	4	$16	5,220	$563	15	24	607	4
Dec-24	101	$224	6,420	$540	17	22	1,037	0
2023 Sum	928	$4,422	78,840	$6,583			6,019	727
2024 Sum	344	$1,264	93,360	$8,152			5,614	942

7 Appendix B

Table 13: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Efficiency	Capacity 2	Approx Year Installed
AHU	1	Air handling unit, CV				146 MBH			~1999
	1	Split AC, Dx	AHU	Carrier	38AKS016	12.8 TON			
	1	Boiler for heat	B and C buildings	Weil McLain	LGB-9	520 MBH	83%		2012
DH	1	Domestic water heater (summer)		Lochinvar	RJS120	119 GAL			1985
	1	Steam boiler (winter) for HW		Lochinvar					
	1	Air Compressor		Quincy	QTS3QCB				

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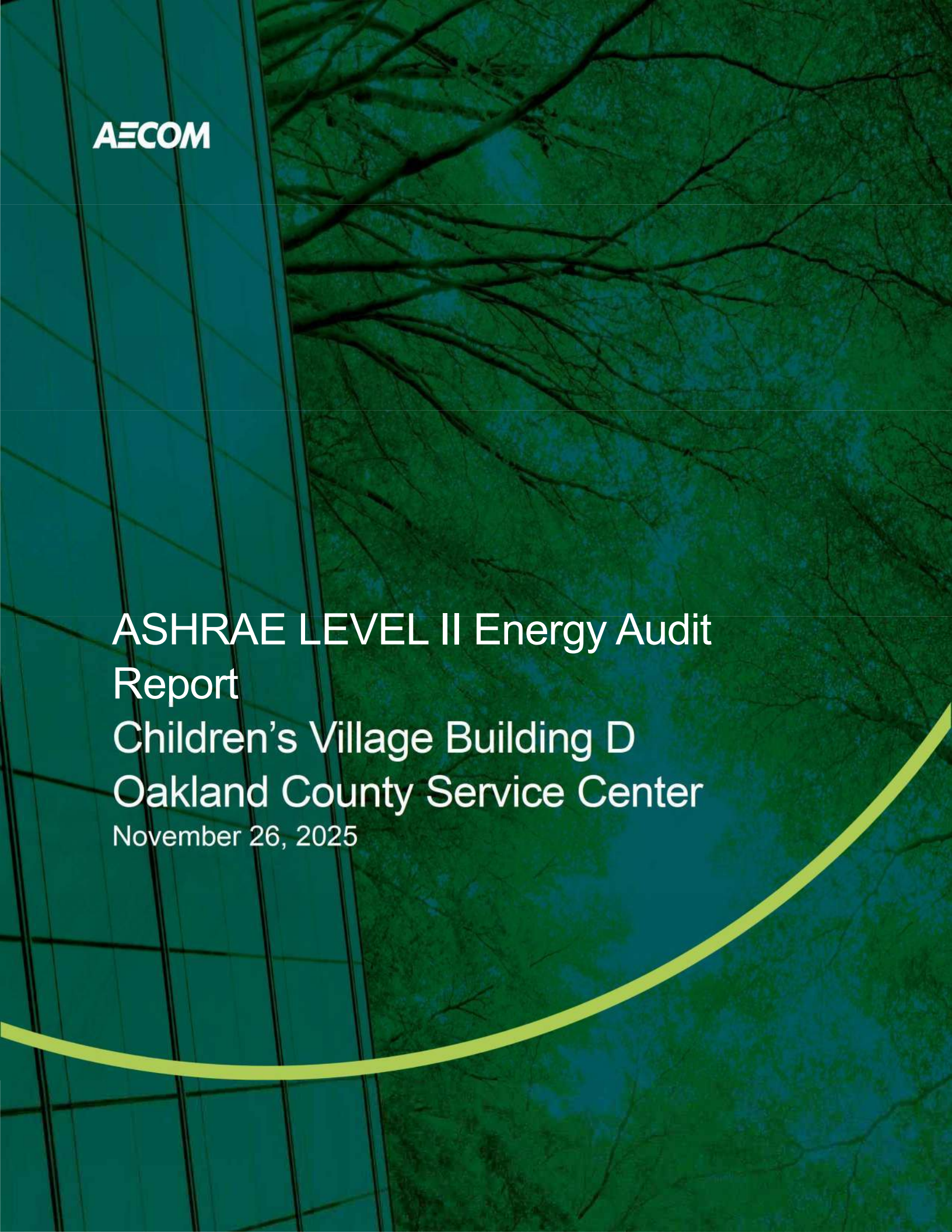

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ASHRAE LEVEL II Energy Audit Report
Children's Village Building D
Oakland County Service Center

November 26, 2025

Quality information

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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Children's Village D Building in accordance with ASHRAE Standard 211-2018. Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County Children's Village is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Wednesday April 16, 2025 was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates three ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The recommended measures represent a projected 17% annual energy cost savings with an aggregate simple payback of 11.7 years. Building envelope improvements including window upgrades and additional attic insulation are not recommended as a standalone project due to poor payback, but should be considered as part of a comprehensive building renovation project.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Children's Village Building D Proposed Energy Savings Summary

Energy Conservation Measures												
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	MMBTU	tCO2e	$/yr	$/yr	$	Years
1	LED Lighting Upgrade	H	R	13,182	2	0	45	5.8	$530	$1,980	$13,350	6.7
2	Retro-Commissioning	H	R	3,044	0	39	41	2.9	$0	$480	$17,198	26.9
Sum of Recommended Measures				17,241	2	39	0	99	$530	$2,620	$30,548	11.7
Overall % Reduction				22%	11%	9%	0%	14%		14%	17%	-
3	Building Envelope Improvements	N/A	NR	313	0	46	49	3	$0	$265	$40,200	315

Notes
Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Children's Village, a detention facility, functions as a residential center for juvenile residents, offering a structured environment that supports their education during rehabilitation. Building D, a residential treatment facility, was built in 1974. The concrete masonry unit (CMU) building features a beige brick veneer and is two stories tall, with a roofing system that includes an attic.

The facility can accommodate up to 10 children who can receive treatment for approximately six to nine months. The children in these residential units have completed their initial treatment and no longer require detention. The building includes sleeping units, a playroom, and a kitchen that prepares them to reintegrate into social life seamlessly.

2.1 Building Systems

2.1.1 Building Envelope

The building has two above-grade and one below-grade floor. The window/wall ratio is estimated to be about 25%. The windows appear to be in good condition; however, they are single-pane windows and are assumed to be original to the building.

The walls are CMU structures with brick veneer on the exterior. There is no insulation on the interior side behind the drywall. The attic was not accessible, and the insulation levels are not known at this stage.

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	CMU with brick veneer	Good
Roof	Attic	Good
Glazing	Single-pane, aluminum frame, tinted windows are original, 25% window/wall ratio	Good

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The heating is provided by P. K. Mach 450 MBH input capacity boiler installed in 2007. The boiler has a turn-down ratio of 90 MBH. The boiler is rated as 92% efficient, which can provide 414 MBH peak heating. The boiler is in good condition.

A 20-ton Johnson Controls packaged air handling unit (AHU) with 400 MBH heating capacity supply heating and cooling to the building's three variable air volume (VAV) zones. All VAV boxes are located in the mechanical room. Each VAV zone is served by hot water reheat from the boiler. The AHU and the boiler are in good operating condition; however, these units are relatively oversized for this building.

Two 5-ton direct expansion (DX) condenser units serve other zones in the building. Both condenser units appeared to be in good operating condition.

2.1.3 Plumbing

The domestic hot water is provided by a Bock gas-fired boiler. The boiler modulates heating between 60 MBH and 150 MBH and the water is stored in 99-gallon storage tank.

2.1.4 Building Controls

The AHU VAVs are controlled by electric actuators linked to the BMS. The boiler has its controller, maintaining the water temperature within the preset conditions.

2.1.5 Lighting Systems

During the site visit, lighting fixtures were observed to vary based on room layout. Fixtures were either recessed, ceiling-mounted, or suspended. The mechanical rooms have 12W light emitting diode (LED) fixtures, while the remaining areas use 32W fluorescent fixtures.

Table 3: Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
Fluorescent Lights	89	2 lamps
LED Light	2	1 lamp
LED CAN Lights	3	-

The total approximate quantity of light fixtures is 93, with an approximate total wattage of 5,756 watts. The approximate area per drawing is 8,599 ft², and the calculated lighting density is approximately 0.67 W/ft².

2.1.6 Electrical Infrastructure

The facility is served by a 150 kVA transformer located outside the building. The main electrical service shared by both Buildings D and the Counseling Center is rated at 800 amps, 120/208 volts, 3-phase, and is associated with a meter number 30804654. A spot measurement was taken and recorded at 8,758 kWh * 120. Backup power is provided by a 154-kW generator.

3 Utility Billing Analysis

3.1 Utility Type and Usage

Children's Village Building D receives electric service and natural gas service. Metering is shared between Building D and the Counseling Center. Therefore, usage is distributed by square footage. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

Table 4 summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

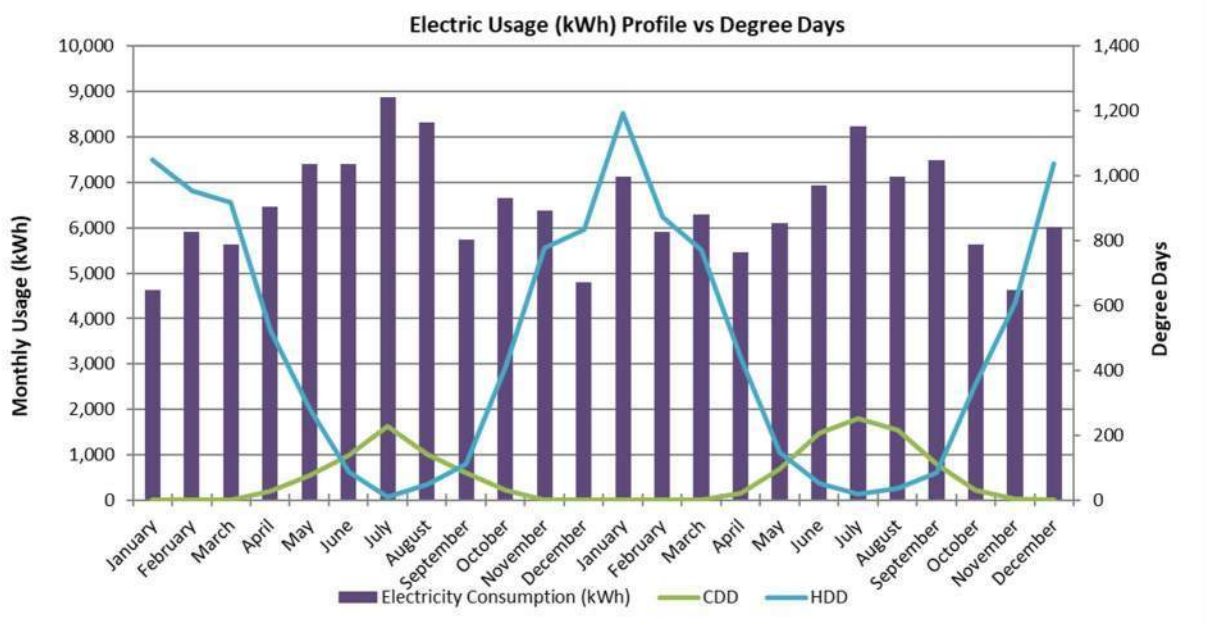
Utility	Annual Usage	Annual Usage (MMBtu)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	76,901 kWh	262	$8,459	$0.11/kWh	0.0004427	34
Natural Gas	447 MCF	464	$2,225	$4.98/MCF	0.0549206	25
Total	**--**	**726**	**$10,684**	**--**	**--**	**59**

**Natural Gas (1 MCF = 1,038,000 Btu); Electricity (1 kWh = 3413 Btu)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a correlation to CDD, representing seasonal loads associated with cooling in the summer months. The electricity usage for the remainder of the year is relatively stable due to baseload usage such as lighting and fan loads which are consistent throughout the year. The annual usage for the baseline 12-month period from January to December 2024 is 76,901 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

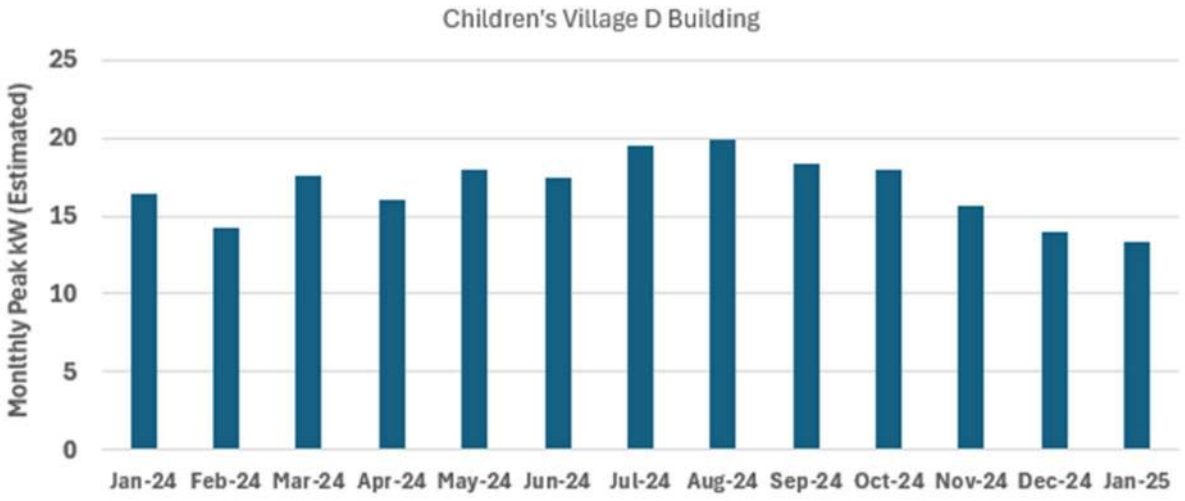
The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based energy consumption of each building. Due to this, energy demand reduction measure savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate the peak demand of the building which uses the metered consumption of the building, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below. Note that Building D electrical service equipment also supports the Counseling Center with significant remaining capacity.

Table 5: Electric Capacity Results

Maximum Building Capacity at Service Transformer	150 kW
Maximum Capacity at Switchgear (A*V*Ph)	288 kW
Estimated Peak Demand	19.8 kW (estimated)
Remaining Capacity	**130 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy, and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric

consumption readings at the individual building submeters. This arrangement accurately distributes the cost of electricity consumption, but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand but high usage are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: $0.057/kWh

DTE Electric Demand Charge: $6.15/kW/Month

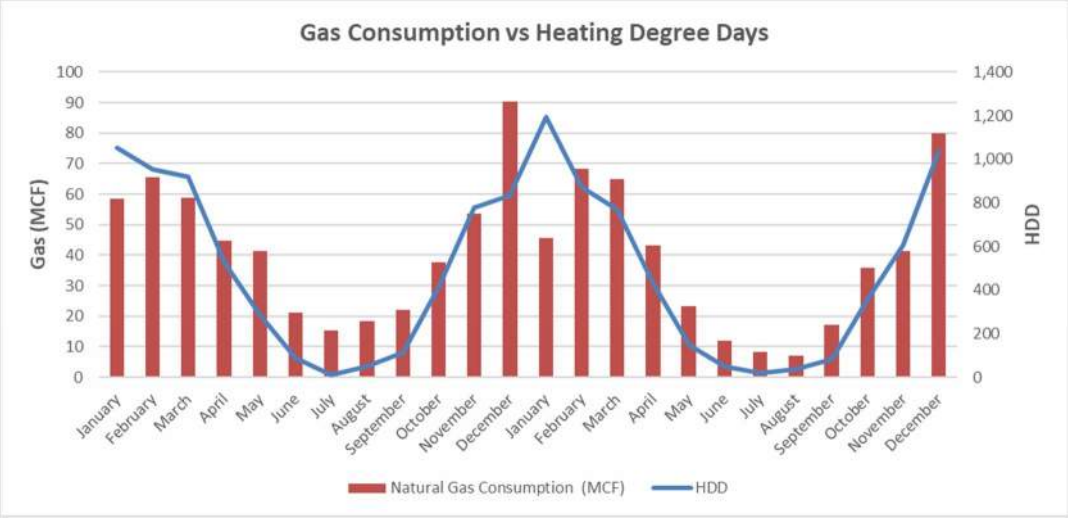
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows a direct correlation to weather data, as natural gas is primarily used for space heating. However, since this is a 24/7 occupied facility and the VAV AHU uses hot water reheat, there is baseload summer usage due to domestic hot water usage for bathrooms and showers and hot water reheat. The annual usage for the baseline 12-month period is 447 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electric, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): $3.48/dTh (decatherm, or 1.038MCF)

Constellation NG Usage Charge (Day Gas): $5.29/dTh (decatherm, or 1.038MCF)

Average Dollar per MCF Used in Calculations: $4.98/MCF

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$8,459
Natural Gas	$2,226
Total	$10,685
ECI $/yr/sf	$1.24

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each

emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

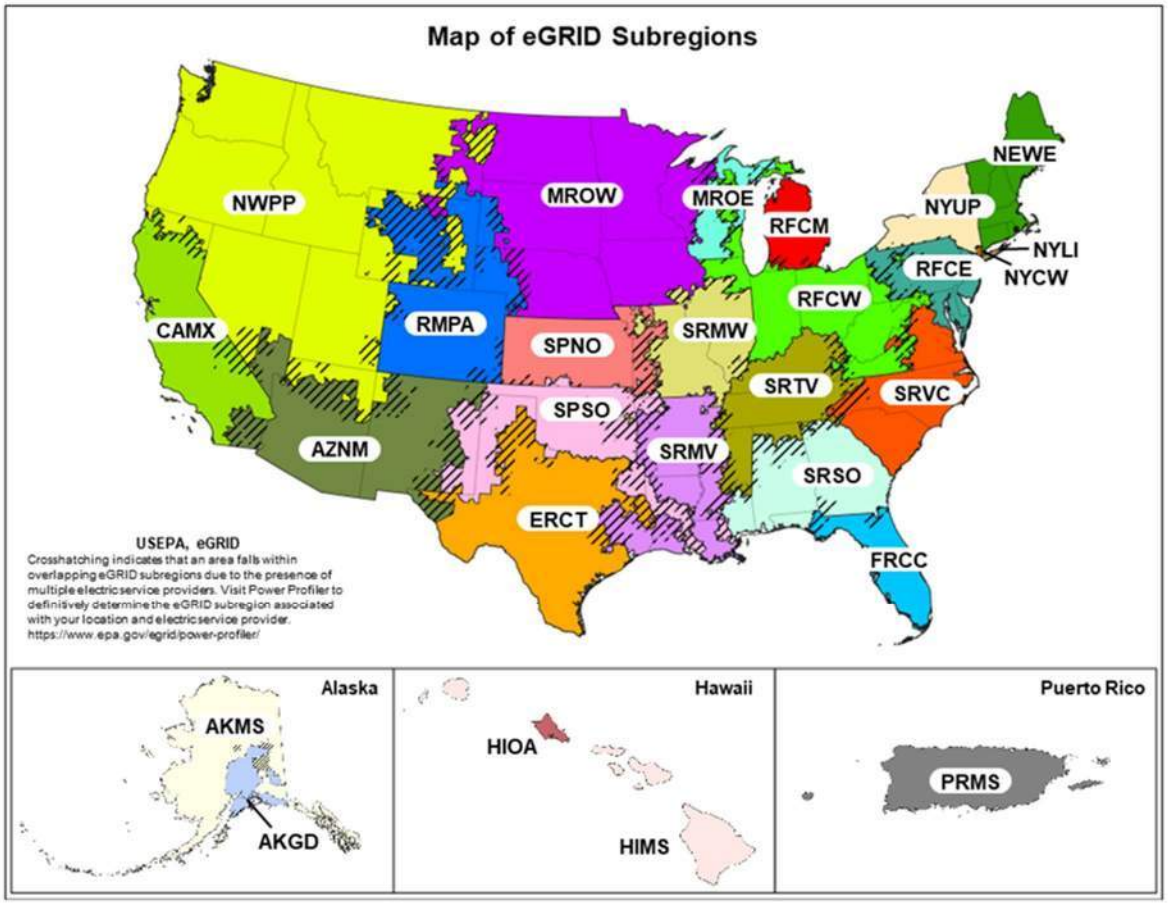
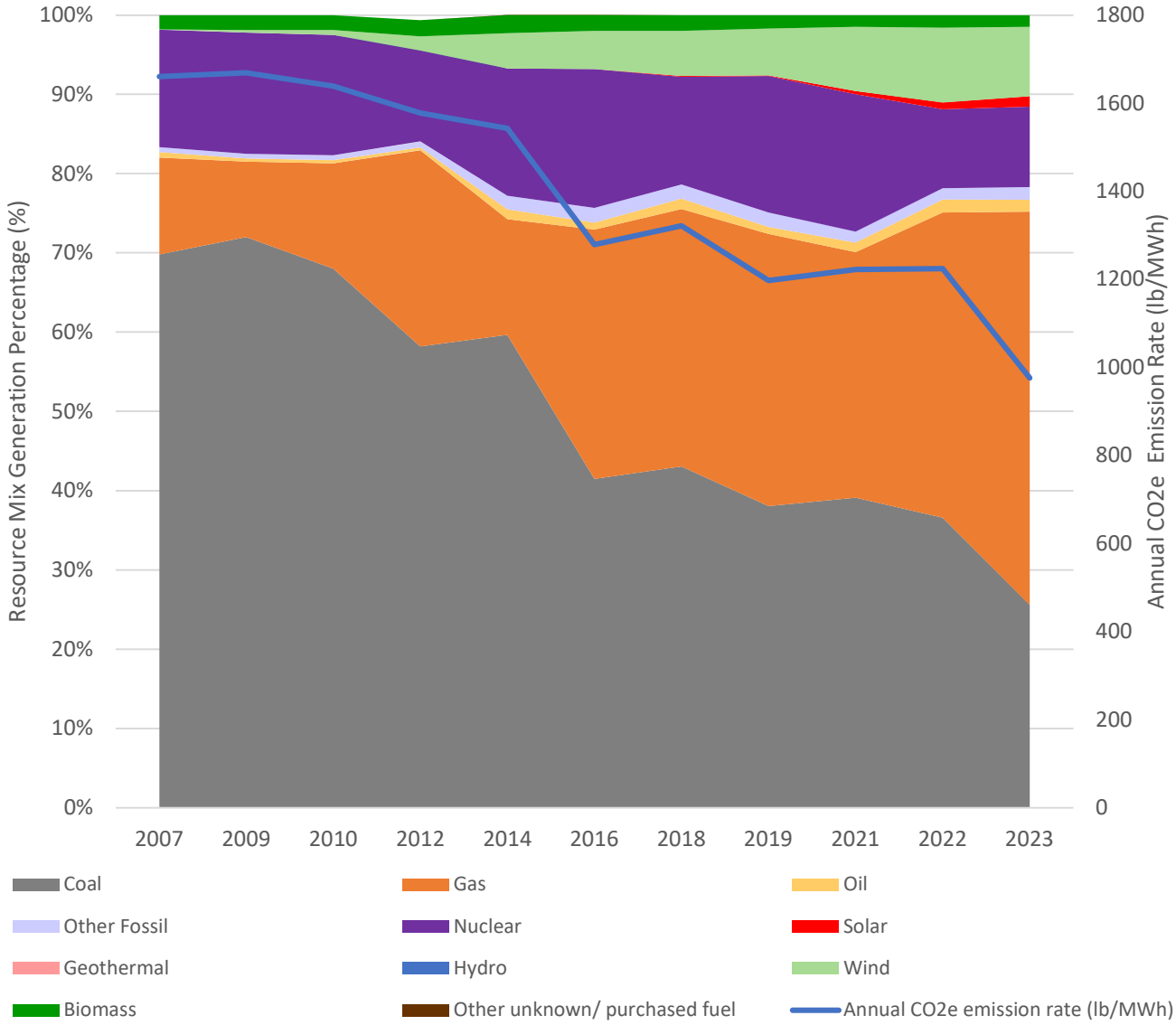


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 42 percent of carbon emissions are attributed to natural gas and 58 percent associated with electricity. Natural gas combustion for space heating and imported electricity resulted in 25 tCO2e (Scope 1) and 34 tCO2e (Scope 2) emissions, respectively, for a total of 59 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficient per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBtu) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for Children's Village D, are converted to kBtus units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Children's Village D		**Electric EUI:**	31	kBtu/SF/yr
GFA:	8,599	SF	**Gas EUI:**	54	kBtu/SF/yr
eGRID Subregion:	RFCM		**Current EUI**	84	kBtu/SF/yr

Annual Utility Summary

Energy Type	Total Annual Use		Conversion Factor	MMBTU	CO2 Coeff	GHG (tCO2e)	Annual Cost ($)	Cost %
Electricity	76,901	kWh	3.412	262	0.0004427	34	$8,459	79%
Natural Gas	447	MCF	1.038	464	0.0549206	25	$2,225	21%
Totals				**726**		**59**	$10,684	100%

According to the US EPA, the average site energy use intensity for a residence hall is 57.9 kbtu/SF/yr. The total EUI for the existing condition of the building is calculated as 84 kBtu/SF, which is significantly higher than the national benchmark. It's important to note the national benchmark does not factor in the variance for weather conditions whereas Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison indicates there is still opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient

3.8 End Use Distribution

Table 8 shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees and residents. Table 8 and Figure 7 and Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBtu)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	388	0	402,741	47	21
Space Cooling	16,557	0	0	56,494	7	7
Fans	24,030	0	0	81,992	10	11
Pumps	2,841	0	0	9,694	1	1
DHW	0	59	0	61,030	7	3
Conveyance	0	0	0	0	0	0
Lighting	25,235	0	0	86,101	10	11
Plug Loads	7,737	0	0	26,400	3	3
Process Loads	0	0	0	0	0	0
Refrigeration	500	0	0	1,706	0	0
Cooking	0	0	0	0	0	0
Information Technology	0	0	0	0	0	0
TOTAL	76,901	447	0	726,158	84	59
Historical Billing	76,901	**447**	0			
Percent of Actual	100%	100%	0%			
per sqft	8.9	**0.1**	0.0			

Figure 7: Existing Electricity End Use Distribution

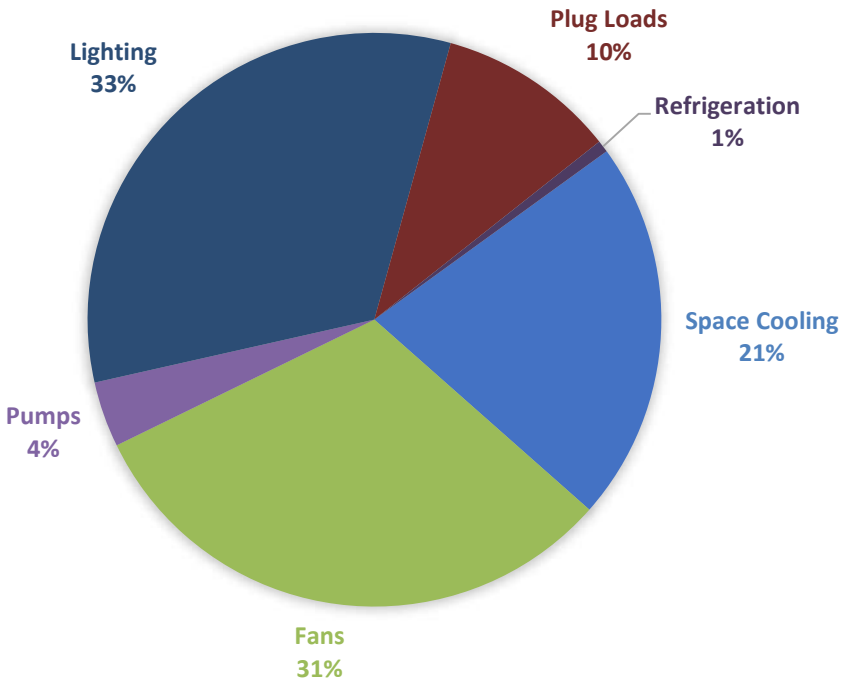
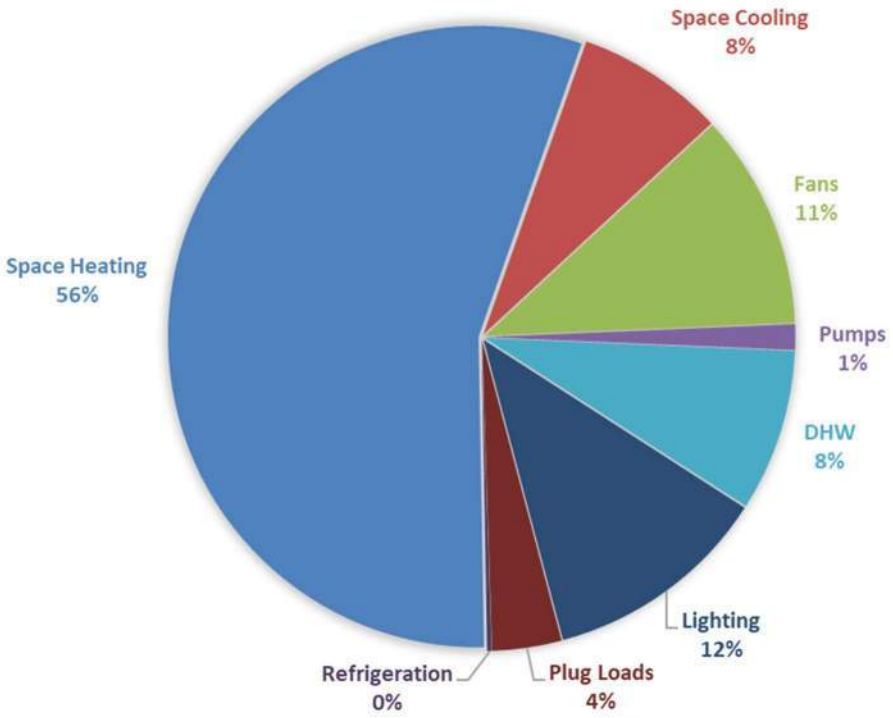


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures (ECM)

The measures discussed in this section are economically viable when bundled together but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – LED Lighting

This measure proposes upgrading all remaining fluorescent lighting to light-emitting diode (LED) lightbulbs with motion sensors and dimming functionality where appropriate to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements. The current lighting in Children's Village Building D is primarily fluorescent and the estimated wattage is approximately 0.67 W/ft².

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.

Figure 9: Example Fixture with Integrated Occupancy Controls



Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- This measure assumes lighting savings of approximately 0.36 W/ft² and 20% reduction in lighting energy through implementation of controls.
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture. Lighting controls that include dimming will likely require full fixture replacement, which drive up the total cost of implementation for the measure.
- Interior lights operate 18 hours per day for 252 business days per year, which averages the different occupancy schedules for different parts of the building (24/7 and normal business hours).
- O&M savings assume an average cost of $2.94/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- LED upgrades cost $215/fixture, applied to 89 fixtures. This assumes integrated control sensors and no additional wiring and control circuits. Low-cost fixtures and external controls can be used as an alternative to this implementation method. The costs have been split out between the fixtures and controls in the summary table below.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, if integrated controls are not included in each fixture, subsequent steps are required that may consist of conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 9: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	O&M Savings ($)	Est Project Cost	Simple Payback (Yrs)
LED Upgrade	0	13,182	45	6	$1,450	$530	$13,350	6.7
Overall % Reduction	0%	17%	6%	10%	14%		--	--

4.2 2 - Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent. Unlike Children's Village Buildings B and C, which have similar layouts, Building D HVAC systems and controls were upgraded to modern systems with DDC controls connected to a central BAS system. Observations from the site visit and high-level review of the BAS system indicate that not all systems are operating optimally and can be modified to improve efficiency. A couple examples include:

- A hot water reset schedule is shown but not enabled or operating correctly. The boiler setpoint is 140F but operating at 180F as shown by the hot water supply temperature of 178F. Condensing boilers operate most efficiently closer to 140F.
- The economizer changeover setpoint is 55F and could be raised to 65F and/or an enthalpy sensor can be installed to use 28 Btu/lb as the changeover setpoint to maximize free-cooling.

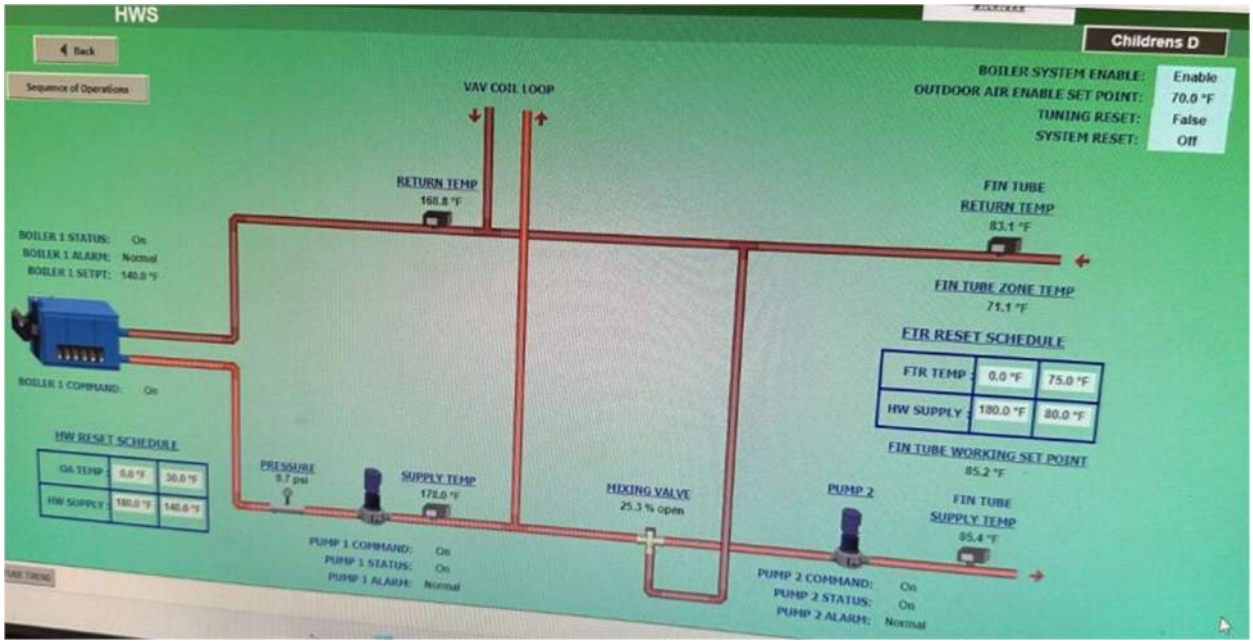


Image 1: BAS screenshot of Building D Hot Water System

The following list represents RCx opportunities that should be evaluated to validate operation, and then to modify and/or repair discrepancies identified if systems not scheduled for timely replacement. This effort will proactively improve building system operation and optimize energy usage.

- Optimize HVAC scheduling in non 24/7 occupied spaces
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water supply reset
- Discharge air setpoint reset
- Outside air temperature lockouts
- Outside air damper control
- Duct static pressure reset
- Repair airside economizing
- Demand-controlled ventilation
- Repair/seal AHU air leaks

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 7.5% reduction in estimated heating, cooling, and fan end use energy consumption.
- Project cost is estimated at $2 per square foot of building area (8,599 SF).
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: This measure proposes engaging a third-party contractor to determine if this building is eligible for the DTE RCx program and systematically evaluate and prioritize major HVAC and control systems and complete retro-commissioning to restore systems to their original design intent. This measure is recommended for implementation and should be coordinated and sequenced with ECMs 4 and 5. This ECM should be implemented simultaneously with other small buildings to reduce costs.

ECM Savings and ROM Cost:

Table 10: ECM 2 Savings and ROM Cost

	Savings Summary							
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Annual O&M Savings($)	Est Project Cost	Simple Payback (Yrs)
RCx	39	4,059	54	3.9	$640	$0	$17,198	26.9
Overall % Reduction	7%	4%	7%	7%	6%		--	--

5 Measure Requiring Additional Consideration

5.1 Building Envelope Improvements

Effective insulation and a well-sealed building envelope are critical for managing the transfer of heat between the exterior and interior environments. In Michigan, where seasonal temperature variations can be significant, improving building envelope integrity not only reduces energy consumption for heating and cooling but also helps maintain a consistent and comfortable indoor environment for staff, residents, and visitors. In addition to insulation, proper vapor sealing prevents moisture intrusion and minimizes indoor air quality issues related to high humidity. As building energy codes and insulation standards have evolved, older buildings can greatly benefit from upgrades that align with modern requirements, enhancing their energy efficiency. This measure includes building envelope improvements such as sealing air gaps around points of infiltration, adding insulation into the attic, and upgrading windows to double-pane windows. These steps not only reduce energy usage and associated emissions but also lower heating capacity requirements, making them an essential precursor to any major HVAC system upgrades. While this measure is beneficial to reduce the energy load and minimize infiltration, it has a poor payback as a standalone project. These envelope improvements should be considered as part of a comprehensive building renovation project.

ECM Savings and ROM Cost:

Table 11: ECM 2 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Annual O&M Savings($)	Est Project Cost	Simple Payback (Yrs)
Building Envelope Improvements	46	313	49	3	$265	$0	$40,200	315

6 Appendix A

Table 12: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	58	$358	4,621	$496	8	11	1,051	0
Feb-23	66	$384	5,915	$557	11	14	955	0
Mar-23	59	$179	5,638	$506	10	16	918	0
Apr-23	45	$156	6,470	$569	12	19	525	28
May-23	41	$124	7,394	$583	13	21	283	76
Jun-23	21	$52	7,394	$554	13	21	86	139
Jul-23	15	$62	8,873	$718	15	21	11	227
Aug-23	18	$53	8,319	$661	15	21	48	141
Sep-23	22	$63	5,731	$528	10	17	113	85
Oct-23	38	$109	6,655	$541	12	19	415	31
Nov-23	54	$200	6,378	$490	12	19	779	0
Dec-23	90	$446	4,806	$341	8	11	834	0
Jan-24	46	$200	7,117	$164	12	16	1,194	0
Feb-24	68	$372	5,915	$605	11	14	874	1
Mar-24	65	$367	6,285	$507	11	18	771	2
Apr-24	43	$90	5,453	$478	11	18	437	21
May-24	23	$48	6,100	$556	11	17	148	98
Jun-24	12	$39	6,932	$637	13	20	51	207
Jul-24	8	$27	8,226	$733	14	20	18	251
Aug-24	7	$15	7,117	$655	12	18	37	215
Sep-24	17	$42	7,487	$600	14	22	84	112
Oct-24	36	$96	5,638	$535	10	16	356	31
Nov-24	41	$142	4,621	$498	8	14	607	4
Dec-24	80	$178	6,008	$505	10	13	1,037	0
2023 Sum	528	$2,184	78,195	$6,544			6,019	727
2024 Sum	447	$1,617	76,901	$6,474			5,614	942

7 Appendix B

Table 13: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Efficiency	Capacity 2	Approx Year Installed
AHU	1	Packaged air handling unit, VAV (NG, Dx)		Johnson controls	J20ZJS40K2C1FCD6G1	400 MBH		20 TON	
	1	Boiler	AHU	PK Mach		450 MBH	92%		2007
	2	Dx condenser units	Elsewhere from 3 VAV AHU zones	Carrier	24ABB348A0051010	4 TON	13 SEER		2013
DW heater	2	HHW heater		Bock water heaters	OT150N	90 GAL			2020
	1	HW Pump				0.5 HP			

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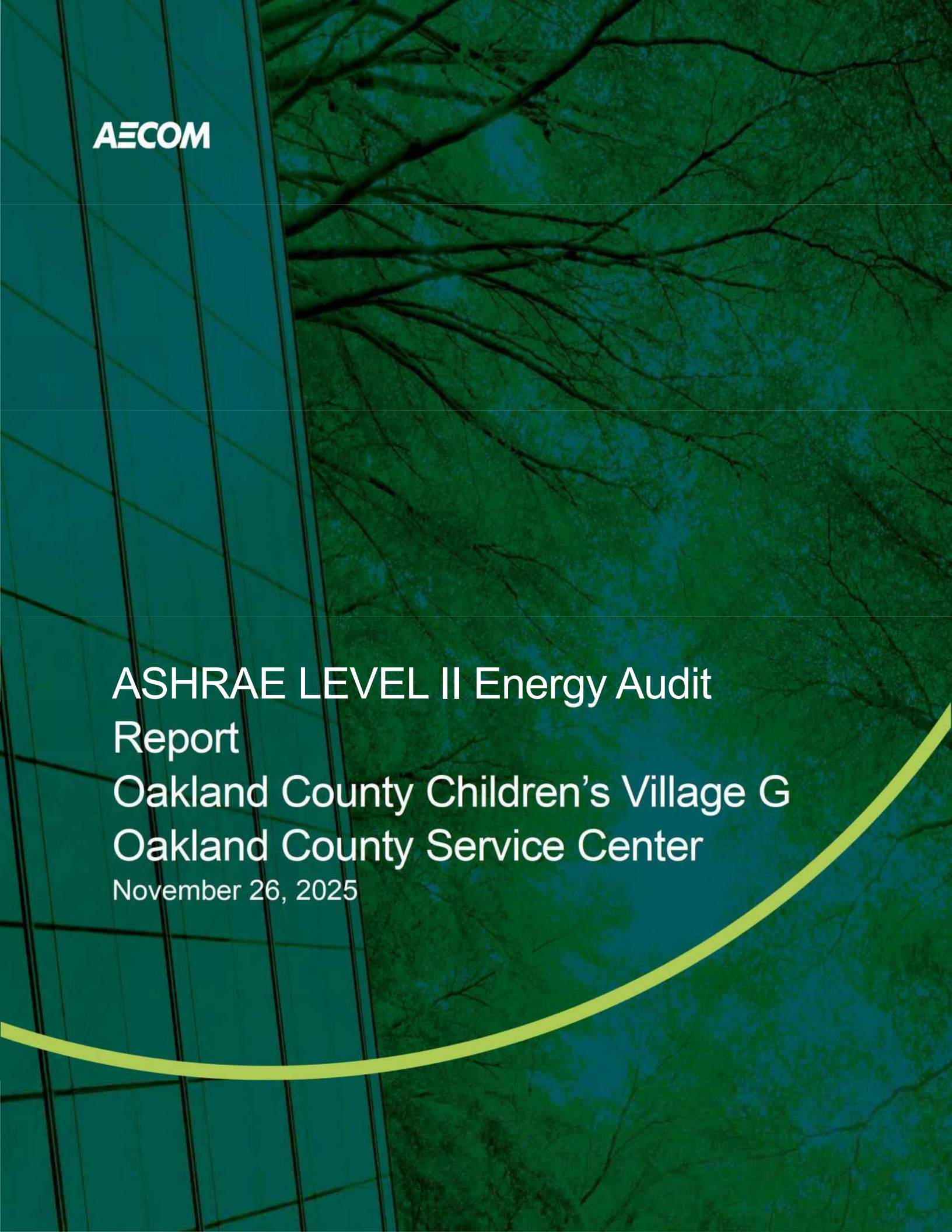

AECOM

ASHRAE LEVEL II Energy Audit Report
Oakland County Children's Village G
Oakland County Service Center

November 26, 2025

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

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OAKLAND COUNTY, MI Government

Prepared by:
AECOM

Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Children's Village G Building in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County Children's Village is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Wednesday April 16, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates five ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The recommended measures represent a projected 20% annual energy cost savings with an aggregate simple payback of 37 years. This high payback is because ECM 1 is a comprehensive measure which includes equipment upgrades, retro-commissioning and controls upgrades, but is considered necessary for future development plans for the building.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Children's Village Building G Proposed Energy Savings Summary

Energy Conservation Measures												
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	MMBTU	tCO2e	$/yr	$/yr	$	Years
1	HVAC Upgrade (RCx + Controls)	H	R	28,546	1	70	170	16	$0	$3,489	$131,496	38
2	Low Flow Fixtures	L	R	0	0	19	20	1	$0	$97	$1,250	13
Sum of Recommended Measures				28,546	1	89	190	17	$0	$3,586	$132,746	37
Overall % Reduction				30%	3%	11%	0%	17%		17%	20%	-
N/A	Retro-Commissioning	N/A	NR	3,568	0	36	49	3.5	$0	$570	$11,874	21
N/A	Upgrade Pneumatic Controls to DDC	N/A	NR	4,189	1	0	14	2	$0	$461	$35,622	77
N/A	Building Envelope Improvements	N/A	NR	394	0	62	66	4	$0	$353	$57,600	163

Notes
Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Children's Village, a detention facility, functions as a residential center for juvenile detainees, offering a structured environment that supports their education during rehabilitation. The G Building within this complex was built in 1974 and is used as shelter care. The concrete masonry unit (CMU) building features a beige brick veneer and is one story, with an attic. The insulation in the attic is expected to be min R20.

The G Building can accommodate up to 8 children and 8 employees. Each child is taken care of by one employee who assists with their education during their detention period. The children have concluded their initial phase of treatment and are no longer required to remain in full detention. The building includes a TV room, office spaces, a dining room, two server racks in the electrical room, and a kitchen. This facility prepares the children to reintegrate into social life seamlessly.

2.1 Building Systems

2.1.1 Building Envelope

The building has two above-grade and one below-grade floor. The window/wall ratio is estimated to be about 25%. The windows appear to be in good condition; however, they are single-pane windows and are assumed to be original to the building.

The walls are CMU structures with brick veneer on the exterior. There is no insulation on the interior side behind the drywall. The attic was not accessible, and the insulation levels are unknown at this stage.

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	CMU with brick veneer	Good
Roof	Insulation in the attic	Good
Glazing	Single pane, aluminum frame, tinted windows are original, 10% window/wall ratio	Good

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

A PK Mach boiler, installed in 2007, provides heating with a peak capacity of 450 MBH input at an 82% combustion efficiency rating. The boiler's turn-down ratio is as low as 90 MBH input. The hot water boiler is in good operating condition.

One air handling unit (AHU) serves twelve zones controlled by pneumatic damper actuators. The zones are split on the AHU unit with a hot and cold deck configuration. The AHU is served

by a direct expansion (DX) coil and a hot water heating coil. The 28-ton split-AC condenser unit, installed in 2012, is located on the roof and in good operating condition.

2.1.2.2 Plumbing

An 80-gal Lochinvar indirect water heater supplies domestic hot water installed in 2022. A Lochinvar boiler installed in 2001 supplies hot water to the indirect water heater. A 1/6 HP Bell Gossett pump constantly circulates hot water in the building. The domestic water distribution infrastructure is equipped with mixing valves in the restrooms. It's recommended to always store hot water above 140°F to eliminate Legionella bacteria growth.

2.1.2.3 Building Controls

The building systems are controlled by a pneumatic system serving damper actuators. All pumps and fans are equipped with constant-speed motors. The lighting systems are manually controlled.

2.1.3 Lighting Systems

During the site visit, lighting fixtures were observed to vary based on room layout. Fixtures were either recessed, ceiling-mounted, or suspended. All fixtures are LED rated at 12W.

Table 3: Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
LED Lights	133	2 lamps
LED Lights	37	1 lamp

The total approximate quantity of light fixtures is 170, with an approximate total wattage of 3,636 watts. The approximate area per drawing is 11,874 ft² and calculated lighting density is approximately 0.306 W/ft².

2.1.4 Electrical Infrastructure

The facility is served by a 150 kVA transformer located outside the building. The main electrical service is rated at 600 amps, 208/120 volts, 3-phase, and is associated with meter number 30884693. Backup power is provided by a 60 kW diesel generator.

3 Utility Billing Analysis

3.1 Utility Type and Usage

Children's Village Building G receives electric service, natural gas service, and is not connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

Table 4 summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	96,120 kWh	328	$10,573	$0.11/kWh	0.0004427	43
Natural Gas	792 MCF	822	$3,945	$4.98/MCF	0.0549206	44
Total	**--**	**1,150**	**$14,518**	**--**	**--**	**86**

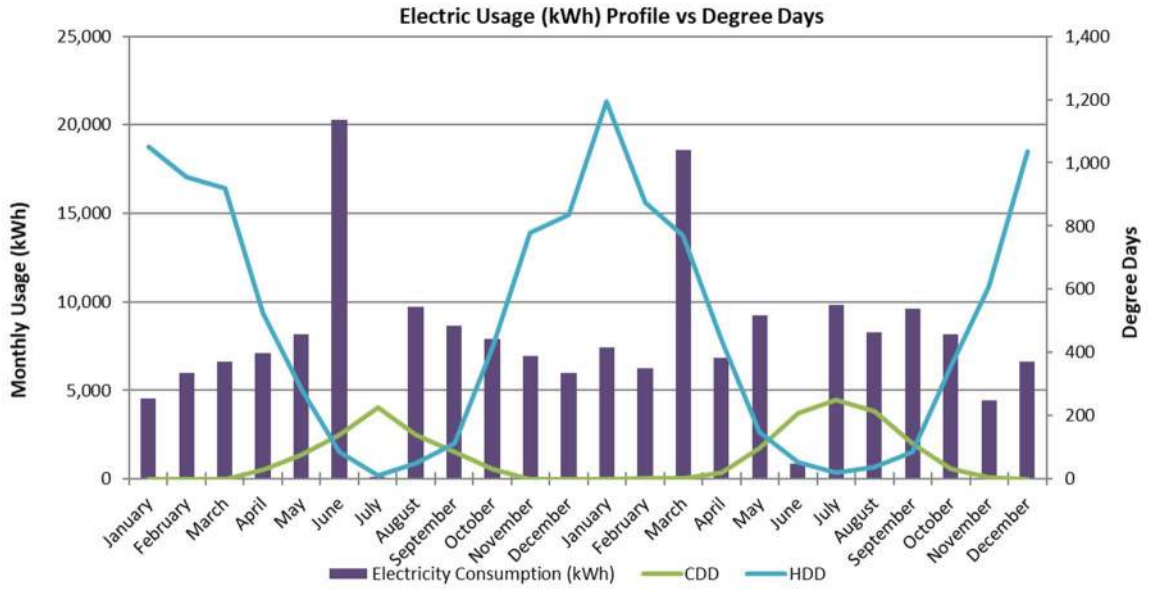
**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage does not show a strong correlation to weather data, indicating the majority of electricity usage consists of baseload usage. This usage does not vary much from month to month and includes loads such as lighting, fans, and pump loads. However, there are a few data anomalies, specifically in June 2023, March 2024, and June 2024. The first of which appears to be two months of use and June 2024 low use is assumed to be a reconciliation for the March

2024 spike. The annual usage for the baseline 12-month period from January to December 2024 is 96,120 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

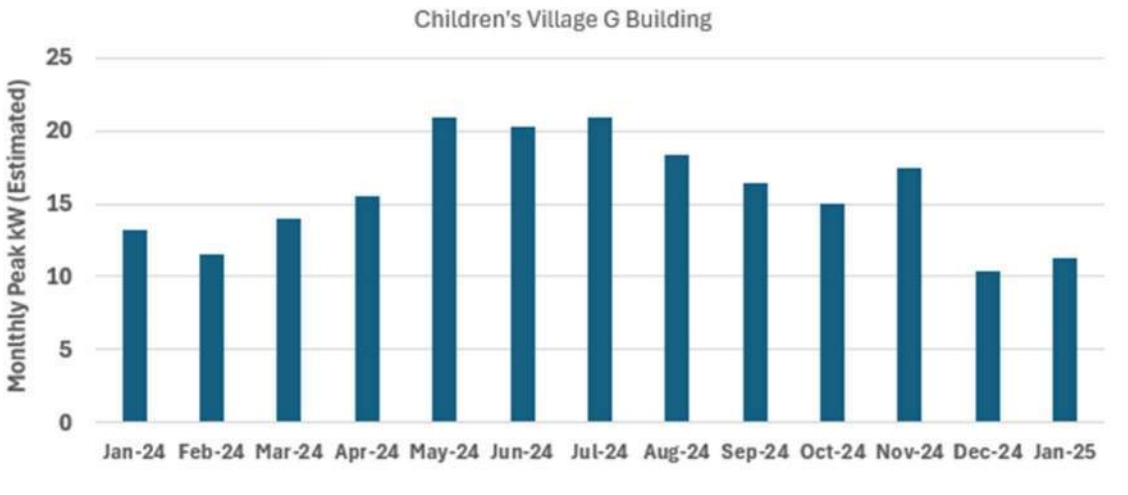
The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 5: Electric Capacity Results

Maximum Building Capacity at Service Transformer	150 kW
Maximum Capacity at Switchgear (A*V*Ph)	216 kW
Estimated Peak Demand	21 kW (estimated)
Remaining Capacity	**129 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge: **$6.15/kW/Month**

Average Dollar per kWh Used in Calculations: **$0.11/kWh**

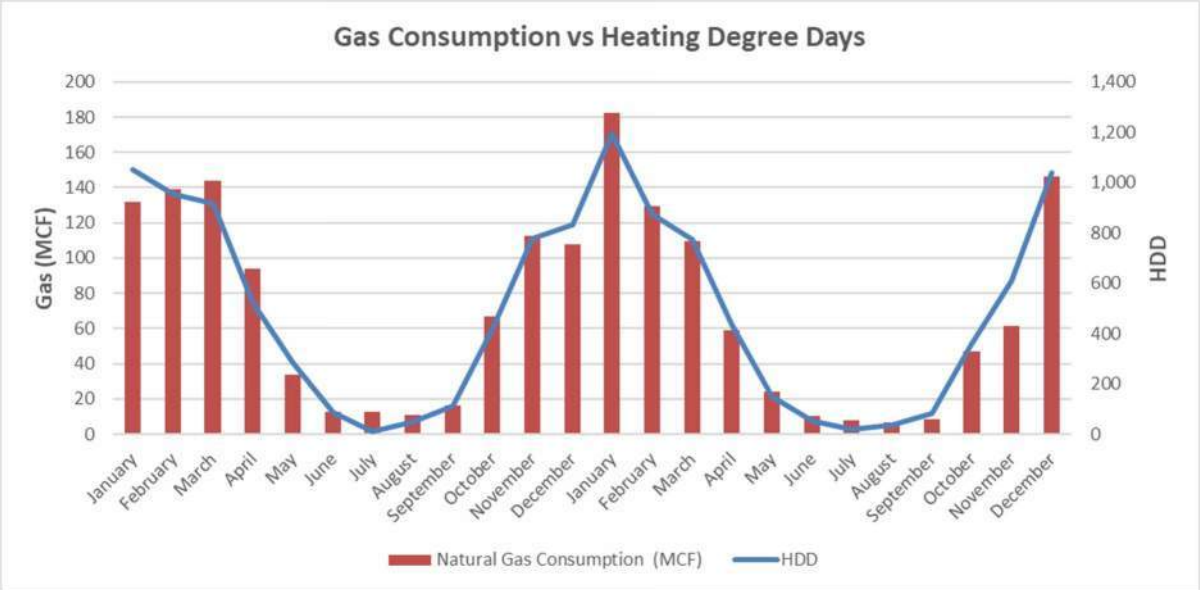
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows a direct correlation to weather data, as natural gas is primarily used for space heating. However, since this is a 24/7 occupied facility there is baseload summer usage due to domestic hot water usage for bathrooms, showers, and cleaning. The annual usage for the baseline 12-month period from January to December 2024 is 792 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master

account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): $3.48/dTh (decatherm, or 1.038 MCF)

Constellation NG Usage Charge (Day Gas): $5.29/dTh (decatherm, or 1.038 MCF)

Average Dollar per MCF Used in Calculations: $4.98 MCF

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$10,573
Natural Gas	$3,947
Total	$14,520
ECI $/yr/sf	$1.22

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO_2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

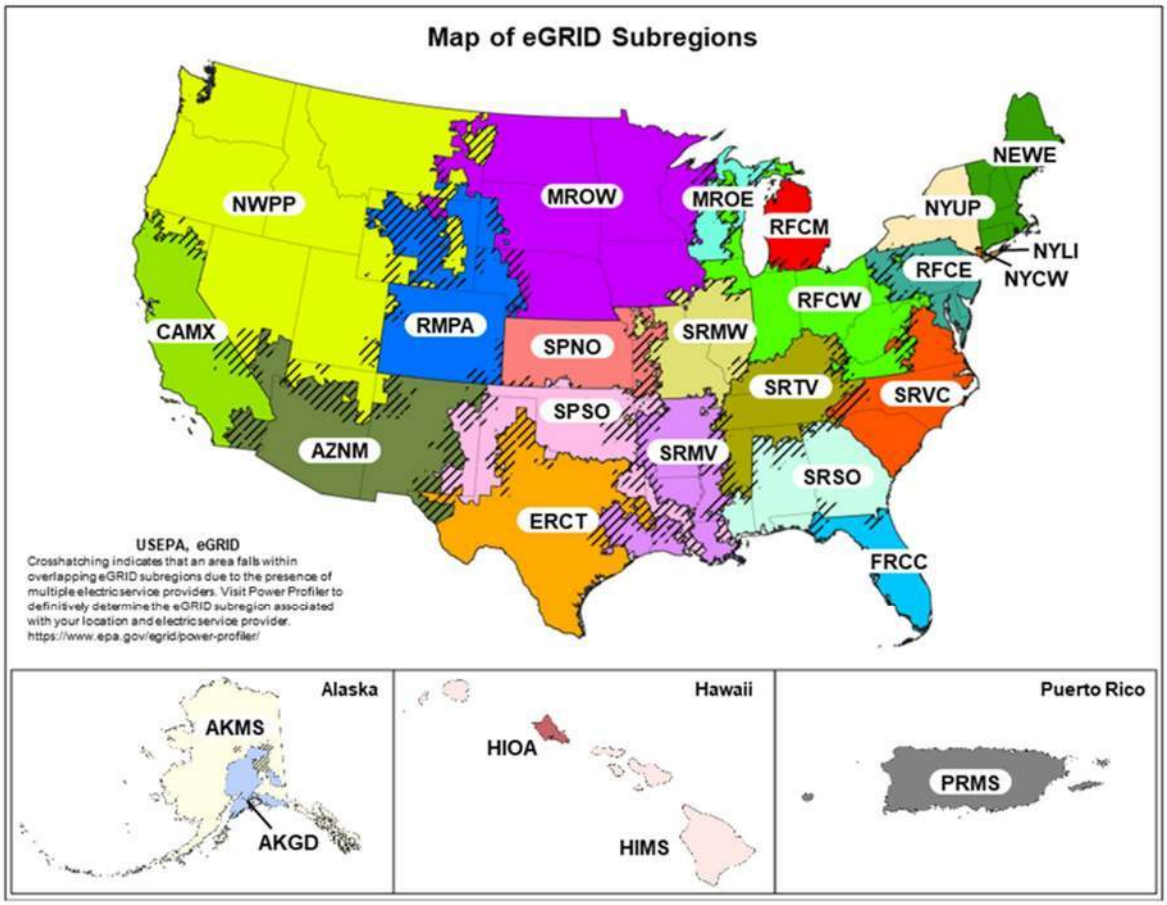
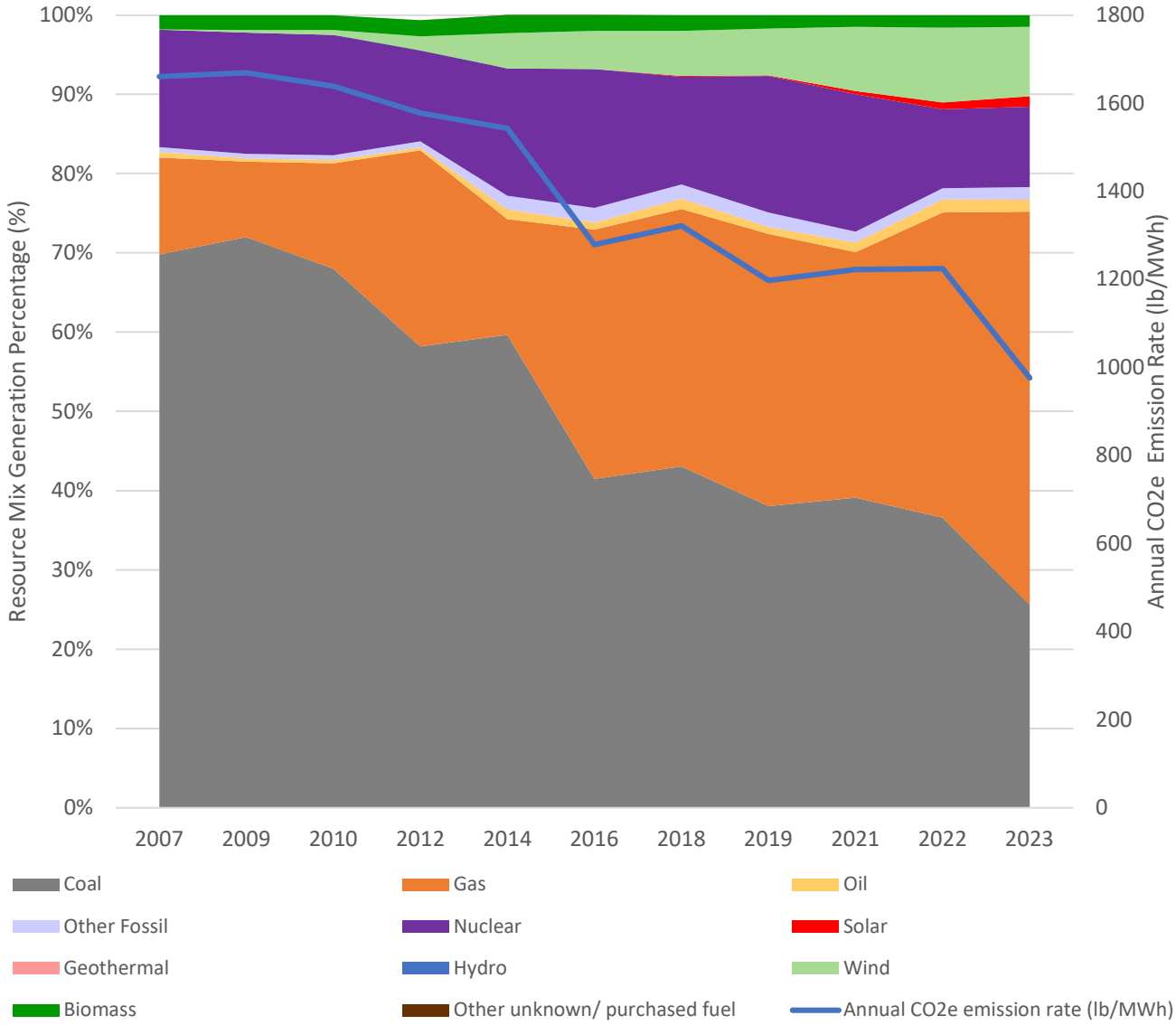


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 51 percent of carbon emissions are attributed to natural gas and 49 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 44 tCO2e (campus-level Scope 1) and 43 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 86 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for Children's Village G are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Children's Village G					**Electric EUI:**	28	kBTU/SF/yr
GFA:	11,874	SF				**Gas EUI:**	69	kBTU/SF/yr
eGRID Subregion:	RFCM					**Current EUI**	97	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	96,120	kWh	3.412	328	0.0004427	43	$10,573	73%
Natural Gas	729	MCF	1.038	822	0.0549206	44	$3,945	27%
		Totals		1,150		86	$14,518	100%

According to the US EPA, the average site energy use intensity for a residence hall is 57.9 kbtu/SF/yr. The total EUI for the existing condition of the building is calculated as 97 kBTU/SF, which is significantly higher than the national benchmark. It's important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison indicates there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Counseling Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient

3.8 End Use Distribution

Table 8 shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees and residents. Table 8 and Figure 7 and Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	714	0	741,577	62	39
Space Cooling	25,838	0	0	88,161	7	11
Fans	44,305	0	0	151,168	13	20
Pumps	1,210	0	0	4,129	0	1
SHW/DHW	0	78	0	80,652	7	4
Conveyance	0	0	0	0	0	0
Lighting	18,567	0	0	63,350	5	8
Plug Loads	4,689	0	0	15,998	1	2
Process Loads	1,511	0	0	5,155	0	1
Refrigeration	0	0	0	0	0	0
Cooking	0	0	0	0	0	0
Information Technology	0	0	0	0	0	0
TOTAL	96,120	792	0	1,150,190	97	86
Historical Billing	96,120	**792**	0			
Percent of Actual	100%	100%	0%			
per sqft	8.1	**0.1**	0			

Figure 7: Existing Electricity End Use Distribution

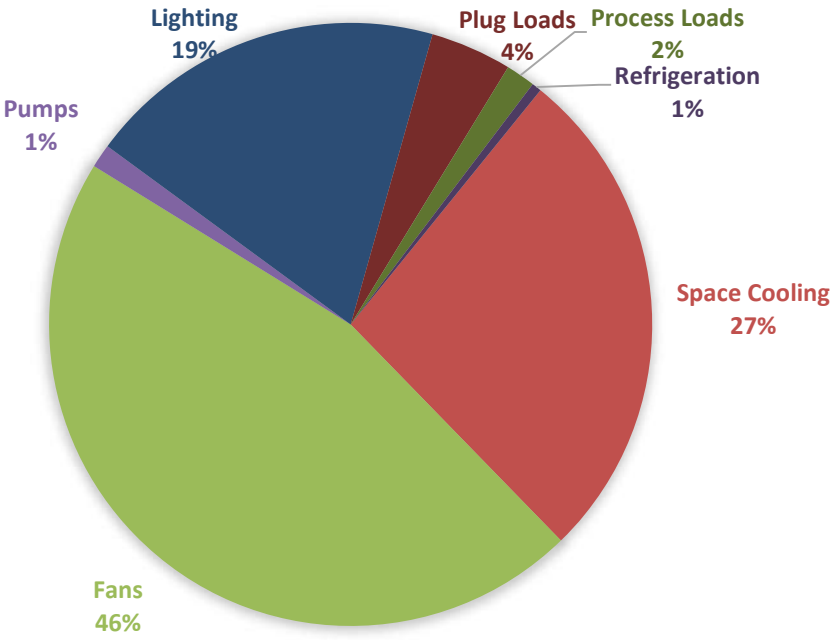
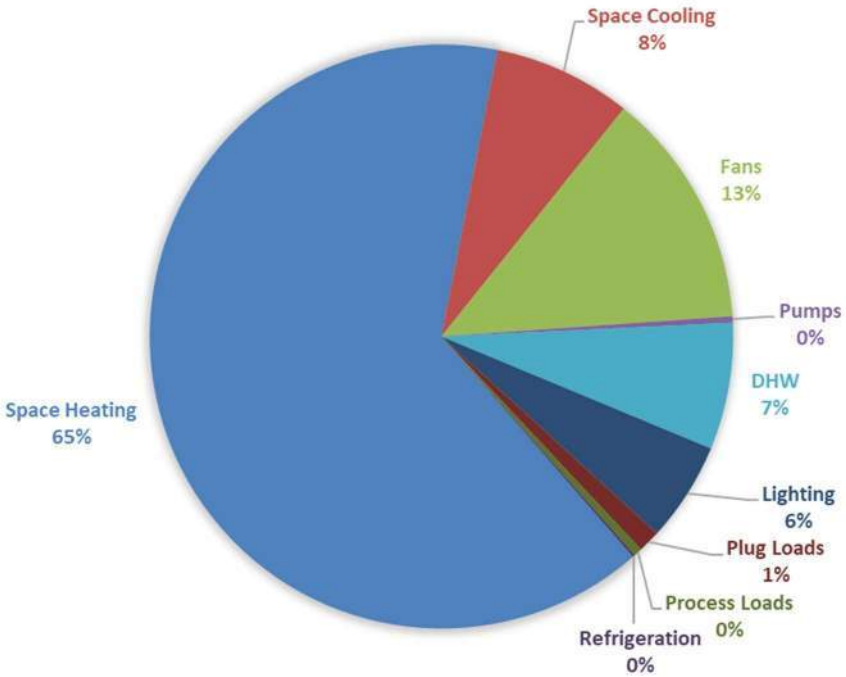


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable when bundled together but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure, but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 - HVAC Upgrades

Upgrading outdated HVAC systems, such as constant volume multi-zone and dual-duct systems, to modern single-duct variable air volume (VAV) systems is a highly effective energy conservation measure. VAV systems dynamically adjust airflow and temperature based on real-time demand, significantly reducing energy consumption compared to older, less efficient systems that operate at constant output levels. This upgrade not only enhances energy efficiency but also improves indoor air quality and thermal comfort for occupants. Implementing this measure as part of a routine capital upgrade ensures the integration of modern energy-efficient equipment into the facility's infrastructure, maximizing the overall benefit and lifecycle performance of the new systems.

The single approximately 14,000 CFM dual-duct AHU and its pneumatic controls are outdated and beyond its expected useful life. This system is due for a routine capital upgrade. The paired 28-ton split-AC condensing unit and condensing hot water boiler are still in good operating condition. A single-duct VAV AHU system with modern DDC controls should be installed to optimize energy use and comfort. This ECM includes upgrading controls and retro-commissioning.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- HVAC equipment identified is due for routine end-of-life replacement.
- Assumes upgrading the AHU to a VAV AHU with a high-efficiency split-AC condensing unit and using existing hot water heating. Assumes system is “electrification-ready” with hot water coils.
- This measure assumes energy savings due to the adjustment of constant volume 100% fan speed to an average of 75% fan speed and assumes minor cooling and heating savings associated with the variable airflow.
- Project cost is estimated at $6/CFM, $1500/ton, and $3 per square foot of building area (11,849 SF) for controls work.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Conduct a thorough assessment of the existing HVAC systems to determine the scope of upgrades required. Following this, detailed planning and design should be undertaken to ensure the new systems are appropriately sized and configured to meet the building’s specific needs. This should include ensuring the new system is “electrification-ready” such that it either uses hot water for heating and/or is a dual-fuel heat pump that can use either source as the RFCM grid emissions improve or Oakland County renewable energy procurement makes it more favorable to use electricity over gas for heating to meet decarbonization goals. This process should be integrated into the facility’s routine capital upgrade schedule to optimize the benefits of the new equipment and ensure seamless implementation along with other county priorities. This ECM should be implemented simultaneously with other small buildings to reduce costs.

ECM Savings and ROM Cost:

Table 9: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MMBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**Annual O&M Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
HVAC Upgrades	70	28,546	170	16	$3,489	$0	$131,496	38
Overall % Reduction	9%	30%	15%	19%	24%		--	--

4.2 ECM 2 – Low Flow Fixtures

Domestic hot water systems provide heated water for uses such as handwashing, cleaning, showering, cooking, and laundry. This can represent a significant portion of a building's overall energy usage. Maintaining proper water temperature and control is not only critical for energy efficiency but also for health and safety – temperatures must be 140F to prevent bacteria growth such as Legionella, yet low enough to prevent scalding and prevent excessive energy use. This measure proposes upgrading faucets to low-flow fixtures to reduce water and energy to meet existing hot water demand.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Energy savings assumes approximately 15% reduced hot water usage.
- Assumes approximately 5 fixtures upgraded.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Survey the number and type of fixtures requiring replacement. Coordinate with a contractor to procure and install fixtures. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 10: ECM 2 Savings and ROM Cost

	Savings Summary							
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MMBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**Annual O&M Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
Low Flow Fixtures	19	0	20	1	$97	$0	$1,250	13
Overall % Reduction	2%	0%	2%	1%	1%		--	--

5 Measure Requiring Additional Consideration

5.1 Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent. Building G does not currently have modern controls at this time, but it is anticipated ECM 1 will be implemented as the main dual-duct AHU is beyond its useful life and due for routine replacement. This can be completed for existing systems or combined with the HVAC and controls upgrade recommended in ECM 1. Due to the need for a routine capital upgrade, it's recommended to include RCx and optimization sequences as part of a routine capital upgrade for the dual-duct AHU.

The following list represents RCx opportunities that should be evaluated to validate operation, modify and/or repair if discrepancies identified if systems not scheduled for timely replacement. This effort will proactively improve building system operation and optimize energy usage.

- Optimize HVAC scheduling in non 24/7 occupied spaces
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water supply reset
- Discharge air setpoint reset
- Outside air temperature lockouts
- Outside air damper control
- Duct static pressure reset
- Repair airside or waterside economizing
- Demand-controlled ventilation
- Upgrade pneumatic controls to direct-digital controls (DDC) and integrate with BAS

ECM Savings and ROM Cost:

Table 11: Savings and ROM Cost

	Savings Summary							
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Annual O&M Savings ($)	Est Project Cost	Simple Payback (Yrs)
Retro-Commissioning	36	3,568	49	3.5	$570	$0	$11,874	21

5.2 Upgrade Pneumatic Controls to DDC

Pneumatic controls upgrades refers to the process of upgrading antiquated pneumatic control systems and components to direct digital controls (DDC) and integrating it with a centralized control system. Pneumatic controls use compressed air to operate valves and dampers and are prone to operational and maintenance issues. Upgrading these antiquated controls to DDC will enhance the overall efficiency, functionality, and manageability of HVAC system operation. This measure directly produces electricity savings by eliminating the need for a compressed air system, but also indirectly contributes additional energy savings by enabling better control and functionality such as scheduling and optimization. The main dual-duct AHU in this building has outdated pneumatic controls for all components. A 1.5 HP air compressor provides compressed air to the system to control the AHU. This measure is not recommended as a standalone measure due to the age and condition of the dual-duct AHU and need for a routine upgrade. The controls upgrade will be included in ECM 1.

ECM Savings and ROM Cost:

Table 12: Savings and ROM Cost

	Savings Summary							
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Annual O&M Savings ($)	Est Project Cost	Simple Payback (Yrs)
Upgrade Pneumatic Controls	0	4,189	14	2	$461	$0	$35,622	77

5.3 Building Envelope Improvements

Effective insulation and a well-sealed building envelope are critical for managing the transfer of heat between the exterior and interior environments. In Michigan, where seasonal temperature variations can be significant, improving building envelope integrity not only reduces energy consumption for heating and cooling but also helps maintain a consistent and comfortable indoor environment for staff, residents, and visitors. In addition to insulation, proper vapor sealing prevents moisture intrusion and minimizes indoor air quality issues related to high humidity. As building energy codes and insulation standards have evolved, older buildings can greatly benefit from upgrades that align with modern requirements, enhancing their energy efficiency. This measure includes building envelope improvements such as sealing air gaps around points of infiltration, adding insulation into the attic, and upgrading windows to double-pane windows. These steps not only reduce energy usage and associated emissions but also lower heating capacity requirements, making them an essential precursor to any major HVAC system upgrades. While this measure is beneficial to reduce the energy load and minimize infiltration, it has a poor payback as a standalone project. These envelope improvements should be considered as part of a comprehensive building renovation project.

ECM Savings and ROM Cost:

Table 13: ECM 2 Savings and ROM Cost

	Savings Summary							
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Annual O&M Savings ($)	Est Project Cost	Simple Payback (Yrs)
Building Envelope Improvements	62	394	66	4	$353	$0	$57,600	163

6 Appendix A

Table 14: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	132	$809	4,560	$489	6	8	1,051	0
Feb-23	139	$812	6,000	$565	9	11	955	0
Mar-23	144	$438	6,600	$592	9	14	918	0
Apr-23	94	$326	7,080	$623	10	16	525	28
May-23	34	$101	8,160	$644	11	18	283	76
Jun-23	13	$31	20,280	$1,519	28	44	86	139
Jul-23	13	$52	120	$10	0	0	11	227
Aug-23	11	$31	9,720	$772	13	19	48	141
Sep-23	16	$46	8,640	$795	12	20	113	85
Oct-23	67	$193	7,920	$644	11	17	415	31
Nov-23	113	$420	6,960	$534	10	16	779	0
Dec-23	108	$531	6,000	$426	8	10	834	0
Jan-24	183	$804	7,440	$172	10	13	1,194	0
Feb-24	130	$706	6,240	$638	9	12	874	1
Mar-24	110	$621	18,600	$1,501	25	40	771	2
Apr-24	59	$123	6,840	$600	13	21	437	21
May-24	24	$49	9,240	$236	12	20	148	98
Jun-24	10	$32	840	$77	1	2	51	207
Jul-24	8	$25	9,840	$877	13	18	18	251
Aug-24	6	$14	8,280	$761	11	16	37	215
Sep-24	9	$21	9,600	$770	13	22	84	112
Oct-24	47	$126	8,160	$775	11	18	356	31
Nov-24	61	$212	4,440	$479	6	10	607	4
Dec-24	146	$325	6,600	$555	9	11	1,037	0
2023 Sum	882	$3,790	92,040	$7,613			6,019	727
2024 Sum	792	$3,058	96,120	$7,441			5,614	942

7 Appendix B

Table 15: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Efficiency	Capacity 2	Approx. Year Installed
AHU	1	Air Handling Unit (Dx, HHW)	AHU	Trane	LZ-31 K3G243479	14,000 CFM		20 TON	
ACCU	1	Air cooled condensing unit	ACCU	York	YCAL0028EE28XEBSDTX HXXRLXXXX44XX1XXXX XX1XXXXXNB1XXXX	28 TON	92%		2012
N/A	1	HHW Boiler	N/A	Mach Series	Model C-450	414 MBH	82%		2007
N/A	1	Domestic hot water tank	N/A	Lochnivar	RJS120	119 GAL			2022
N/A	1	Domestic water heater	N/A	Lochnivar	RWN160	360 MBH			
AC	1	Air compressor	AC	JCI Pureflow	AS-015-132	1.5 HP			
HHWP	1	Heating Hot Water Pump	HHWP	Baldor					

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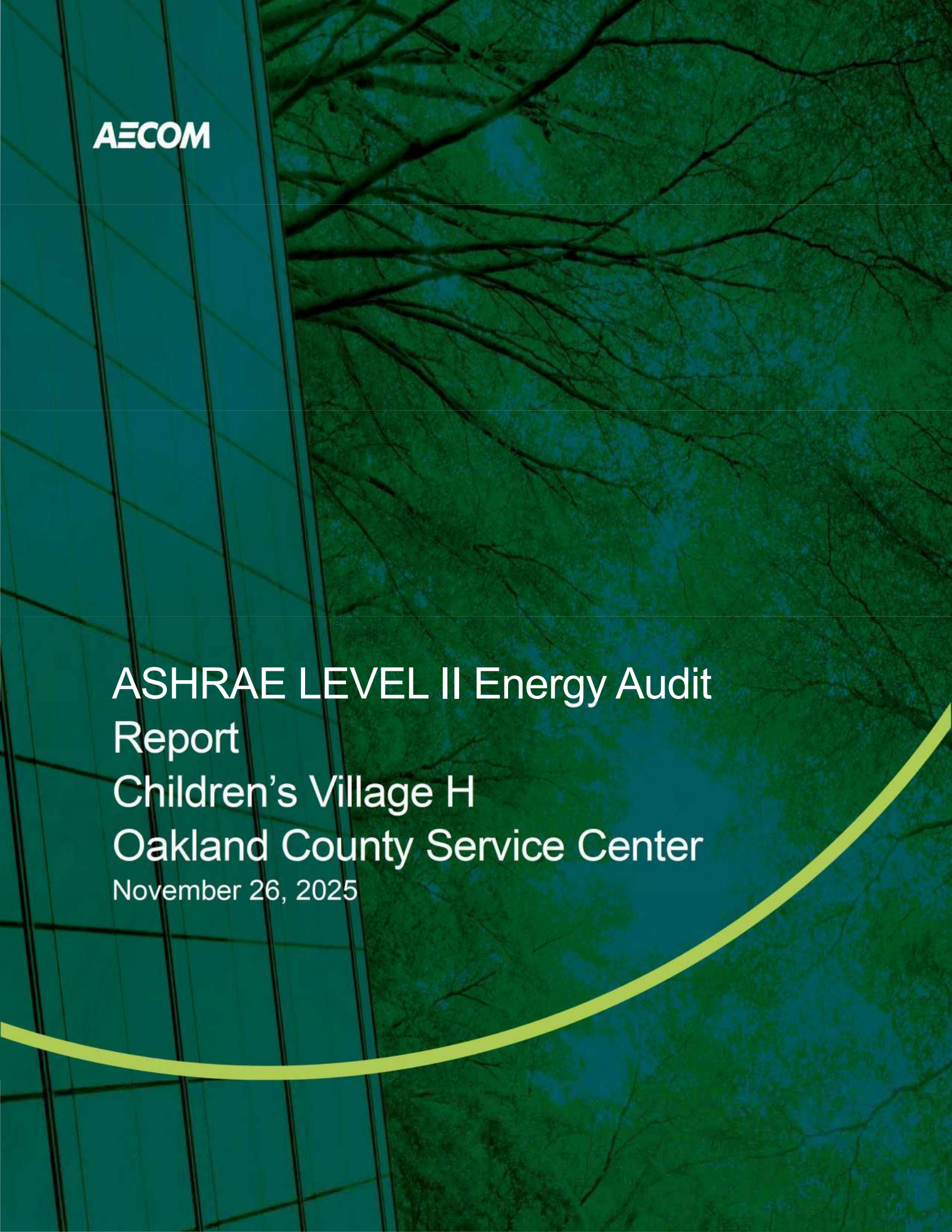

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ASHRAE LEVEL II Energy Audit Report
Children's Village H
Oakland County Service Center

November 26, 2025

Quality information

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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Children's Village H Building in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County Children's Village is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Wednesday April 16, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates four Energy Conservation Measures (ECMs) for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The recommended measure represents a projected 28% annual energy cost savings with an aggregate simple payback of 36 years. The recommended measure is a comprehensive measure which includes retro-commissioning and controls upgrades.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be "electrification-ready" to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE's prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Children's Village Building H Proposed Energy Savings Summary

Energy Conservation Measures												
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	tCO2e	$/yr	$	Years
1	HVAC Upgrades (Controls + RCx)	H	R	67,943	1	220	0	460	42	$8,570	$311,568	36
Sum of Recommended Measures				**67,943**	**1**	**220**	**0**	**460**	**42**	**$8,570**	**$311,568**	**36**
Overall % Reduction				**32%**	**2%**	**15%**	**0%**	**20%**	**24%**	**28%**	**-**	**-**
2	Retro-Commissioning	N/A	NR	8,206	0	70	0	102	8	$1,258	$7,757	6
3	Upgrade Pneumatic Controls to DDC	N/A	NR	2,989	1	0	0	10	1	$329	$58,176	177
4	Building Envelope Improvements	N/A	NR	651	0	68	0	73	4	$413	$57,400	139

Notes
Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed
No O&M savings are included, assuming that current O&M labor is minimal and any new system will require additional O&M budget to guarantee optimum performance.

2 Existing Conditions and Observations

The Children's Village, a detention facility, functions as a residential center for juvenile detainees, offering a structured environment that supports their education during rehabilitation. The H Building within this complex was built in 1974 and is used as shelter care. The concrete masonry unit (CMU) building features a beige brick veneer and is one story, with an attic. The insulation in the attic is expected to be min R20.

The H Building can accommodate up to 8 children and 8 employees. Each child is taken care of by one employee who assists with their education during their detention period. The children have concluded their initial phase of treatment and are no longer required to remain in full detention. The building includes a TV room, office spaces, a dining room, two server racks in the electrical room, and a kitchen. This facility prepares the children to reintegrate into social life seamlessly.

2.1 Building Systems

2.1.1 Building Envelope

The building has two above-grade and one below-grade floor. The window/wall ratio is estimated to be about 25%. The windows appear to be in good condition; however, they are single-pane windows and are assumed to be original to the building.

The walls are CMU structures with brick veneer on the exterior. There is no insulation on the interior side behind the drywall. The attic was not accessible, and the insulation levels are unknown at this stage.

Table 2. Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	CMU with brick veneer	Good
Roof	Insulation in the attic	Good
Glazing	Single pane, aluminum frame, tinted windows are original, 10% window/wall ratio	Good

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

A PK Mach boiler, installed in 2007, provides heating with a peak capacity of 712 MBH. The hot water boiler is in good operating condition.

One air handling unit (AHU) serves eleven zones controlled by pneumatic damper actuators. The zones are split on the AHU unit with hot and cold deck configuration. The AHU is served by a direct exchange (DX) coil and a hot water heating coil. The 36-ton split-AC condenser unit, installed in 2001, is located on the roof and in poor operating condition. The AHU and split-AC condenser unit are due for routine upgrade.

2.1.2.2 Plumbing

A 119-gal Lochinvar indirect water heater, installed in 2018, supplies domestic hot water. A boiler installed in 1990 supplies hot water to the indirect water heater. A 1/6 HP Bell Gossett pump constantly circulates hot water in the building. The domestic water distribution infrastructure is equipped with mixing valves in the restrooms. It's recommended to always store hot water above 140°F to eliminate Legionella bacteria growth.

2.1.2.3 Building Controls

The building systems are controlled by a pneumatic system serving damper actuators. All pumps and fans are equipped with constant-speed motors. The lighting systems are manually controlled.

2.1.3 Lighting Systems

During the site visit, lighting fixtures were observed to vary based on room layout. Fixtures were either recessed, ceiling-mounted, or suspended. All fixtures are LED rated at 12W.

Table 3. Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
LED Lights	136	2 lamp
LED Lights	18	1 lamp

The total approximate quantity of light fixtures is 152 with an approximate total wattage of 3,276 watts. The approximate area per drawing is 19,392ft² and calculated lighting density is approximately 0.16 W/ft².

2.1.4 Electrical Infrastructure

The site is served by a 150 kVA, 208/120 V transformer located outside the building. The meter is not available at this location, and no main service rating data (voltage, amperage, or phase) could be confirmed during the visit. The storage room was locked Main Switchboard (MSB) and electrical panel data are not available. Backup power is provided by a 150 kW diesel generator.

3 Utility Billing Analysis

3.1 Utility Type and Usage

Children's Village Building H receives electric service, natural gas service, and is not connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

Table 4 summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

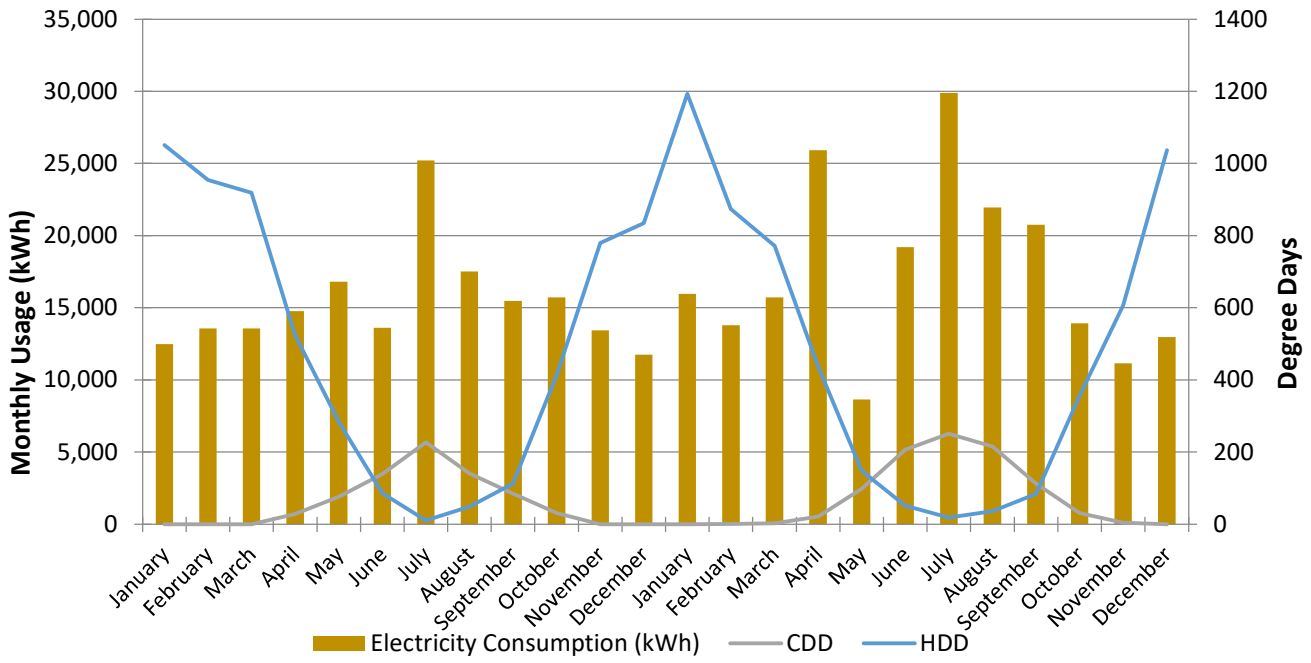
Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	209,880 kWh	716	$23,087	$0.11	0.0004427	93
Natural Gas	1,481 MCF	1,534	$7,363	$4.98	0.05294	81
Total	**--**	**2,250**	**$30,449**	**--**	**--**	**174**

**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a slight correlation to CDD, indicating some cooling usage in the summer months, however the majority of electricity usage consists of baseload usage. This usage does not vary much from month to month and includes loads such as lighting, fans, and pump loads. The annual usage for the baseline 12-month period from January to December 2024 is 209,880 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

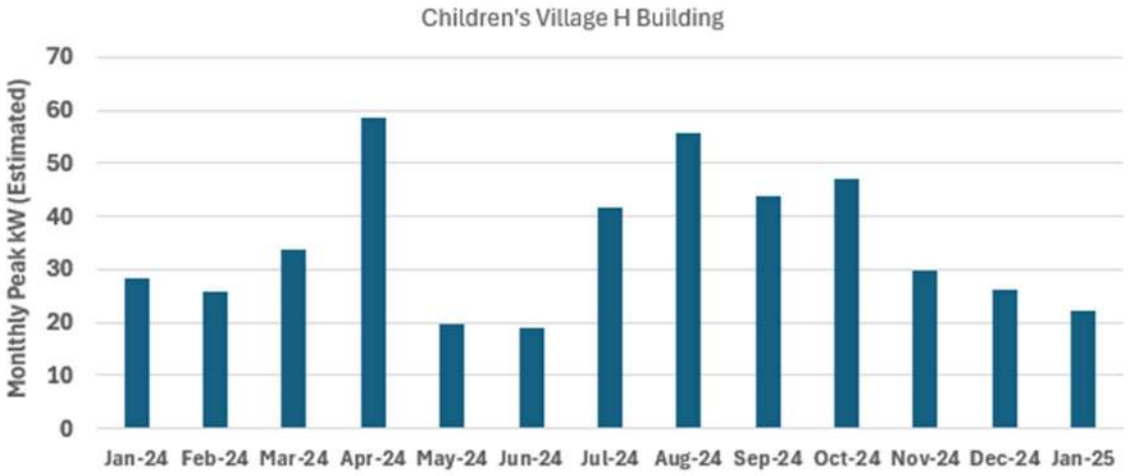
The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 5. Electric Capacity Results

Maximum Building Capacity at Service Transformer	150 kW
Maximum Capacity at Switchgear (A*V*Ph)	NA kW
Estimated Peak Demand	59 kW (estimated)
Remaining Capacity	**91 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge:	**$0.057/kWh**
DTE Electric Demand Charge:	**$6.15/kW/Month**
Average Dollar per kWh Used in Calculations:	**$0.11/kWh**

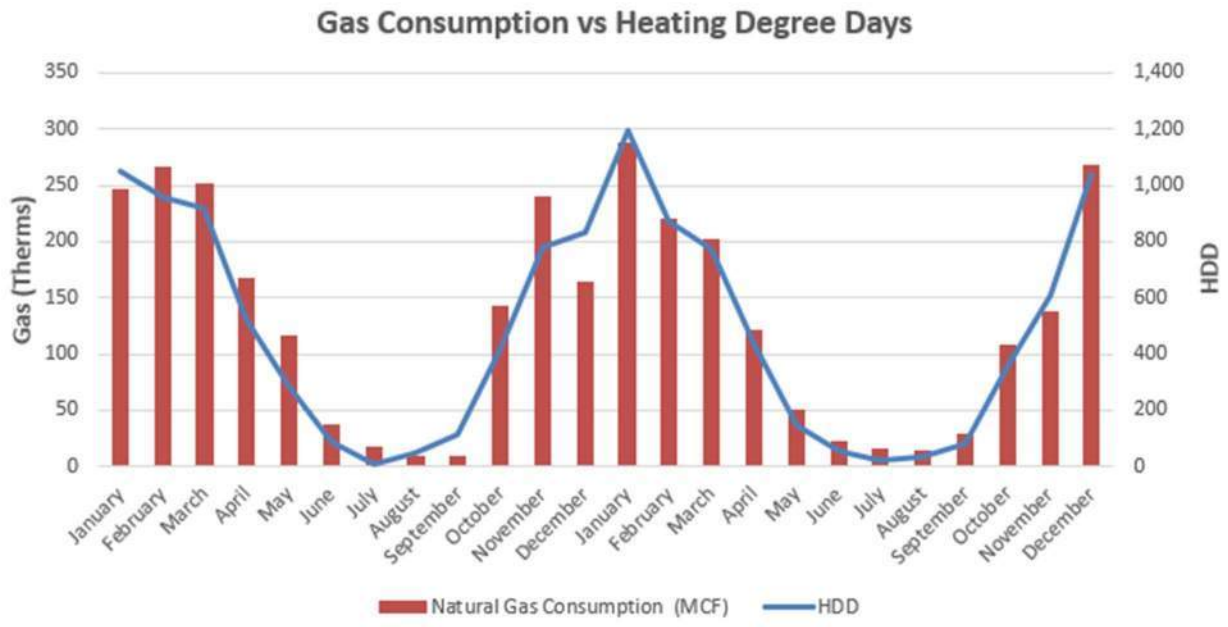
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows a direct correlation to weather data, as natural gas is primarily used for space heating. However, since this is a 24/7 occupied facility there is baseload summer usage due to domestic hot water usage for bathrooms, showers, and cleaning. The annual usage for the baseline 12-month period from January to December 2024 is 1,481 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for

supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: **$1.33/MCF (1,038,000 BTU)**

Constellation NG Usage Charge (fixed Fee): **$3.48/dTh (1,000,000 BTU)**

Constellation NG Usage Charge (Day Gas): **$5.29/dTh (1,000,000 BTU)**

Average Dollar per MCF Used in Calculations: **$4.98/MCF**

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$23,087
Natural Gas	$7,363
Total	$30,449
ECI $/yr/sf	$1.57

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO_2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

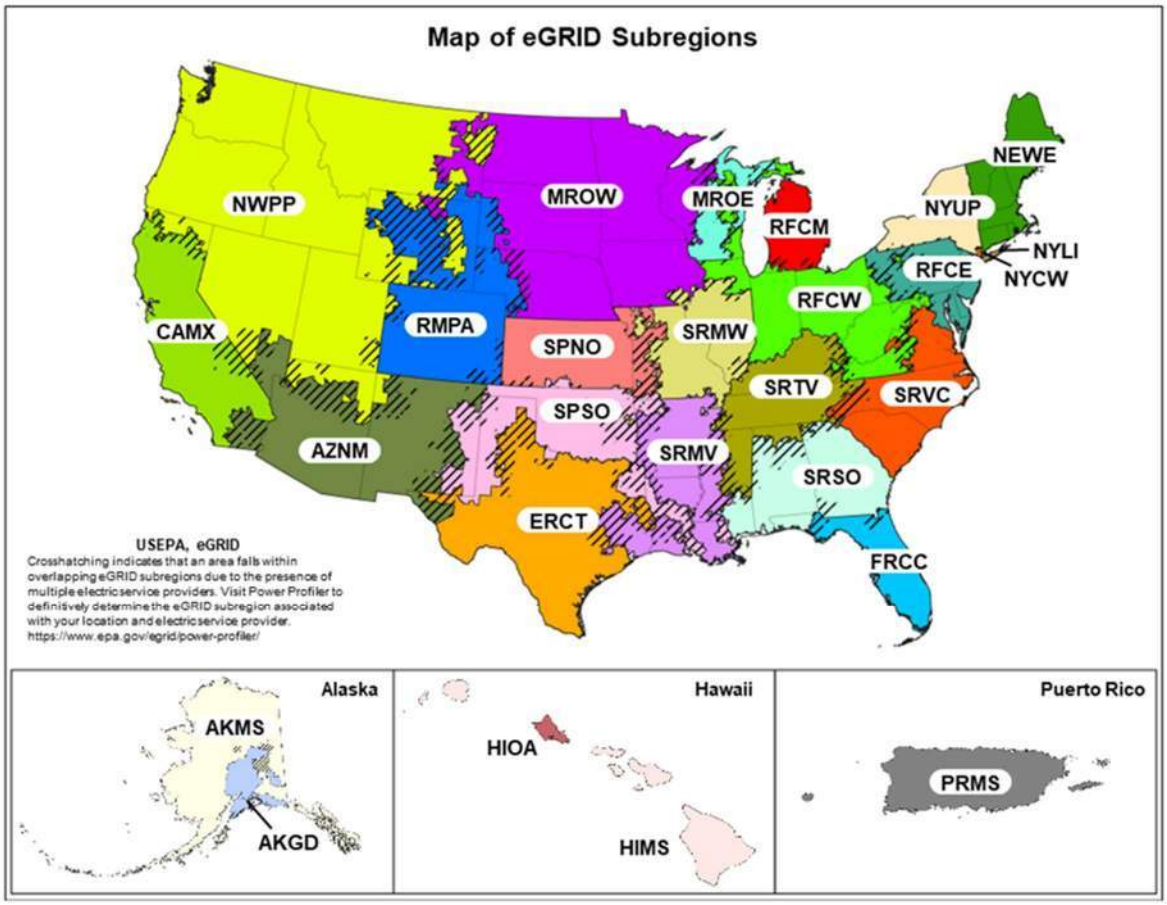
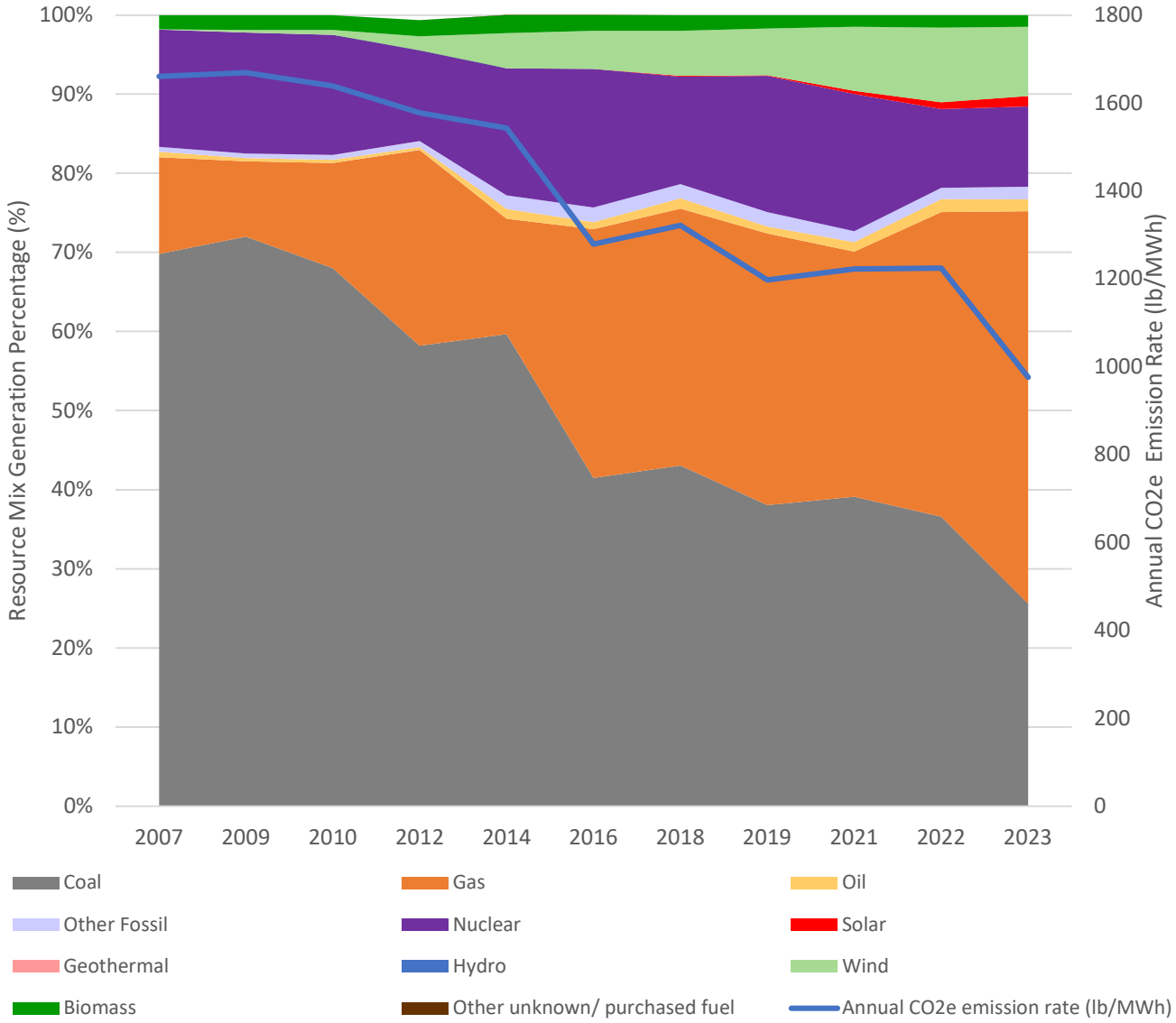


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 47 percent of carbon emissions are attributed to natural gas and 53 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 81 tCO2e (campus-level Scope 1) and 93 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 174 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for Children's Village H are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Children's Village H					**Electric EUI:**	37	kBTU/SF/yr
GFA:	19,392	SF				**Gas EUI:**	79	kBTU/SF/yr
eGRID Subregion:	RFCM					**Current EUI**	116	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	209,880	kWh	3.412	716	0.0004427	93	$23,087	76%
Natural Gas	1,481	MCF	1.038	1,534	0.05294	81	$7,363	24%
Steam	0	klbs	1194	0	0.0000076	0	$0	0%
		Totals		**2,250**		**174**	**$30,449**	**100%**

According to the US EPA, the average site energy use intensity for a residence hall is 57.9 kbtu/SF/yr. The total EUI for the existing condition of the building is calculated as 116 kBTU/SF, which is significantly higher than the national benchmark. It's important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison indicates there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Counseling Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient

3.8 End Use Distribution

Table 8 shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees and residents. Table 8 and

Figure 7 and Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	1,426	0	1,480,131	76	78
Space Cooling	73,086	0	0.	249,369	13	32
Fans	88,610	0	0	302,336	16	39
Pumps	2,420	0	0	8,258	0	1
SHW/DHW	0	52	0	53,739	3	3
Conveyance	0	0	0	0	0	0
Lighting	15,855	0	0	54,097	3	7
Plug Loads	25,921	0	0	88,442	5	11
Process Loads	2,989	0	0	10,197	1	1
Refrigeration	1,000	0	0	3,412	0	0
Cooking	0	0	0	0	0	0
Information Technology	0	0	0	0	0	0
TOTAL	**209,880**	**1,478**	**0**	**2,249,981**	**116**	**174**
Historical Billing	209,880	1,478	0			
Percent of Actual	100%	100%	0%			
per sqft	10.8	0.8	0			

Figure 7: Existing Electricity End Use Distribution

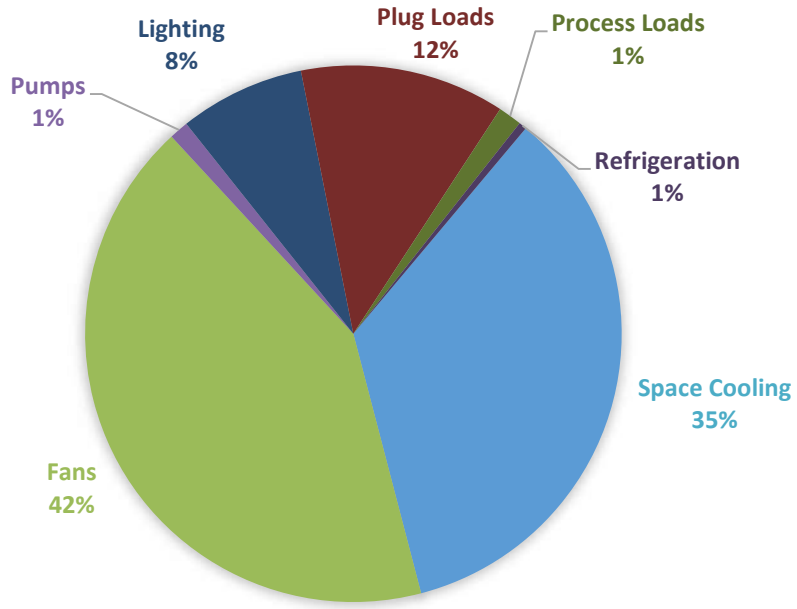
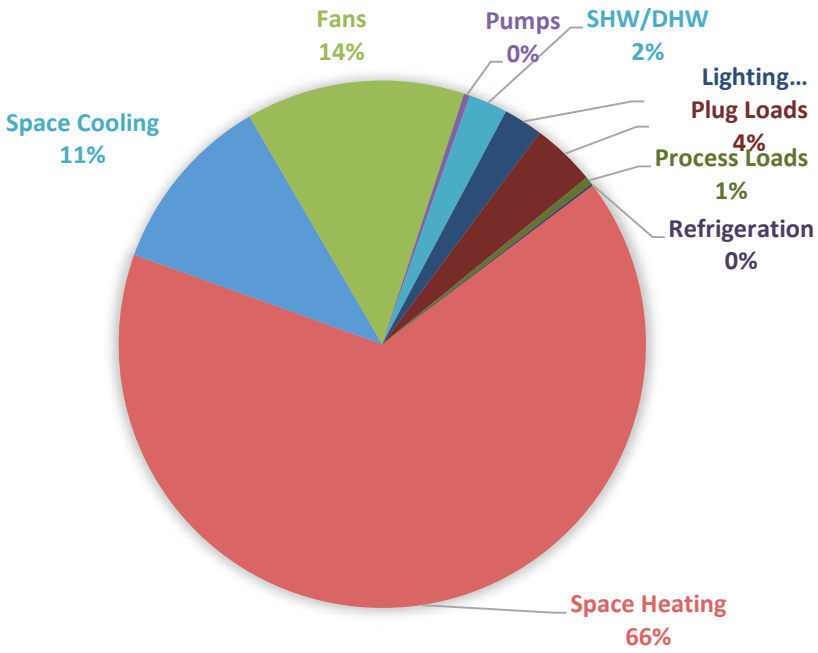


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable when bundled together but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 4 - HVAC Upgrades

Upgrading outdated HVAC systems, such as constant volume multi-zone and dual-duct systems, to modern single-duct variable air volume (VAV) systems is a highly effective energy conservation measure. VAV systems dynamically adjust airflow and temperature based on real-time demand, significantly reducing energy consumption compared to older, less efficient systems that operate at constant output levels. This upgrade not only enhances energy efficiency but also improves indoor air quality and thermal comfort for occupants. Implementing this measure as part of a routine capital upgrade ensures the integration of modern energy-efficient equipment into the facility's infrastructure, maximizing the overall benefit and lifecycle performance of the new systems.

The dual-duct AHU and its pneumatic controls and paired 36-ton split-AC R-22 condenser unit are outdated and beyond its expected useful life. This system is due for a routine capital upgrade. The condensing hot water boiler is still in good operating condition. A single-duct VAV AHU system and high-efficiency condenser unit with modern DDC controls should be installed to optimize energy use and comfort. This ECM includes upgrading controls and optimizing control sequences.

Assumptions:

- Implementation of this measure will improve occupant health or safety.
- HVAC equipment identified is due for routine end-of-life replacement.
- Assumes upgrading the AHU and split-AC condensing unit to a VAV AHU with a high-efficiency split-AC condensing unit and using existing hot water heating. Assumes system is "electrification-ready" with hot water coils.
- This measure assumes energy savings due to the adjustment of constant volume 100% fan speed to an average of 75% fan speed and assumes cooling savings from modern high efficiency condensing unit and minor heating savings due to the variable airflow system.

- Costs assume $6.00/CFM and $1,500/ton for new HVAC design, construction, and commissioning.
- No O&M savings are included, assuming that current O&M labor is minimal and any new system will require additional O&M budget to guarantee optimum performance.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Conduct a thorough assessment of the existing HVAC systems to determine the scope of upgrades required. Following this, detailed planning and design should be undertaken to ensure the new systems are appropriately sized and configured to meet the building's specific needs. This should include ensuring the new system is "electrification-ready" such that it either uses hot water for heating and/or is a dual-fuel heat pump that can use either source as the RFCM grid emissions improve or Oakland County renewable energy procurement makes it more favorable to use electricity over gas for heating to meet decarbonization goals. This process should be integrated into the facility's routine capital upgrade schedule to optimize the benefits of the new equipment and ensure seamless implementation along with other county priorities.

ECM Savings and ROM Cost:

Table 9. ECM 1 Savings and ROM Cost

	Savings Summary							
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
HVAC Upgrades	220	67,943	460	42	$0	$8,570	$311,568	36
Overall % Reduction	**15%**	**32%**	**20%**	**24%**		**28%**	**--**	**--**

5 Measures Requiring Additional Consideration

This section provides details on measures that were analyzed but are not recommended for immediate implementation at this time. This includes measures that require further study, such as capital-intensive replacements of existing equipment, but are not justified through energy savings alone. This section may also include measures that conflict with building electrification plans, or projects that are simply not recommended due to being financially impractical or not being technically feasible.

Table 10. Measures Requiring Additional Consideration or Study

Measures Requiring Additional Study									
ECM #	Measure Description	Year -1 Electricity Savings	Demand Reduction	Year -1 Gas Savings	Total Energy Saved	Year - 1 GHG Savings	Year - 1 Cost Savings	Project Cost (Est)	Simple Payback Period
No	Description	kWh/yr	kW	MCF/yr	MMBTU	tCO2e	$/yr	$	Years
2	Retro-Commissioning	8,206	0	70	102	8	$1,258	$7,757	6
3	Upgrade Pneumatic Controls to DDC	2,989	1	0	10	1	$329	$58,176	177
4	Building Envelope Improvements	651	0	68	73	4	$413	$57,400	139

5.1 Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent. Building H does not currently have modern controls at this time, but it is anticipated ECM 1 will be implemented as main dual-duct AHU is beyond its useful life and due for routine replacement.

The following list represents RCx opportunities that should be evaluated to validate operation, modify and/or repair if discrepancies identified if systems not scheduled for timely replacement. This effort will proactively improve building system operation and optimize energy usage.

- Optimize HVAC scheduling in non 24/7 occupied spaces
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water supply reset

- Discharge air setpoint reset
- Outside air temperature lockouts
- Outside air damper control
- Duct static pressure reset
- Repair airside or waterside economizing
- Demand-controlled ventilation
- Upgrade pneumatic controls to direct-digital controls (DDC) and integrate with BAS

RCx is not recommended as a standalone measure because the main dual-duct AHU and pneumatic control system are at the end of their useful life and are anticipated to be replaced under the recommended HVAC upgrade ECM. The intent is to incorporate RCx activities into the HVAC retrofit scope once new DDC controls are in place, rather than invest in commissioning an aging pneumatic system that is slated for near-term replacement.

5.2 ECM 2 - Upgrade Pneumatic Controls to DDC

Pneumatic controls upgrades refers to the process of upgrading antiquated pneumatic control systems and components to direct digital controls (DDC) and integrating it with a centralized control system. Pneumatic controls use compressed air to operate valves and dampers and are prone to operational and maintenance issues. Upgrading these antiquated controls to DDC will enhance the overall efficiency, functionality, and manageability of HVAC system operation. This measure directly produces electricity savings by eliminating the need for a compressed air system, but also indirectly contributes additional energy savings by enabling better control and functionality such as scheduling and optimization. The one dual-duct AHU in this building has outdated pneumatic controls for all components. A 1.5 HP air compressor provides compressed air to the system to control the AHU. This measure is not recommended as a standalone measure due to the age and condition of the dual-duct AHU and need for a routine upgrade. The controls upgrade will be included in ECM 1.

5.3 Building Envelope Improvements

Effective insulation and a well-sealed building envelope are critical for managing the transfer of heat between the exterior and interior environments. In Michigan, where seasonal temperature variations can be significant, improving building envelope integrity not only reduces energy consumption for heating and cooling but also helps maintain a consistent and comfortable indoor environment for staff, residents, and visitors. In addition to insulation, proper vapor sealing prevents moisture intrusion and minimizes indoor air quality issues related to high humidity. As building energy codes and insulation standards have evolved, older buildings can greatly benefit from upgrades that align with modern requirements, enhancing their energy efficiency. This measure includes building envelope improvements such as sealing air gaps around points of infiltration, adding insulation into the attic, and upgrading windows to double-pane windows. These steps not only reduce energy usage and associated emissions but also lower heating capacity requirements, making them an essential precursor to any major HVAC system upgrades. While this measure is beneficial to reduce the energy load and minimize infiltration, it has a poor payback as a standalone project. These envelope improvements should be considered as part of a comprehensive building renovation project.

6 Appendix A

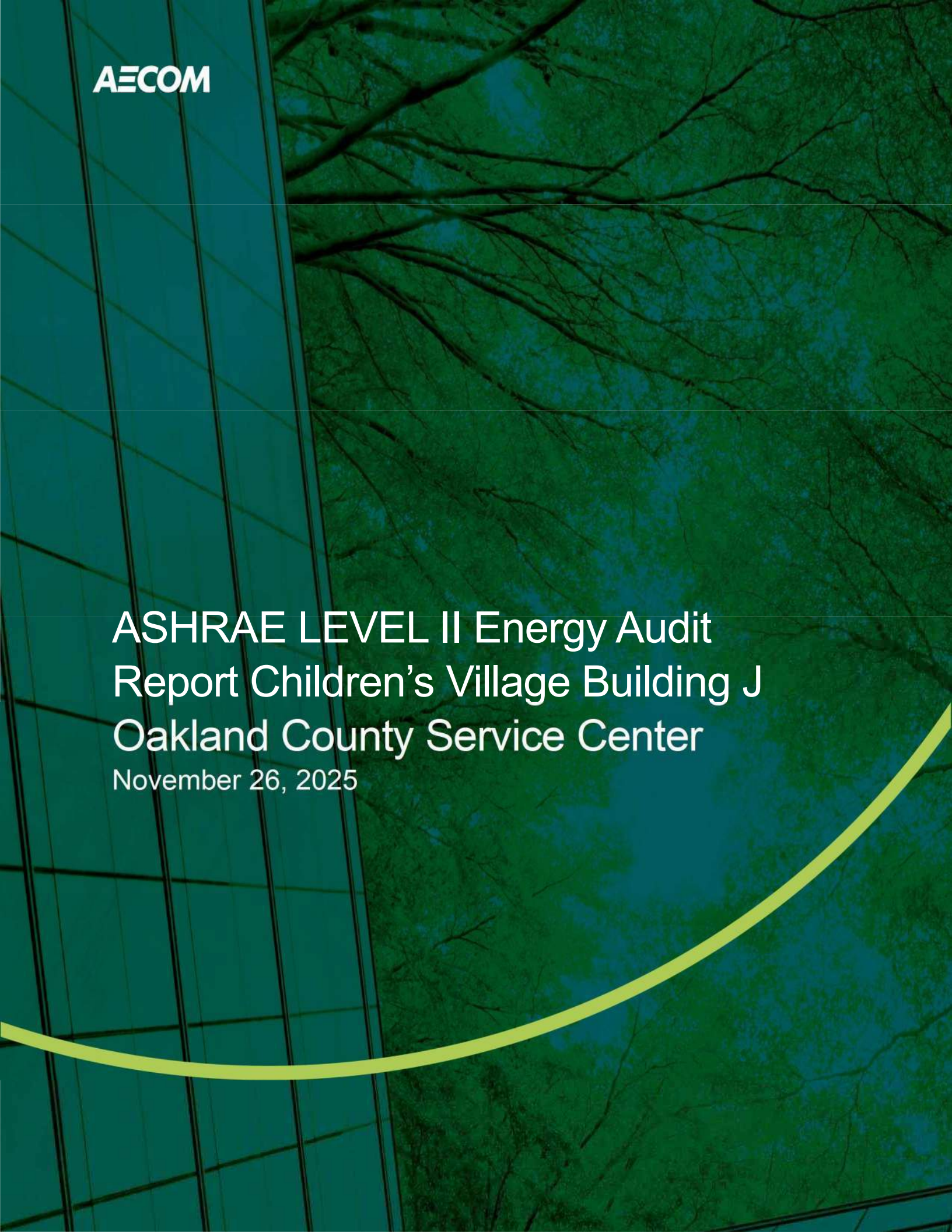
Table 11: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	246	$1,510	12,480	$1,339	17	22	1,051	0
Feb-23	267	$1,556	13,560	$1,277	20	25	955	0
Mar-23	251	$763	13,560	$1,216	18	29	918	0
Apr-23	168	$581	14,760	$1,299	21	33	525	28
May-23	116	$346	16,800	$1,325	23	37	283	76
Jun-23	38	$93	13,620	$10,202	19	30	86	139
Jul-23	18	$71	25,200	$2,040	34	47	11	227
Aug-23	10	$30	17,520	$1,392	24	35	48	141
Sep-23	10	$28	15,480	$1,425	22	35	113	85
Oct-23	142	$410	15,720	$1,279	21	34	415	31
Nov-23	240	$895	13,440	$1,032	19	31	779	0
Dec-23	165	$812	11,760	$835	16	20	834	0
Jan-24	288	$1,265	15,960	$368	21	28	1,194	0
Feb-24	220	$1,194	13,800	$1,411	21	26	874	1
Mar-24	203	$1,147	15,720	$1,268	21	34	771	2
Apr-24	122	$254	25,920	$2,274	36	59	437	21
May-24	51	$103	8,640	$1,377	12	19	148	98
Jun-24	22	$71	19,200	$1,764	27	42	51	207
Jul-24	17	$54	29,880	$2,662	40	56	18	251
Aug-24	15	$32	21,960	$2,019	30	44	37	215
Sep-24	29	$71	20,760	$1,665	29	47	84	112
Oct-24	108	$288	13,920	$1,322	19	30	356	31
Nov-24	138	$476	11,160	$1,204	16	26	607	4
Dec-24	269	$597	12,960	$1,090	17	22	1,037	0
2023 Sum	1,672	$7,095	183,900	$24,661			6,019	727
2024 Sum	1,481	$5,552	209,880	$18,424			5,614	942

7 Appendix B

Table 12: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Efficiency	Capacity 2	Approx. Year Installed	Condition
AHU	1	Air handling unit (HW, Dx)		Trane	LZ-41				2007 (not 1995)	
	1	Gas fired HHW boiler		PK Mach	C-750	750 MBH	92%		1998	Very old
	1	Domestic water heater		Lochnivar	RWN160	360 MBH	82%		2001	
ACU	1	Split system condensing unit		Carrier	38AKS044---500--	36 TON			2020	
DWH	1	Domestic hot water tank		Lochnivar	RJS120M000	119 GAL				
AC	1	Air compressor		JCI pureflow	A5-015-132	1.5 HP				
	1	HW Circulation Pump		B&G		1/6 HP				



AECOM

ASHRAE LEVEL II Energy Audit Report Children's Village Building J Oakland County Service Center

November 26, 2025

Quality information

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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Children's Village Building J in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based upon feasibility considerations.

All identified energy reduction opportunities have been characterized in this report as ECMs regardless of scope and scale of capital investment. Additionally, AECOM recognizes that Oakland County wishes to pursue the future electrification of its facilities to the extent practical, as described in AECOM's Service Center-wide assessment of future electrification options. The ECMs listed in this report address opportunities within existing conditions and existing energy infrastructure. The report's proposed ECMs may or may not be relevant to an energy infrastructure environment evolved from fossil fuel-driven energy infrastructure to fully electrically powered energy infrastructure.

The Oakland County Children's Village is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise its provisional report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from Oakland County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Wednesday April 16, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted field data collection and obtained additional information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team sought to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates six Energy Conservation Measures for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks of four recommended ECMs. Each measure is assigned a priority based upon implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The four recommended measures represent a projected 33% annual energy cost savings with an aggregate simple payback of 20 years. The simple payback is higher than a typical ECM payback due to the major capital upgrade required to extend the lifespan of the building systems. ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices.

This report focuses on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in a Service Center-wide electrification report. If immediate HVAC upgrades are necessary, the recommended upgrades should be "electrification-ready" to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE's prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy

[2] 2025 Program Rebate Catalog

Table 1: Children's Village Building J Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	MTCO2e	$/yr	$/yr	$	Years
1	LED Lighting	High	R	72,040	14	0	0	246	32	$2,874	$7,924	$70,520	7
2	Building Envelope Improvements	Med	R	0	0	135	0	140	7	$0	$672	$31,200	46
3	HVAC Upgrades	High	R	98,407	2	646	0	1,007	79	$6,760	14,048	$580,000	28
4	Variable Frequency Drives for Pumps	Med	R	20,307	0	0	0	69	9	$0	$2,234	$4,500	2
			Sum	190,753	16	781	0	1,462	127	$9,634	$24,878	$686,220	20
Total				42%	17%	16%	0%	22%	27%		33%	-	-

Measures Requiring Additional Consideration													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	MTCO2e	$/yr	$/yr	$	Years
5	Retro-Commissioning	N/A	RS	3,532	0	3,358	0	348	19.3	$0	$2,000	$21,147	11
6	Upgrade Pneumatic Controls to DDC	N/A	RS	4,357	2	0	0	15	2	$11,500	$479	$134,570	281

Notes
Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Oakland County Children's Village, a detention facility, serves as a residential facility for juvenile detainees, providing a structured environment that supports the continuation of their education throughout the duration of their rehabilitation. The original J Building structure was erected between 1960 and 1970, with a subsequent addition constructed in the early 2000s.

The facility can hold 200 people: there were about 100 detainees during the site visit. The building comprises sleeping units, classrooms, admin office spaces, a gym, and a kitchen.

2.1 Building Systems

2.1.1 Building Envelope

The building has two above-grade and one below-grade floors. The window/wall ratio is estimated to be about 10%. The windows appear to be in good condition; however, they are single-pane windows and are assumed to be original to the building.

The CMU and poured concrete building is clad in a beige brick veneer and is predominantly two stories in height, with one section extending to three stories. There is no insulation on the interior side, with only bare CMU blocks. The roof insulation levels are unknown at this stage; however, it is assumed to be a minimum of R19 providing a moderate level of thermal resistance.

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	CMU with brick veneer	Good
Roof	Insulation above deck, black membrane	Good
Glazing	Low window/wall ratio double pane	Good

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

There are 11 air handling units (AHU) in total, nine original to the building and two that serve the New Section constructed in the 2000s. The old block has nine AHUs supplying conditioned air via constant volume (CV) AHUs, serving CV boxes at each thermal zone. The AHUs are controlled by pneumatic damper actuators.

Two natural gas condensing boilers, totaling 4000 MBH, provide heating to the AHUs, reheat, and baseboard heating systems, and one 170-ton air-cooled chiller provides chilled water to the AHUs.

Distribution throughout the building is provided by hot and chilled water pumps. Two 25 horsepower (HP) chilled water pumps provide variable volume chilled water. A 2 HP reheat pump provides hot water to AHU heating coils and VAV boxes located throughout the facility, and a 0.5 HP baseboard heating pump provides hot water to the perimeter heating baseboards.

Additional heating and cooling systems are located throughout the facility. A unit heater provides heating to mechanical and electrical room (MER). Two mini-splits installed in 2014 serve the server rooms. They are in good operating condition.

The heating of the building is taken care of by two condensing boilers 1,923,000 BTUh capacity each. One baseboard heater pump and one reheat coil pump, both in old condition are used to pump heating hot water (HHW) to the respective terminal units. Baseboard pump has a 0.5 HP motor and carries 35 Gallon water and reheat pump has a 2 HP motor and carries 50-Gal water. Another very old Lochinvar HW boiler with no known capacity. There was a recent renovation that occurred in this building.

The cooling is taken care of by nine existing AHUs for the existing building and one new AHU for the addition. The heating and cooling capacity of each AHU is as follows:

Table 3: AHU Summary

AHU	Heating Capacity (MBH)	Cooling Capacity (MBH)
AHU-1	378	190
AHU-2	276	156
AHU-3	276	138
AHU-4	286	162
AHU-5	226	128
AHU-6	276	156
AHU-7	267	144
AHU-8	210	90
AHU-9	200	-
AHU-1 (new)	666	538

There are two split air conditioning (AC) units of 1 ton capacity each serving the data rooms in this building. There is 1 air cooled chiller of 170 tons providing chilled water at 44°F to the AHUs. There are two chilled water pumps driven by a 25 HP motor. The existing AHUs are towards the end of their useful life. There are eight exhaust fans with 2 HP total motor power requirement.

2.1.2.2 Plumbing

A condensing boiler heats the domestic hot water, and it enters a storage tank with a heating coil that maintains the temperature. A circulation pump constantly circulates hot water within the domestic hot water distribution infrastructure. The unit was installed in 2019 and appears in good condition. The water temperature in the tank was observed to be about 125°F. The storage temperature should be increased to 140°F to prevent legionella bacteria growth in the tank and provide a buffer during peak times. Although no energy savings will result from the change, it is

recommended to install a mixing valve on the supply side of the hot water tank and increase the water storage temperature to 140°F.

2.1.2.3 Building Controls

Some of the facility's equipment, particularly the new AHUs serving the building addition, are integrated into the Niagara BMS. While the majority of systems remain under pneumatic control or internal unit controls, the Niagara platform provides visibility and digital control over select newer equipment. Pneumatic actuators control the building except for the new AHUs serving the new block. The air and water distribution systems are constant volume. The heating and domestic hot water (DHW) boilers have their internal controls leading operation according to the local setpoints. Some exhaust fans are on timers.

2.1.3 Lighting Systems

During the site visit, lighting fixtures were observed to vary based on room layout, including recessed, ceiling mounted, and suspended types. Fluorescent fixtures are rated at 32W, while light emitting diode (LED) fixtures are rated at 12W. Lighting controls throughout the facility are manual, with no occupancy sensors present. All mechanical rooms and the basement have been fully converted to LED lighting. Overall, the lighting across the facility is approximately 60% LED and 40% fluorescent.

Based on the drawings, the lighting fixture counts are as follows:

Table 4: Lighting Summary

Total Fixtures	Lamps per Fixture
608	2 lamp
70	4 lamp
89	3 lamp
14	6 lamp
39	1 lamp

There are estimated to be 820 lighting fixtures, with the approximate total wattage being 34,432 watts. The building area per drawing is 64,081ft², and the calculated lighting density (W/ft²) is approximately 0.54 W/ft².

2.1.4 Electrical Infrastructure

The facility is served by a 750 kVA transformer located outside the building, supplying a main electrical service rated at 480/277 volts, 1200 amps, three-phase. The primary utility meter (No. 30885276) is situated in the basement electrical room. Demand data is 1.42 kW (mechanical room) and demand in electrical room shows a value of 13,829 kWh. Backup power is provided by two generators: an 85 kW unit supporting the older section of the building, and a 175 kW (218 kVA) unit dedicated to the newer section. Additional step-down transformers are installed throughout the facility, including two 112.5 kVA transformers (one in the basement electrical room and one in Mechanical Room 5), as well as 45 kVA and 75 kVA transformers located in an electrical room.

3 Utility Billing Analysis

3.1 Utility Type and Usage

Children's Village Building J receives electric service, natural gas service, and is not connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

Table 5 summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 5: Total Energy Usage and GHG Emissions (2024)

Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	456,160 kWh	1,556	$50,178	$0.11	0.0004427	202
Natural Gas	4,919 MCF	5,107	$24,512	$4.98	0.0524921	270
Total	--	6,663	$74,690	--	--	472

**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage does not show a strong correlation to weather data, indicating the majority of electricity usage consists of baseload usage. This usage does not vary much from month to month and includes loads such as lighting, fans, and pump loads. The annual usage for the baseline 12-month period from January to December 2024 is 456,160 kWh. Detailed monthly electricity usage and costs are in Appendix A.

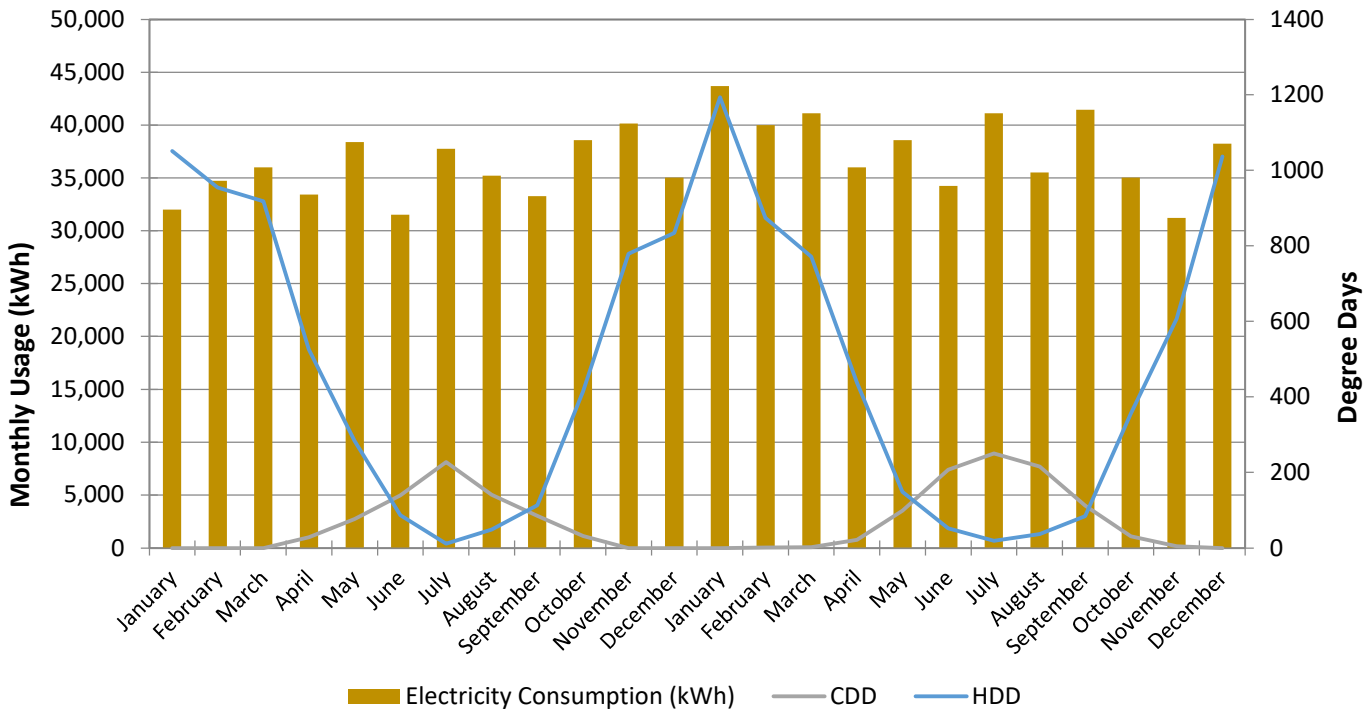


Figure 1: Electricity Usage Profile (January 2023 to December 2024)

3.3 Building Electrical Capacity Analysis

The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 6: Electric Capacity Results

Maximum Building Capacity at Service Transformer	750 kW
Maximum Capacity at Switchgear (A*V*Ph)	900 kW
Estimated Peak Demand	88 kW (estimated)
Remaining Capacity	**667 kW**

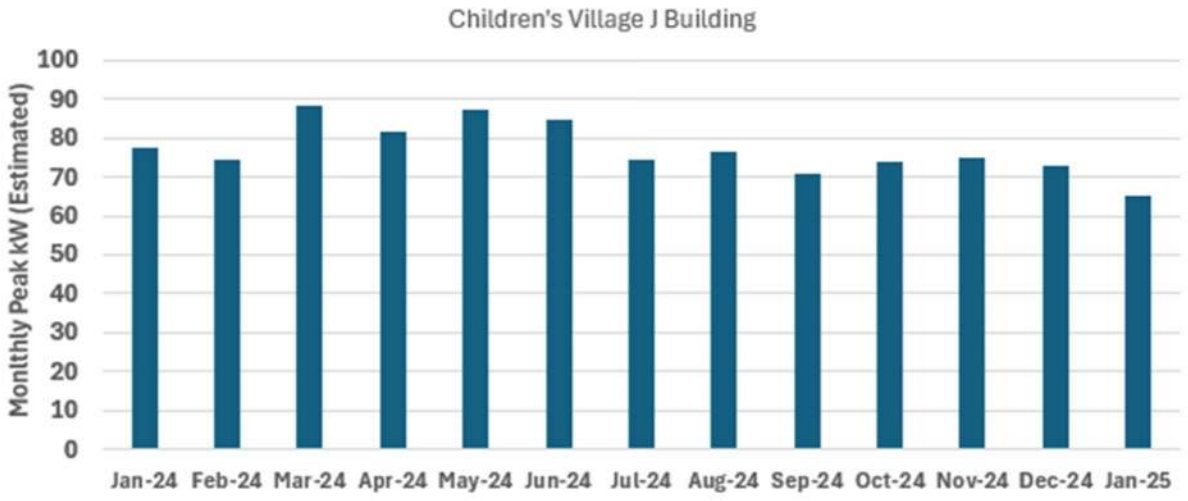


Figure 2: Estimated Electricity Demand Profile

3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge: **$6.15/kW/Month**

Average Dollar per kWh Used in Calculations: **$0.11/kWh**

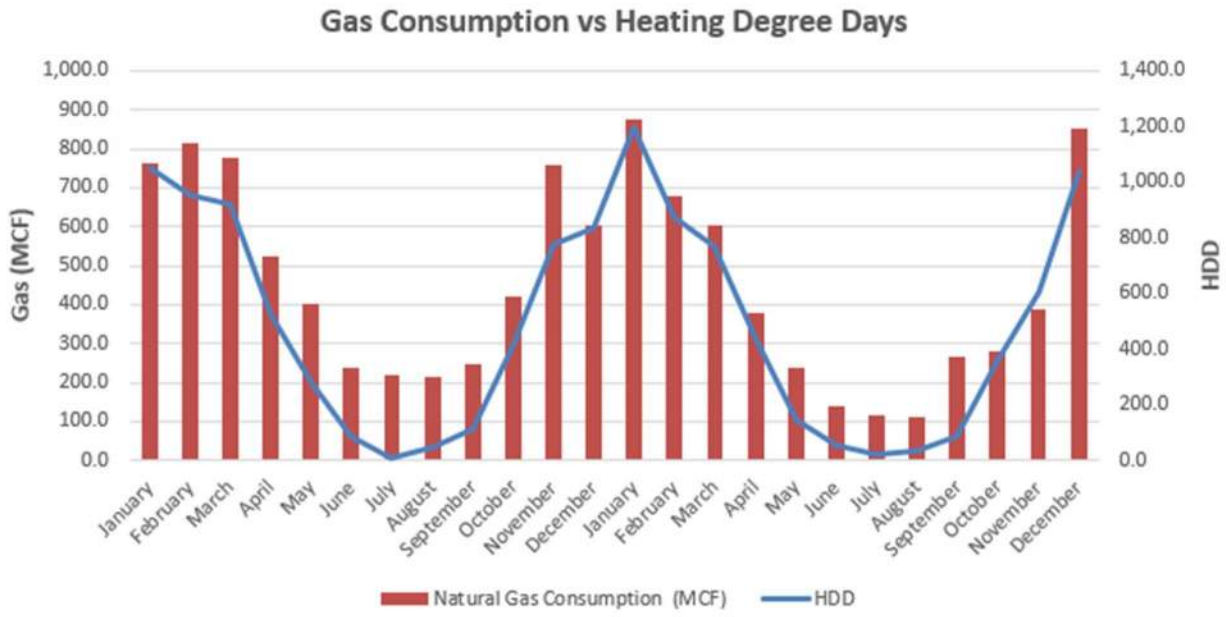
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows a direct correlation to weather data, as natural gas is primarily used for space heating. However, since this is a 24/7 occupied juvenile detention facility there is baseload summer usage due to domestic hot water usage for bathrooms, showers, cleaning, and laundry. The annual usage for the baseline 12-month period from January to December 2024 is 4,919 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): $3.48/dTh (decatherm, 1.038 MCF)

Constellation NG Usage Charge (Day Gas): $5.29/dTh (decatherm, 1.038 MCF)

Average Dollar per MCF Used in Calculations: $4.98/MCF

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 7 below.

Table 7: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$50,178
Natural Gas	$24,512
Total	$74,690
ECI $/yr/sf	$1.17

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

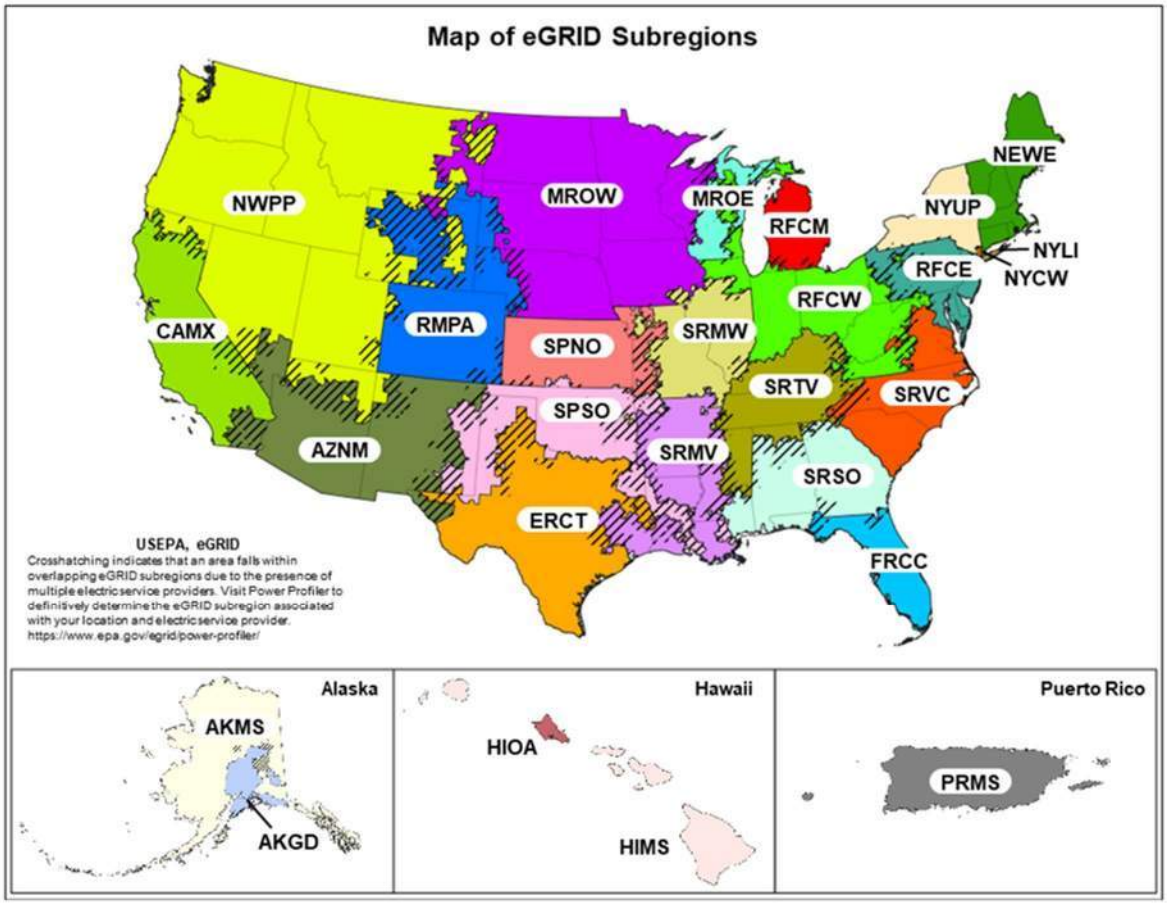


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher

than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

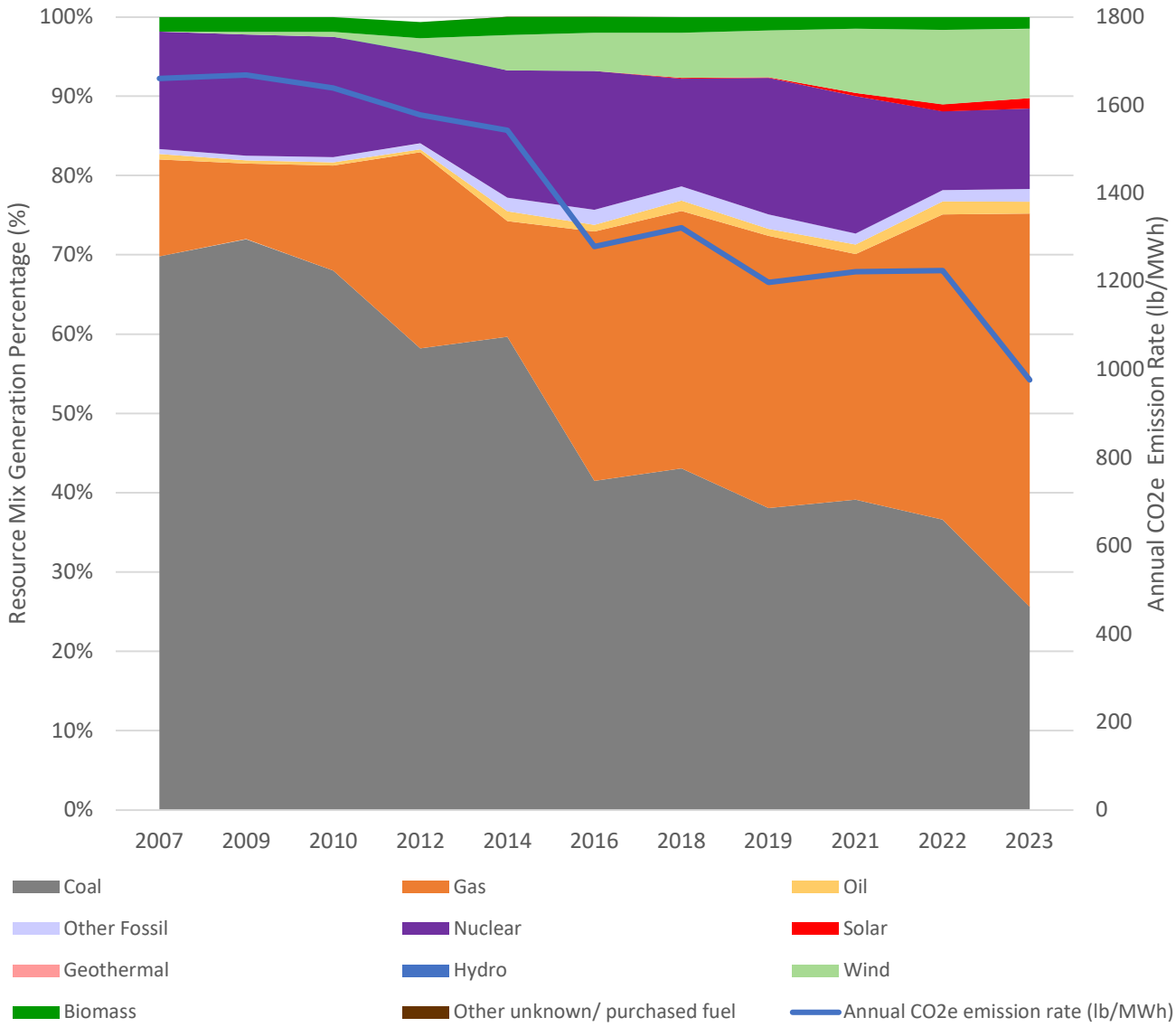


Figure 5: RFCM eGRID Generation Mix and Emissions Factor

Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 57 percent of carbon emissions are attributed to natural gas and 43 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 270 tCO2e (campus-level Scope 1) and 202 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 472 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for Children's Village J are converted to kBTUs units, summed, and divided by the total square footage.

Table 8: Annual Utility Summary (2024)

Building:	Children's Village J					**Electric EUI:**	24	kBTU/SF/yr
GFA:	64,081	SF				**Gas EUI:**	80	kBTU/SF/yr
eGRID Subregion:	RFCM					**Current EUI**	104	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	456,160	kWh	3.412	1,556	0.0004427	202	$50,178	63%
Natural Gas	4,919	MCF	1.038	5,107	0.0524921	270	$24,512	37%
		Totals		6,663		472	$74,690	100%

According to the US EPA, the average site energy use intensity for a residence hall/dormitory facility is 57.9 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 104 kBTU/SF, which is significantly higher than the national benchmark. It's important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison indicates there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient

Figure 6: Average EUI per Counseling Category Type (Source EPA's Portfolio Manager)

3.8 End Use Distribution

Table 9 shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees and detainees. Table 9 and Figure 7 and Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 9: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	4,313	0	4,476,763	70	237
Space Cooling	70,646	0	0	241,045	4	31
Fans	176,738	0	0	603,032	9	78
Pumps	57,779	0	0	197,141	3	26
SHW/DHW	0	607	0	629,937	10	33
Conveyance	0	0	0	0	0	0
Lighting	121,626	0	0	414,987	6	54
Plug Loads	22,014	0	0	75,112	1	10
Process Loads	4,357	0	0	14,865	0	2
Refrigeration	3,000	0	0	10,236	0	1
Cooking	0	0	0	0	0	0
Information Technology	0	0	0	0	0	0
TOTAL	456,160	4,919	0	6,663,118	104	472
Historical Billing	456,160	4,919	0			
Percent of Actual	100%	100%	0%			
per sqft	7.1	0.8	0			

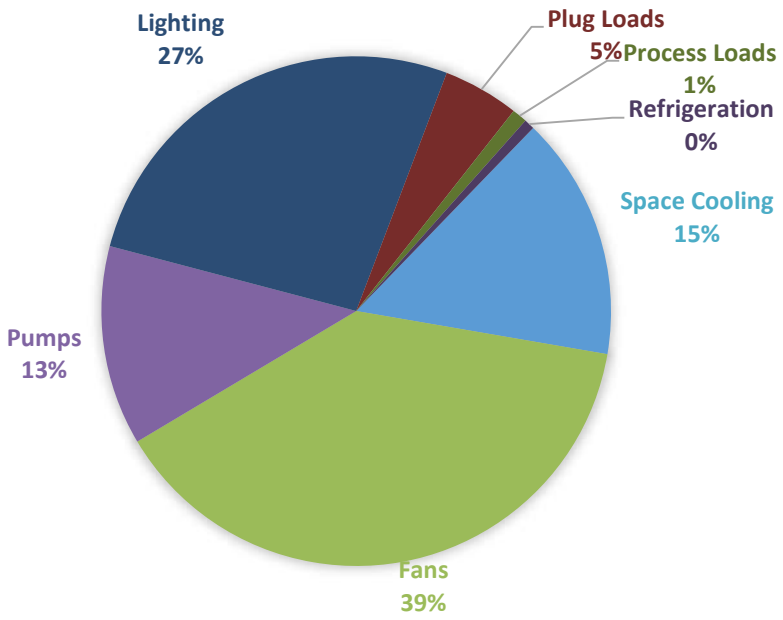


Figure 7: Existing Electricity End Use Distribution

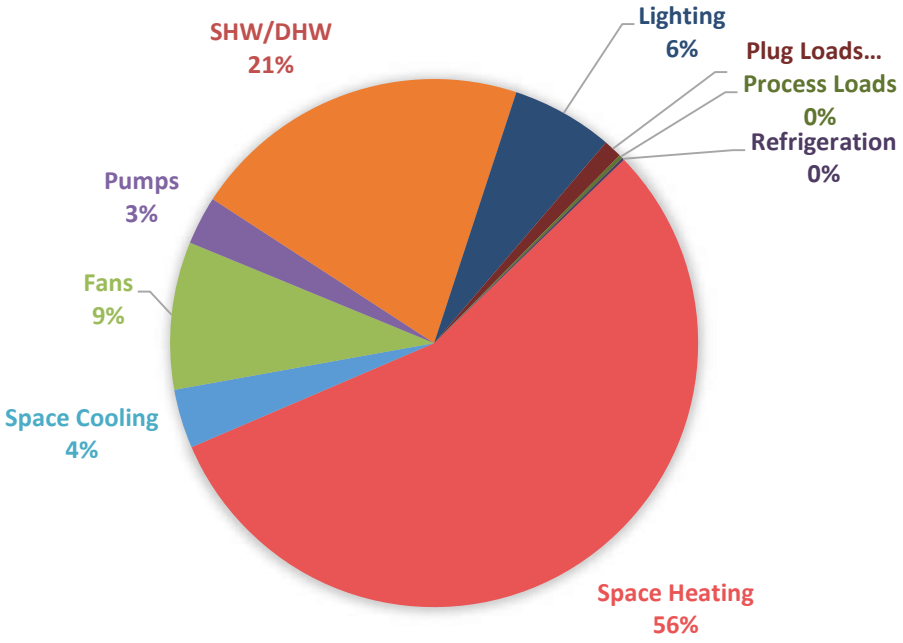


Figure 8: Existing Energy End Use Distribution

4 Energy Conservation Measures

The measures discussed in this section are economically viable when bundled together but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – LED Lighting

This measure proposes upgrading all remaining fluorescent lighting to light-emitting diode (LED) lightbulbs with motion sensors and dimming functionality where appropriate to reduce energy consumption and electrical demand. LEDs are highly energy efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements. The current lighting in Children's Village Building J is approximately 60% LED and 40% fluorescent and the estimated wattage is approximately 0.54 W/ft². A particular focus should be placed on reducing the extremely bright lighting levels in the basement corridor to code-required lumen levels.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.



Image 1: Example Fixture with Integrated Occupancy Controls

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture. Lighting controls that include dimming will likely require full fixture replacement, which drive up the total cost of implementation for the measure.
- Interior lights operate 5110 hours per year, based on estimated on time of 14 hours per day, every day of the year.
- O&M savings assume an average cost of $3.81/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- This measure assumes a 30% reduction in interior lighting power, and a 25% reduction in operating hours for fixtures that are replaced.
- LED upgrades cost $215/fixture, for 328 total fixtures, which include integrated control sensors and no additional wiring and control circuits. Low-cost fixtures and external controls can be used as an alternative to this implementation method. The costs have been split out between the fixtures and controls in the summary table below.
- This measure indirectly supports electrification readiness by realizing a potential kW demand reduction that can be deployed elsewhere for new electric loads.
- It is recommended that similar fixtures be used to replace the existing LED lighting that have been installed as existing fixtures require replacement. This will continue to reduce overall energy consumption of the lighting system by increasing the control capability of the existing fixtures. Alternatively, lighting controls could be added for the existing LED lighting circuits, which would require additional planning and design. Savings will be limited due to the already high efficiency of the LED fixtures.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture counts, locations, and scheduling to minimize disruption to operations. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 10: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	Annual O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
LED Upgrade	0	72,040	246	32	$2,874	$7,920	$70,520	9
Overall % Reduction	0.0%	15.8%	3.7%	6.8%	--	10.6%	--	--

4.2 ECM 2 - Building Envelope Improvements

Effective insulation and a well-sealed building envelope are critical for managing the transfer of heat between the exterior and interior environments. In Michigan, where seasonal temperature variations can be significant, improving building envelope integrity not only reduces energy consumption for heating and cooling but also helps maintain a consistent and comfortable indoor environment for staff, detainees, and visitors. In addition to insulation, proper vapor sealing prevents moisture intrusion and minimizes indoor air quality issues related to high humidity. As building energy codes and insulation standards have evolved, older buildings can greatly benefit from upgrades that align with modern requirements, enhancing their energy efficiency. This measure includes building envelope improvements such as sealing air gaps around points of infiltration and adding insulation under the gym roof. The gym is heated and the roof does not currently have insulation; there are points of air leakage along the perimeter, detected by a thermal camera. There are no cooling savings because the gym does not have active mechanical cooling. Since the only improvement in this measure is adding roof insulation and sealing air gaps in the gym, the energy model only reflects impacts on heating (natural gas).These steps not only reduce energy usage and associated emissions but also lower heating capacity requirements, making them an essential precursor to any major HVAC system upgrades.

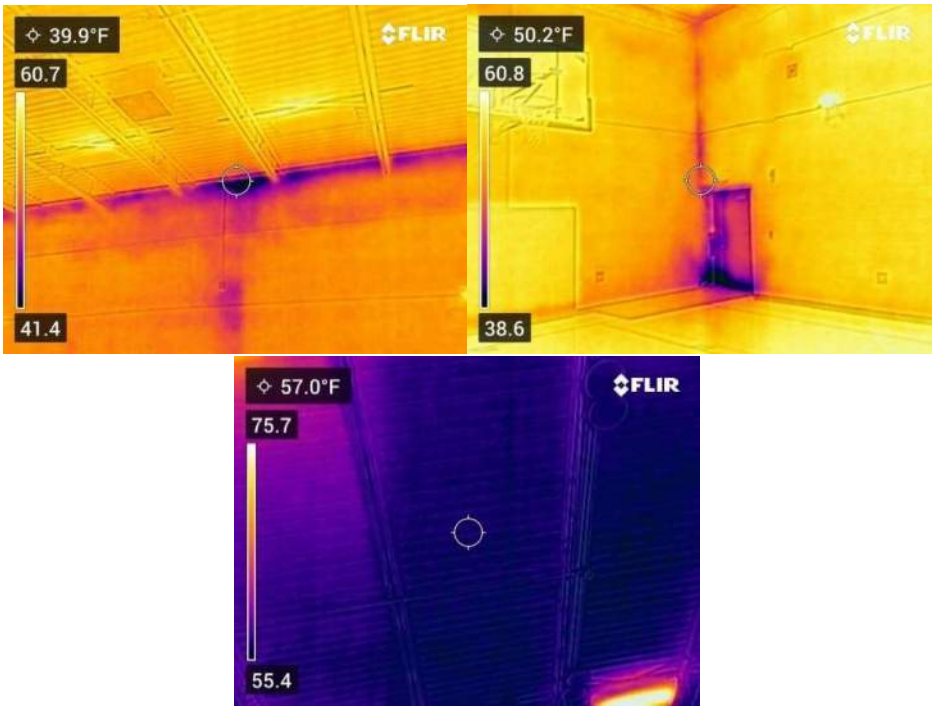


Image 2: Gym Thermal Imaging Showing Air Leakage and Lack of Ceiling Insulation

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- This measure assumes energy savings due to improved R-value and thermal performance. R-values were assumed based on observations and building age. The roof R-value is assumed to improve from R-5 to R-30. Air sealing is assumed to reduce infiltration rates by 20%.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Conduct a comprehensive survey to confirm the type and quantity of insulation required to meet modern energy code requirements, and/or areas requiring air sealing. This measure is recommended is recommended for implementation, and should be considered in coordination with ECM 3 to reduce maximum capacity of equipment (which is not calculable at this time, and therefore is not included in the simple payback of this measure).

ECM Savings and ROM Cost:

Table 11: ECM 2 Savings and ROM Cost

Savings Summary								
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MMBTU)**	**GHG Savings (tCO2e)**	**Annual O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
Envelope Upgrades	134	0	140	7	$0	$672	$31,200	46
Overall % Reduction	3%	0.0%	2%	2%	--	1%	--	--

4.3 ECM 3 - HVAC Upgrades

Upgrading outdated HVAC systems, such as constant volume multi-zone and dual-duct systems, to modern single-duct variable air volume (VAV) systems is a highly effective energy conservation measure. VAV systems dynamically adjust airflow and temperature based on real-time demand, significantly reducing energy consumption compared to older, less efficient systems that operate at constant output levels. This upgrade not only enhances energy efficiency but also improves indoor air quality and thermal comfort for occupants. Implementing this measure as part of a routine capital upgrade ensures the integration of modern energy-efficient equipment into the facility's infrastructure, maximizing the overall benefit and lifecycle performance of the new systems. The nine original dual-duct AHUs and their pneumatic controls are outdated and beyond their expected useful life. These are due for a routine capital upgrade. VAV AHU systems with modern DDC controls should be installed to optimize energy use and comfort. This ECM includes upgrading the existing outdated pneumatic controls and commissioning the systems to optimize operational functionality and maximize system efficiency. More detail about pneumatic controls upgrades and retro-commissioning can be found in the following "Considered but Not Recommended" section, since these are not recommended as standalone measures for this building due to the synergistic nature of these opportunities.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- This measure applies to the original AHUs 1-9.
- HVAC equipment identified is due for routine end-of-life replacement.
- Controls will be upgraded to modern DDC controls and integrated with the central BAS.
- This measure assumes energy savings due to the adjustment of constant volume 100% fan speed to an average of 70% fan speed.
- Heating and cooling savings are achieved by optimizing new system operation (see RCx opportunities) and assumes 10% cooling savings and 15% heating savings.
- O&M Savings for this measure assume reduced maintenance of existing systems equal to an average of 2 hours per week of internal labor to troubleshoot issues with the existing system.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Conduct a thorough assessment of the existing HVAC systems to determine the scope of upgrades required. Following this, detailed planning and design should be undertaken to ensure the new systems are appropriately sized and configured to meet the building's specific needs. This should include ensuring the new system is "electrification-ready" such that it either uses hot water for heating and/or is a dual-fuel heat pump that can use either source as the RFCM grid emissions improve or Oakland County renewable energy procurement makes it more favorable to use electricity over gas for heating to meet decarbonization goals. This process should be integrated into the facility's routine capital upgrade schedule to optimize the benefits of the new equipment and ensure seamless implementation along with other county priorities.

ECM Savings and ROM Cost:

Table 12: ECM 3 Savings and ROM Cost

Savings Summary								
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MMBTU)**	**GHG Savings (tCO2e)**	**Annual O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
HVAC Upgrades	647	98,407	1,007	79	$6,760	$14,048	$580,000	28
Overall % Reduction	13%	22%	15%	17%	--	19%	--	--

4.4 ECM 4 - Variable Frequency Drives for Pumps

Variable Frequency Drives (VFDs) on pumps will provide a dynamic and energy-efficient solution by allowing precise control of pump speed, optimizing performance, and reducing unnecessary energy consumption during periods of lower demand. Currently, the new 25 HP secondary chilled water pumps have VFDs, but the existing hot water pumps do not have VFDs and run at constant speed. This ECM proposes evaluating the heating hot water system pumps for feasibility to add a VFDs to reduce pump energy. This may be coupled with a routine upgrade of pumps as they near end of useful life to include premium efficiency motors and VFDs.

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- VFDs will be most effective when paired with a BAS to automatically control speeds.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed. VFDs will likely increase the service life of the equipment if properly selected and installed.
- The savings for this measure assume an average 30% reduction in equipment speed.
- If coupled with routine upgrades to include premium efficiency motors additional energy savings may be achieved.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the heating hot water system pumps for compatibility with a VFD and assess the usage pattern and energy consumption. Once this data is collected, select the appropriate type of VFD. Choose VFD based on compatibility with current systems, programmability, and reliability.

ECM Savings and ROM Cost:

Table 13. ECM 4 Savings and ROM Cost

Savings Summary								
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MMBTU)**	**GHG Savings (tCO2e)**	**Annual O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
VFDs for Pumps	0	20,307	69	9	$0	$2,234	$4,500	2
Overall % Reduction	0.0%	5%	1%	2%	--	3%	--	--

5 Measures Requiring Additional Consideration

This section provides details on measures that were analyzed but are not recommended for immediate implementation at this time. This includes measures that require further study, such as capital-intensive replacements of existing equipment, but are not justified through energy savings alone. This section may also include measures that conflict with building electrification plans, or projects that are simply not recommended due to being financially impractical or not being technically feasible.

Table 14: Measures Requiring Additional Consideration

Measures Requiring Additional Consideration									
ECM #	Measure Description	Measure Status	Year -1 Electricity Savings	Demand Reduction	Year -1 Gas Savings	O&M and Water Savings	Year - 1 Cost Savings	Project Cost (Est)	Simple Payback Period
No	Description	R, NR, RS	kWh/yr	kW	MCF/yr	$/yr	$/yr	$	Years
5	Retro-Commissioning	RS	3,532	0	323	$0	$2,000	$21,147	11
6	Upgrade Pneumatic Controls to DDC	RS	4,357	2	0	$11,500	$479	$134,570	281

5.1 ECM 5 - Upgrade Pneumatic Controls to DDC

Pneumatic controls upgrades refers to the process of upgrading antiquated pneumatic control systems and components to direct digital controls (DDC) and integrating it with a centralized control system. Pneumatic controls use compressed air to operate valves and dampers and are prone to operational and maintenance issues. Upgrading these antiquated controls to DDC will enhance the overall efficiency, functionality, and manageability of HVAC system operation. This measure directly produces electricity savings by eliminating the need for a compressed air system, but also indirectly contributes additional energy savings by enabling better control and functionality such as scheduling and optimization. Of the 11 AHUs in the building, the original nine have outdated pneumatic controls for all components. A 3 HP air compressor provides compressed air to the system to control these AHUs. The newest AHUs have modern DDC controls and are connected and managed by the central BAS. This measure is not recommended as a standalone measure due to the age and condition of the original nine AHUs and need for a routine upgrade. The controls upgrade will be included in ECM 3.

5.2 ECM 6 - Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve

operational efficiency and performance, and restore systems to their original design intent. Building J does not have widespread use of modern controls at this time, and outdated pneumatic controls cause challenges with HVAC functionality and comfort. RCx is an extremely valuable measure that should be implemented to its fullest extent to ensure systems are operating effectively and efficiently. This can be completed for existing systems connected to the BAS or combined with the HVAC and controls upgrade recommended in ECM 3. Due to the need for a routine capital upgrade, it's recommended to include RCx and optimization sequences as part of a routine capital upgrade for the nine dual-duct AHU systems.

The following list represents RCx opportunities that should be evaluated to validate operation, modify and/or repair if discrepancies identified if systems not scheduled for timely replacement. This effort will proactively improve building system operation and optimize energy usage.

- Optimize HVAC scheduling in non 24/7 occupied spaces
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water and chilled water supply reset
- Discharge air setpoint reset
- Outside air temperature lockouts
- Outside air damper control
- Duct static pressure reset
- Repair airside or waterside economizing
- Demand-controlled ventilation
- Upgrade pneumatic controls to direct-digital controls (DDC) and integrate with BAS

6 Appendix A

Table 15: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	764.5	$4,694	32,000	$3,434	43	57	1,051	0
Feb-23	815.1	$4,765	34,720	$3,271	52	65	955	0
Mar-23	778.0	$2,369	36,000	$3,229	48	77	918	0
Apr-23	522.4	$1,811	33,440	$2,942	46	76	525	28
May-23	403.9	$1,208	38,400	$3,028	52	85	283	76
Jun-23	235.9	$582	31,520	$2,361	44	69	86	139
Jul-23	217.1	$870	37,760	$3,056	51	70	11	227
Aug-23	216.5	$624	35,200	$2,797	47	70	48	141
Sep-23	249.6	$708	33,280	$3,063	46	75	113	85
Oct-23	419.5	$1,209	38,560	$3,137	52	83	415	31
Nov-23	758.5	$2,829	40,160	$3,084	56	94	779	0
Dec-23	603.8	$2,979	35,040	$2,487	47	60	834	0
Jan-24	875.8	$3,857	43,680	$1,008	59	78	1,194	0
Feb-24	680.4	$3,706	40,000	$4,091	60	74	874	1
Mar-24	602.6	$3,412	41,120	$3,318	55	88	771	2
Apr-24	376.2	$784	36,000	$3,158	54	87	437	21
May-24	236.6	$480	38,560	$2,915	52	85	148	98
Jun-24	139.9	$453	34,240	$3,146	48	74	51	207
Jul-24	115.9	$375	41,120	$3,663	55	77	18	251
Aug-24	111.7	$238	35,520	$3,267	48	71	37	215
Sep-24	264.5	$642	41,440	$3,323	58	94	84	112
Oct-24	278.7	$747	35,040	$3,328	47	75	356	31
Nov-24	387.6	$1,341	31,200	$3,366	43	73	607	4
Dec-24	849.9	$1,889	38,240	$3,216	51	65	1,037	0
2023 Sum	5,985	$24,648	426,080	$35,889			6,019	727
2024 Sum	4,920	$17,924	456,160	$37,799			5,614	942

7 Appendix B

Table 16: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Capacity 2	Capacity 3	Capacity 4	Condition
MZ-IJ	1	Air handling unit	Old block	Buffalo	152 PCB	378 (heat) MBH	190 (cool) MBH	7000 CFM	5 HP	
MZ-2J	1	Air handling unit	Old block	Buffalo	152 PCB	276 MBH	156 MBH	5100 CFM	3 HP	
MZ-3J	1	Air handling unit	Old block	Buffalo	152 PCB	276 MBH	138 MBH	5100 CFM	3 HP	
MZ-4J	1	Air handling unit	Old block	Buffalo	152 PCB	286 MBH	162 MBH	5300 CFM	3 HP	
MZ-5J	1	Air handling unit	Old block	Buffalo	123 PCB	226 MBH	128 MBH	4200 CFM	3 HP	
MZ-6J	1	Air handling unit	Old block	Buffalo	123 PCB	276 MBH	156 MBH	3800 CFM	5 HP	
MZ-7J	1	Air handling unit	Old block	Buffalo	122 PCB	267 MBH	144 MBH	3000 CFM	3 HP	
HC-1J	1	Air handling unit	Old block	Buffalo	122 PC	210 MBH	90 MBH	3600 CFM	2 HP	
HV-1J	1	Air handling unit	Old block	Buffalo	122 HV	200 MBH				
AHU-1	1	Air handling unit, VFD	New Addition	Carrier		666 MBH	538 MBH	18000 CFM	20 HP	
AHU-2	1	Air handling unit, VFD	New Addition	Carrier				18000 CFM	10 HP	
CH-1	1	Air cooled chiller	AHUs	York	YVAA0183AOV46BAVBXX XSAXLXXXX6040XOFXXV 210W1SXGA2BMXV1XNXX XXXXJ1SXX	170 TON				
ERP-EC 11, 13	2	Split system heat pump	Server room	Mitsubishi electric	PKA-A12HA6	1 TON				
Boiler 1,2	1	Condensing Boiler, HHW	Building heat	Lochnivar	FBN2001	1923 MBH				Good

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Capacity 2	Capacity 3	Capacity 4	Condition
Boiler 3	1	Condensing Boiler, HHW	Building heat	Lochnivar	AWN501PM	480 MBH				
UH-1	1	Unit Heater, HHW	Mechanical and electrical room	Trane						
N/A	1	Domestic Water Heater, NG		Lochnivar	RJA200	200 GAL				2019
N/A	1	Air Compressor		Speedaire	5Z702A					
PHW-1	1	Primary hot water pump		Bell & Gossett	Series 1510 2-1/2AB	3 HP				
PHW-2	1	Primary hot water pump		Bell & Gossett	Series 1510 2-1/2AB	3 HP				
HWCP-1	1	HW pump	AHU-1	Bell & Gossett	Series 60 2A	2 HP				
HWCP-2	1	HW Pump, existing	AHU	Bell & Gossett	Series 1510 2-1/2AB	2 HP				
RHP-1	1	Reheat coil secondary HHW pump	AHUs and VAVs	Bell & Gossett	Series 60 2A	2 HP				Old
CWP-1	1	Primary chilled water pump		Bell & Gossett	Series 1510 4AC	7.5 HP				
CWP-2	1	Secondary chilled water pump	AHU-1	Bell & Gossett	Series 1510 2-1/2AB	3 HP				
CWP-3	1	Secondary chilled water pump	Existing AHUs	Bell & Gossett	Series 1510 2-1/2AB	3 HP				
CHWP-1&2	1	Chilled water pump		Bell&Gossett	EM4103T-G	25 HP				
BHP-1	1	Baseboard heating pump (HHW)	Perimeter heating baseboards	Bell & Gossett	Series 60 1-1/2AA	0.5 HP				Old
EHP-2	1	Existing heating pump		Bell & Gossett	Series 1510 1-1/2AB	3 HP				
?	1	Primary domestic boiler pump		Bell & Gossett	Series 60 2A	0.8 HP				
?	1	Secondary domestic HW pump		Bell & Gossett	Series 60 1-1/2AA	0.33 HP				

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Capacity 2	Capacity 3	Capacity 4	Condition
?	1	Secondary dom. HW pump, existing		Bell & Gossett	Series 60 1-1/2AA	0.33 HP				
DHWC-1	1	Domestic HW recirculation pump		Bell & Gossett	Series 1AA	0.25 HP				
EF-1	1	Centrifugal Exhaust Fan	NW Cells	Loren Cook	ACRUD-120R100	0.25 HP				
EF-2	1	Centrifugal Exhaust Fan	Central	Loren Cook	ACRUD-100R200M	0.13 HP				
EF-3	1	Centrifugal Exhaust Fan	NE Cells	Loren Cook	ACRUD-120R100	0.25 HP				
EF-4	1	Centrifugal Exhaust Fan	Sally Port	Loren Cook	ACRUD-120R100	0.25 HP				
EF-5	1	Centrifugal Exhaust Fan	Holding	Loren Cook	ACRUD-90R150L	0.13 HP				
EF-6	1	Centrifugal Exhaust Fan	Gymnasium	Loren Cook	ACRUD-136R100	0.25 HP				
EF-7	1	Centrifugal Exhaust Fan	Holding	Loren Cook	ACRUD-70R150L	0.13 HP				
EF-8	1	Centrifugal Exhaust Fan	Kitchen	Loren Cook	VCR-HP-165VH 7B	1 HP				

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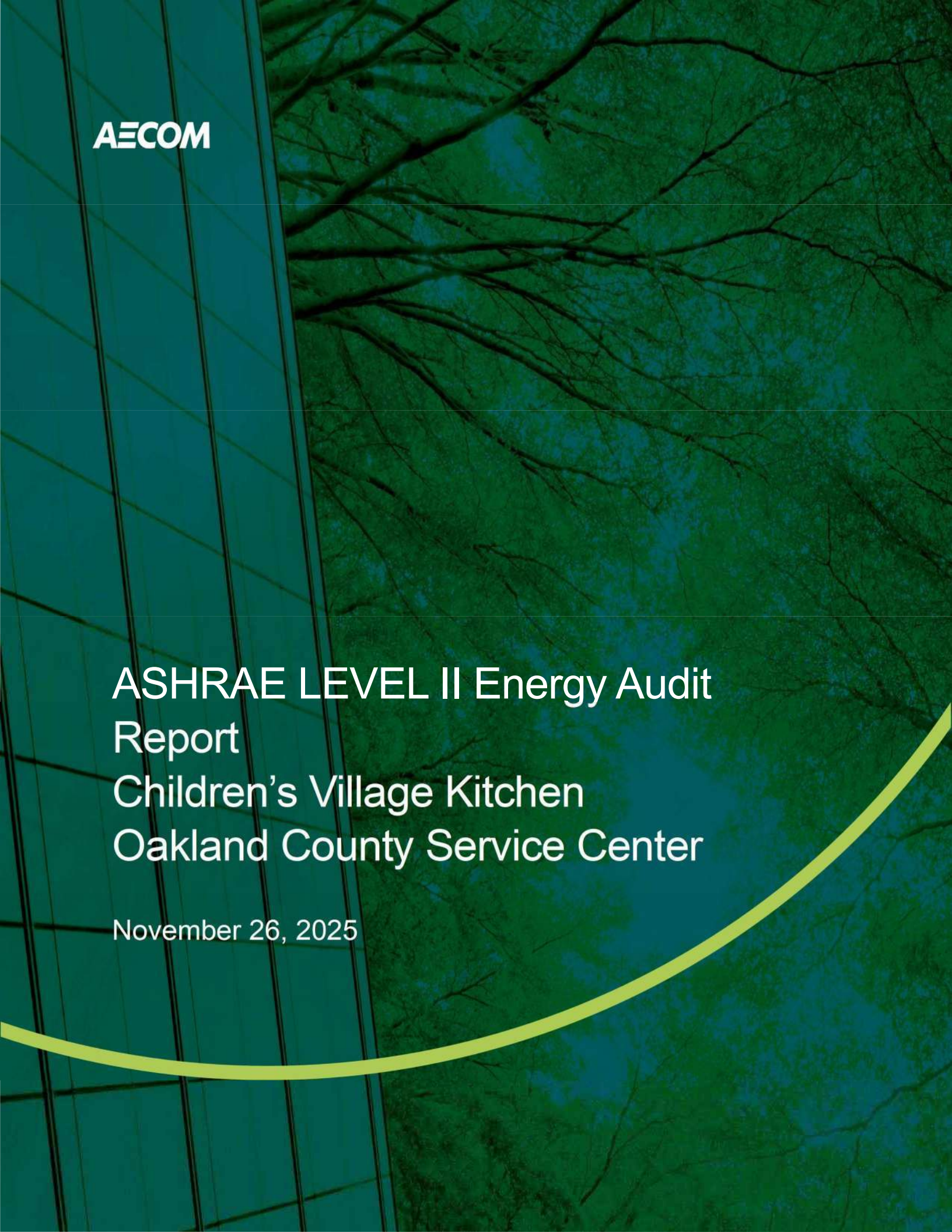

AECOM

ASHRAE LEVEL II Energy Audit Report
Children's Village Kitchen
Oakland County Service Center

November 26, 2025

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

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OAKLAND COUNTY, MI Government

Prepared by:
AECOM

Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Children's Village Kitchen in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County Children's Village is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Wednesday April 16, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates two ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The three recommended measures represent a projected 10% annual energy cost savings with an aggregate simple payback of 4 years.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Children's Village Kitchen Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	tCO2e	$/yr	$/yr	$	Years
1	LED Lighting Upgrade	MED	R	5,341	2	0	0	18	2.4	$255	$590	$6,000	10
2	Retro-Commissioning	HIGH	R	7,354	0	1,904	0	215	13.3	$0	$1,723	$3,799	2
Sum of Recommended Measures				**12,695**	**2**	**1,904**	**0**	**234**	**16**	**$255**	**2,310**	**9,799**	**4**
Overall % Reduction				**7%**	**4%**	**13%**	**0%**	**11%**	**10%**	**--**	**8%**	**---**	**-**

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Children's Village, a detention facility, functions as a residential center for juvenile detainees, offering a structured environment that supports their education during rehabilitation. The kitchen within this complex was built in 1974. The concrete masonry unit (CMU) building features a beige brick veneer and is one story, with a concrete deck roofing. The insulation under the roof membrane is expected to be minimum R-20.

The kitchen can prepare food for up to 200 children who are under their detention period. The kitchen includes standard gas and electric food preparation equipment and a walk-in freezer and refrigerator.

2.1 Building Systems

2.1.1 Building Envelope

The building has one above-grade floor. The window/wall ratio is estimated to be about 5%. The windows appear to be in good condition; however, they are single-pane aluminum-framed windows and are assumed to be original to the building. It's recommended to upgrade the windows to double-pane, insulated framed windows.

The walls are CMU structures with brick veneer on the exterior. There is no insulation on the interior side. The concrete roof deck is covered with black tar roof membrane the insulation levels are unknown at this stage.

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	CMU structure with brick veneer	Good
Roof	Concrete insulation above deck	Good
Glazing	Single pane, aluminum frame, tinted windows are original, 5% window/wall ratio	Good

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The Lochinvar boiler is at the end of its useful life. The boiler provides reheat in the office spaces. There are two makeup air units, one with 640 MBH heating capacity and 2nd with 240 MBH gas-fired heating capacity provide heating for the kitchen. The cooling coil for both units is direct expansion (DX). There are 5 kitchen exhaust fans with a total motor input requirement of 2.75 HP. One gas-fired unit heater provides heating for the loading dock. The capacity of this unit is unknown.

2.1.2.2 Plumbing

The domestic hot water is provided by commercial kitchen electric heaters.

2.1.2.3 Building Controls

The kitchen MAU controls are direct digital control (DDC) systems and operate on a weekly schedule. The kitchen hood and the exhaust fans are linked to manual or local control systems. The walk-ins are controlled by internal thermostats. The unit heaters are tied to local thermostats.

2.1.3 Lighting Systems

During the site visit, lighting fixtures were observed to vary based on room layout. Fixtures were either recessed, ceiling-mounted, or suspended. The fluorescent fixtures are rated at 32W.

Table 3: Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
Fluorescent Lights	28	2 lamps
Fluorescent Lights	12	3 lamps
LED Lights	4	3 lamps

The total approximate quantity of light fixtures is 44 and approximate total wattage is 3,088 watts. The approximate area per drawing is 3,799ft² and calculated lighting density is approximately 0.81 W/ft².

2.1.4 Electrical Infrastructure

The facility is equipped with a 225 kVA transformer located outside the building. The main electrical service is rated at 400 amps, 480/277 volts, 3-phase, and is associated with a meter number 30885605. A spot measurement showed energy usage of 6,721 kWh * 80 (photo documentation recommended). Backup power is provided by a 100 kW diesel generator.

2.1.5 Additional Information

There are a 10x12 ft refrigerator walk-in and a 10x12 ft freezer walk-in serving the kitchen. The walk-ins are situated outside the kitchen and have deteriorated insulation. Significant heat leakage is observed along the exterior of the insulation of the walk-ins. The condensers are mounted on the roof of the walk-ins. The cooling capacities remain unknown.

There are four additional refrigerators and freezers besides walk-ins, ranging from 4 ft to 8 ft long.

There are four electric ovens, fryers, steam kettles, and steamers up to 40 kW capacities, using 480-volt electric source. The gas-fired ranges are coupled with electric coil ranges. Main kitchen hood and multiple exhaust fans serve the kitchen.

3 Utility Billing Analysis

3.1 Utility Type and Usage

The Children's Village Kitchen receives electric service, natural gas service, and is not connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

Table 4 summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

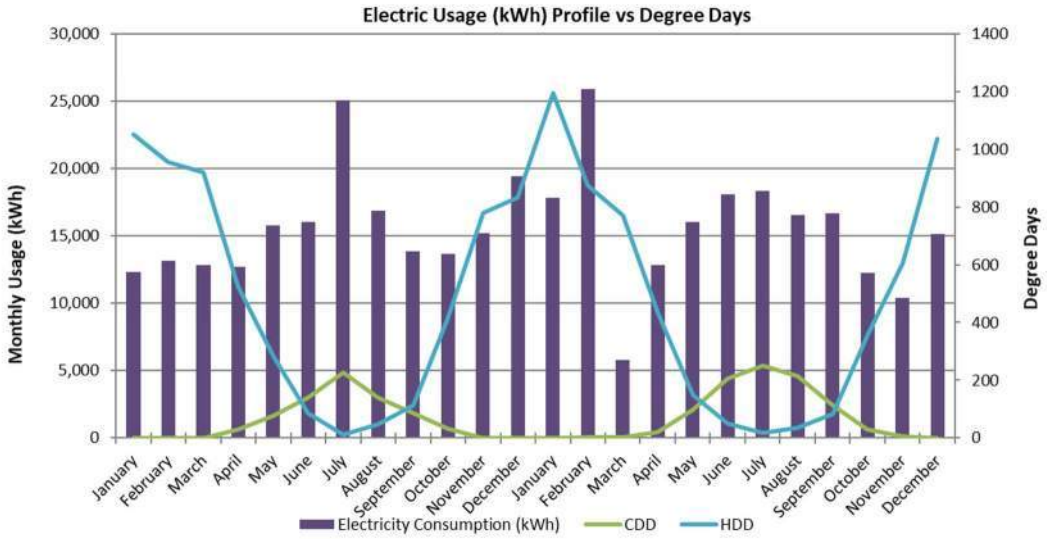
Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	185,680 kWh	634	$20,425	$0.11/kWH	0.0004427	82
Natural Gas	1,380 MCF	1,433	$6,873	$4.98/MCF	0.0549206	76
Total	**--**	**2,066**	**$27,301**	**--**	**--**	**158**

**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage is relatively flat throughout the year with a slight uptick during the summer months associated with summer cooling. The majority of usage appears to consist of baseload usage. This usage does not vary much from month to month and includes loads such as lighting, cooking, refrigeration, and fan loads. Most of the cooking equipment in the kitchen is electric. The annual usage for the baseline 12-month period from January to December 2024 is 185,680 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 5: Electric Capacity Results

Maximum Building Capacity at Service Transformer	225 kW
Maximum Capacity at Switchgear (A*V*Ph)	300 kW
Estimated Peak Demand	48 kW (estimated)
Remaining Capacity	**177 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge:	**$0.057/kWh**
DTE Electric Demand Charge:	**$6.15/kW/Month**
Average Dollar per kWh Used in Calculations:	**$0.11/kWh**

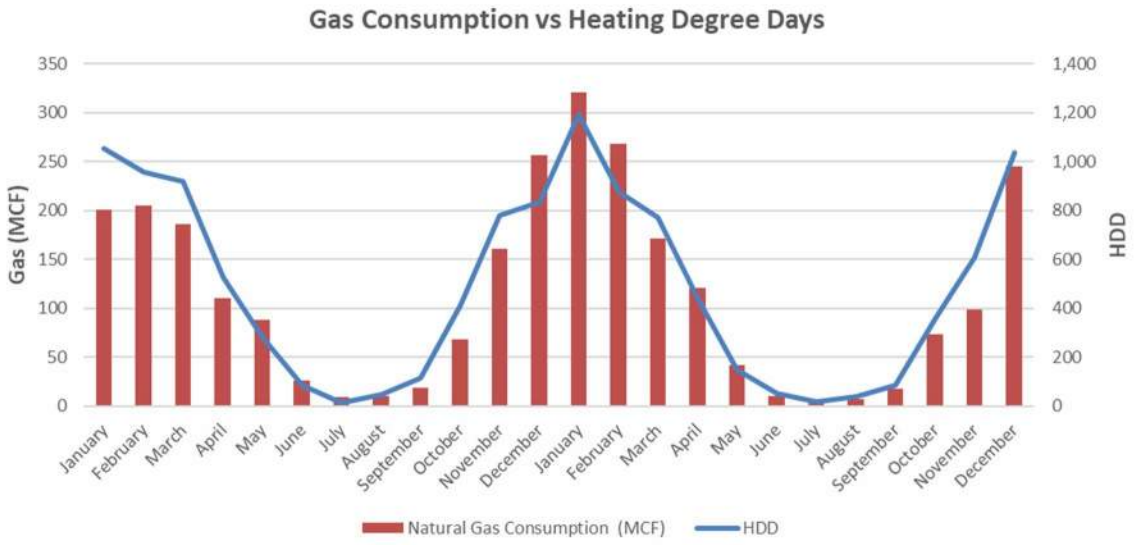
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows a direct correlation to weather data, as natural gas is primarily used for space heating since the majority of kitchen equipment is electric. A small amount of natural gas is used for cooking, which is shown by the summer baseload usage. The annual usage for the baseline 12-month period from January to December 2024 is 1,380 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): **$3.48/dTh (decatherm, or 1.038 MCF)**

Constellation NG Usage Charge (Day Gas): **$5.29/dTh (decatherm, or 1.038 MCF)**

Average Dollar per MCF Used in Calculations: **$4.98/MCF**

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$20,425
Natural Gas	$6,876
Total	$27,301
ECI $/yr/sf	$7.19

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

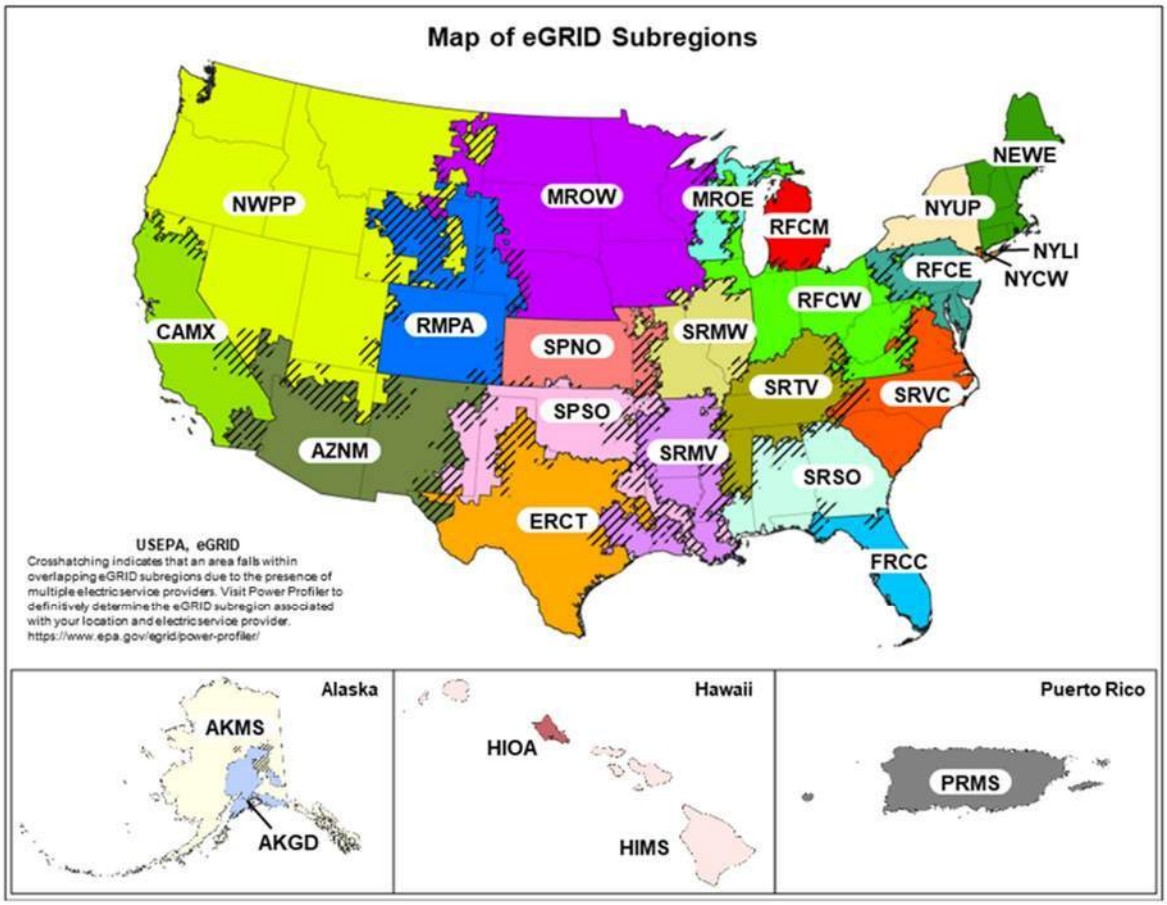
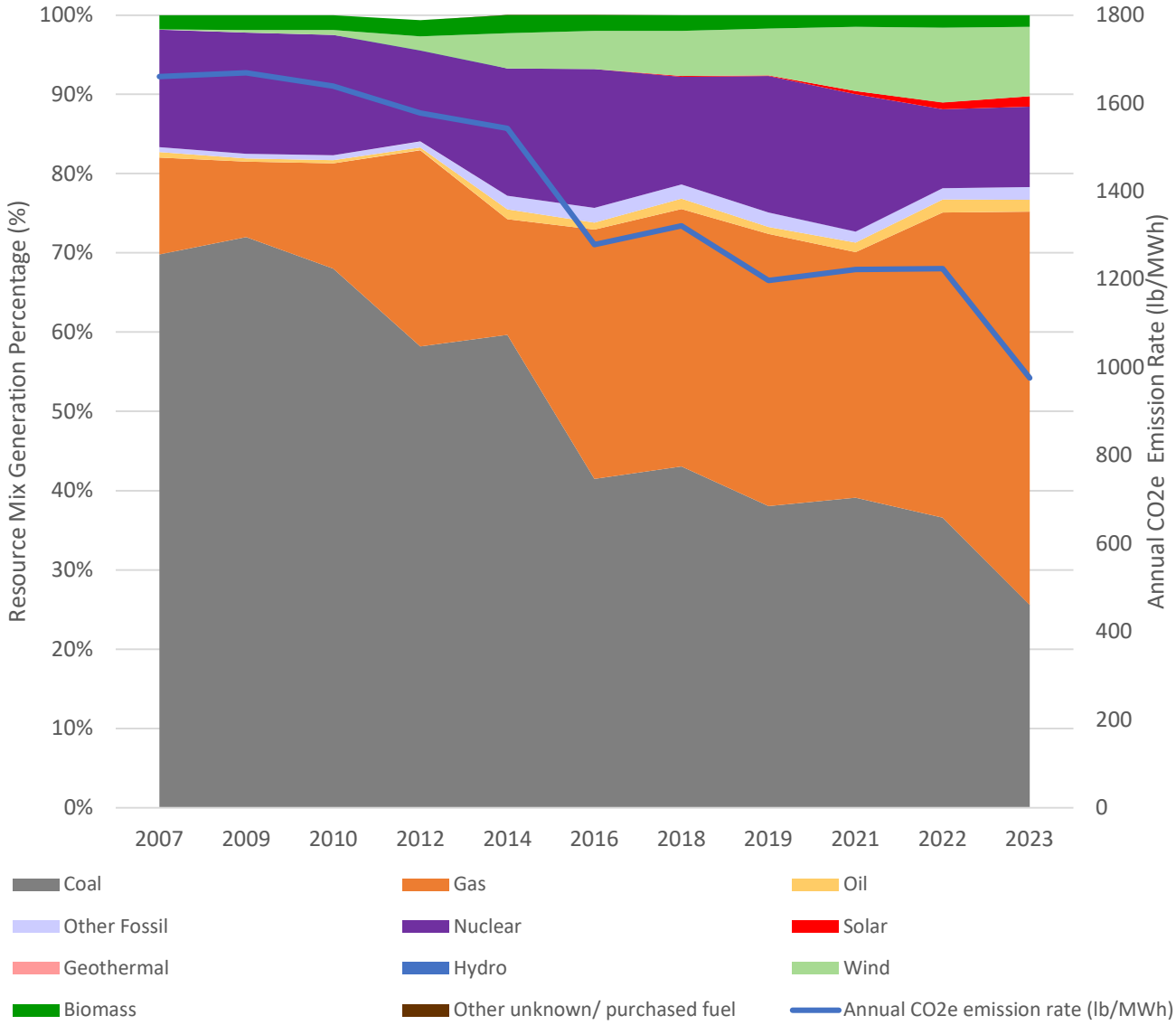


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 48 percent of carbon emissions are attributed to natural gas and 52 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 76 tCO2e (campus-level Scope 1) and 82 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 158 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for the Children's Village Kitchen are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Children's Village Kitchen					**Electric EUI:**	167	kBTU/SF/yr
GFA:	3,799	SF				**Gas EUI:**	377	kBTU/SF/yr
eGRID Subregion:	RFCM					**Current EUI**	544	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	185,680	kWh	3.412	634	0.0004427	82	$20,425	75%
Natural Gas	1,380	MCF	1.038	1,433	0.0549206	76	$6,873	25%
		Totals		**2,066**		**158**	**$27,298**	**100%**

According to the US EPA, the average site energy use intensity for a food service facility or restaurant ranges from 231.4 kBTU/SF/yr to 325.6 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 544 kBTU/SF, which is considerably higher than these benchmarks. It's important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. The EUI, especially the gas EUI, indicate there is an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

3.8 End Use Distribution

Table 8 shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees. Table 8 and Figure 6 and Figure 7 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	1,223	0	1,269,000	334	67
Space Cooling	40,396	0	0	137,831	36	18
Fans	33,814	0	0	115,373	30	15
Pumps	0	0	0	0	0	0
DHW	0	0	0	0	0	0
Conveyance	0	0	0	0	0	0
Lighting	8,985	0	0	30,658	8	4
Plug Loads	1,551	0	0	5,293	1	1
Process Loads	0	0	0	0	0	0
Refrigeration	35,760	0	0	122,011	32	16
Cooking	65,174	158	0	385,874	102	38
Information Technology	0	0	0	0	0	0
TOTAL	**185,680**	**1,380**	**0**	**2,066,040**	**544**	**158**
Historical Billing	185,680	1,380	0			
Percent of Actual	100%	100%	0%			
per sqft	49	0.4	0			

Figure 6: Existing Electricity End Use Distribution

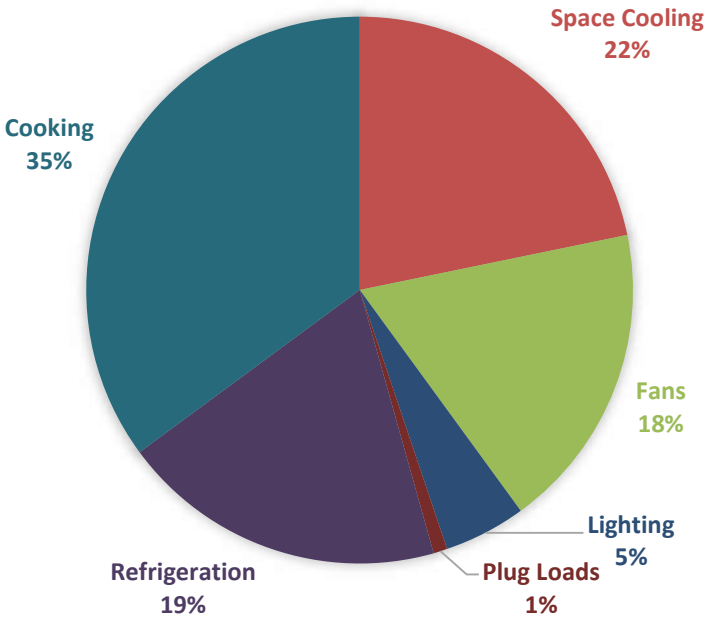
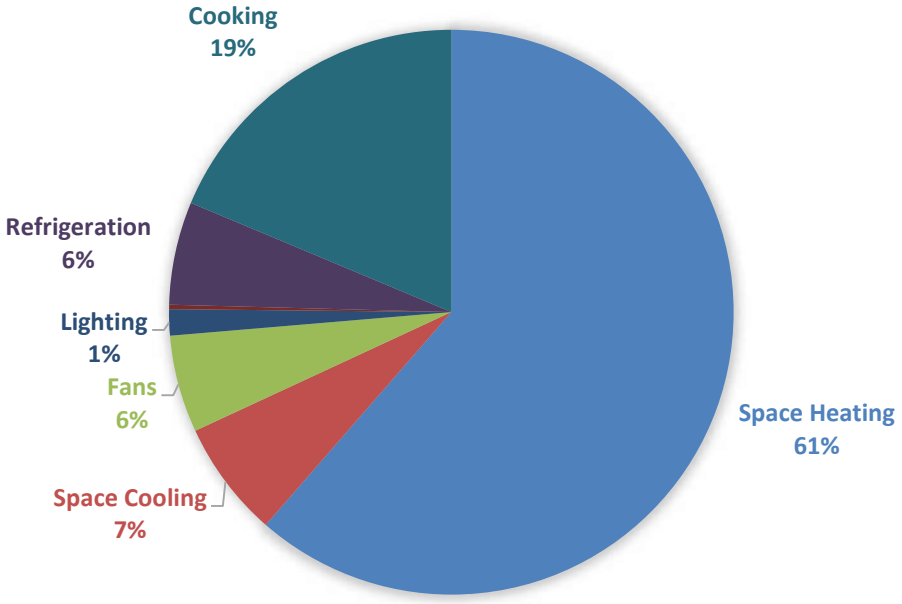


Figure 7: Existing Energy End Use Distribution



4 Energy Conservation Measures (ECM)

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure, but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 - Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent.

Observations from the site visit indicate that not all systems are operating optimally and can be modified or repaired to improve efficiency. A few examples include:

- The gas EUI is extremely high and there are minimal gas cooking appliances, indicating the majority of gas usage is for space heating. The MAUs have modern DDC controls and are assumed to operate on a schedule, but the controls should be evaluated to optimize schedules, setpoints, and sequencing to minimize and unnecessary HVAC operation and over-ventilation.
- Unit heaters are on local controls and likely operate more than necessary.
- The kitchen hood appears to be operated on local controls and operations should be reviewed with staff to ensure the hood is only operating when necessary and turned off at the end of every shift.
- The outdoor walk-in cooler/freezer has areas with deteriorating insulation that needs repair.

Image 1: Outdoor walk-in cooler/freezer deteriorating insulation



While each of these individual examples are minor concerns, these illustrate an opportunity to systematically evaluate all major systems to identify and resolve similar operational discrepancies to optimize system performance and reduce energy usage. The following list represents RCx opportunities that should be evaluated to validate operation, modify and/or repair if discrepancies identified if systems not scheduled for timely replacement. This effort will proactively improve building system operation and optimize energy usage.

- Optimize MAU sequences of operation
- Optimize HVAC scheduling
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Discharge air setpoint reset
- Outside air temperature lockouts
- Repair deteriorating insulation

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 7.5% reduction in estimated cooling and fan use end use energy consumption, 15% reduction in heating end use energy consumption, and 5% reduction in refrigeration energy end use consumption.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: This measure proposes engaging a third-party contractor to determine if this building is eligible for the DTE RCx program and systematically evaluate and prioritize major HVAC and control systems and complete retro-commissioning to restore systems to their original design intent. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 9: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Annual O&M Savings ($)	Est Project Cost	Simple Payback (Yrs)
RCx	1,904	7,354	215	13	$1,723	$0	$3,799	2
Overall % Reduction	13%	4%	10%	8%	6%	--	--	--

4.2 ECM 2 – LED Lighting

This measure proposes upgrading all remaining fluorescent lighting to light-emitting diode (LED) lightbulbs to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements. The current lighting in the Children's Village Kitchen is fluorescent and the estimated wattage is approximately 0.81 W/ft².

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.

Figure 8: Example Fixture with Integrated Occupancy Controls



Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture. Lighting controls that include dimming will likely require full fixture replacement, which drive up the total cost of implementation for the measure.

- This measure assumes lighting savings of approximately 0.48 W/ft² in lighting energy.
- O&M savings assume an average cost of $2.45/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 10: ECM 2 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Annual O&M Savings($)	Est Project Cost	Simple Payback (Yrs)
LED Upgrade	0	5,341	18	2	$588	$255	$6,000	10
Overall % Reduction	0%	3%	1%	1%	2%	--	--	--

5 Measure Requiring Additional Consideration

No additional ECMs have been considered.

6 Appendix A

Table 11: Monthly Utility Data (2023 to 2024)

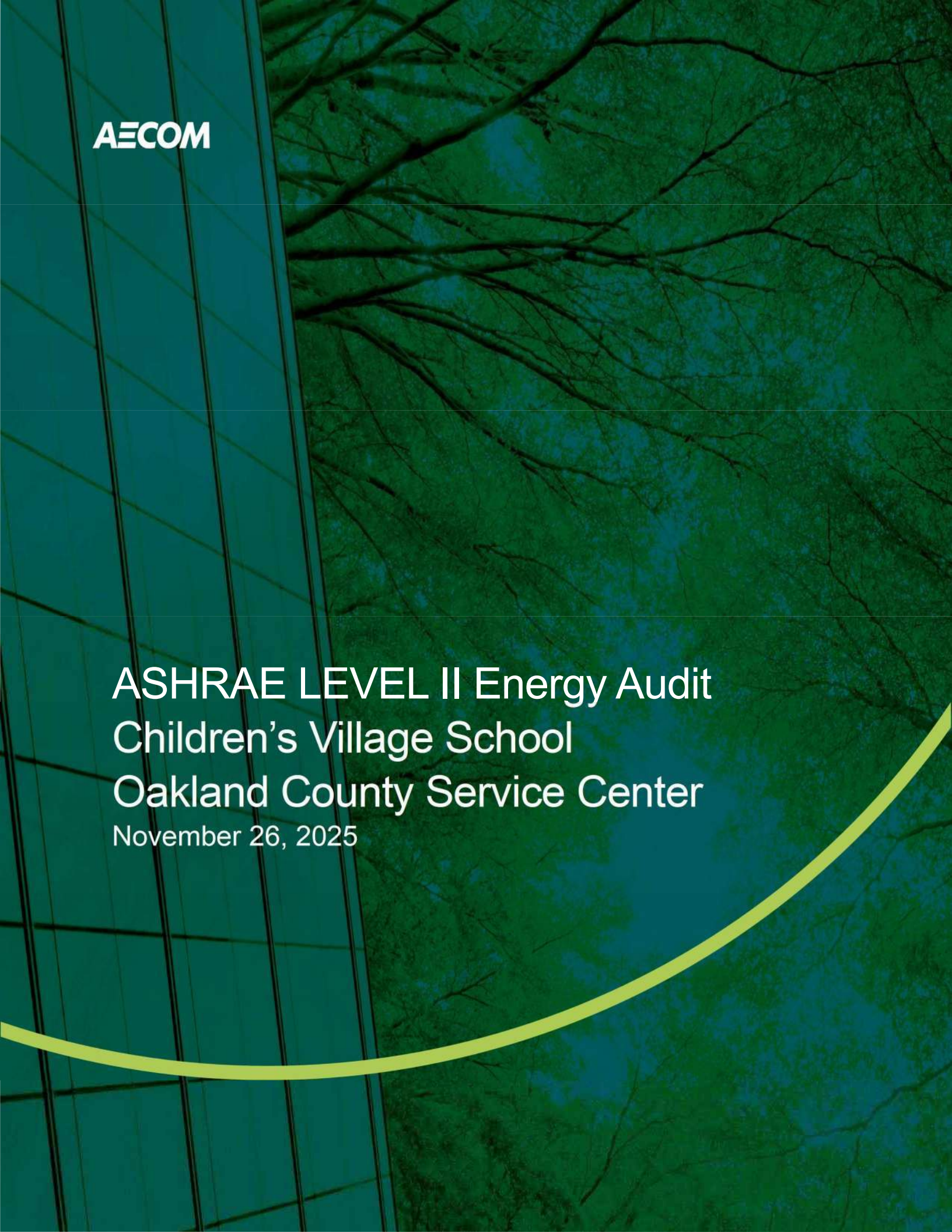
Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	200	$1,231	12,320	$1,322	17	22	1,051	0
Feb-23	204	$1,195	13,120	$1,236	20	24	955	0
Mar-23	185	$565	12,800	$1,148	17	28	918	0
Apr-23	110	$382	12,720	$1,119	18	29	525	28
May-23	88	$264	15,760	$1,243	21	35	283	76
Jun-23	26	$63	16,000	$1,198	22	35	86	139
Jul-23	9	$35	25,040	$2,027	34	47	11	227
Aug-23	10	$29	16,880	$1,341	23	34	48	141
Sep-23	19	$53	13,840	$1,274	19	31	113	85
Oct-23	68	$197	13,680	$1,113	18	29	415	31
Nov-23	161	$600	15,200	$1,167	21	35	779	0
Dec-23	256	$1,262	19,440	$1,380	26	33	834	0
Jan-24	320	$1,410	17,840	$412	24	32	1,194	0
Feb-24	268	$1,460	25,920	$2,651	39	48	874	1
Mar-24	171	$967	5,760	$465	8	12	771	2
Apr-24	121	$253	12,800	$1,123	18	36	437	21
May-24	42	$85	16,000	$1,453	22	35	148	98
Jun-24	11	$34	18,080	$1,661	25	39	51	207
Jul-24	7	$22	18,320	$1,632	25	34	18	251
Aug-24	7	$15	16,560	$1,523	22	33	37	215
Sep-24	18	$43	16,640	$1,334	23	38	84	112
Oct-24	74	$197	12,240	$1,163	16	26	356	31
Nov-24	98	$339	10,400	$1,122	14	24	607	4
Dec-24	245	$544	15,120	$1,272	20	26	1,037	0
2023 Sum	1,337	$5,876	186,800	$15,568			6,019	727
2024 Sum	1,380	$5,369	185,680	$15,811			5,614	942

7 Appendix B

Table 12: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Efficiency	Capacity 2	Approx Year Installed
MAU-1	1	Air handling unit		Greenheck	MPX-P22H34-26-DB	800 in, 640 out	MBTU	5 HP	
MAU-2	1	Air handling unit		Greenheck	RV-35-10.0	300 in, 240 out	MBTU	2 HP	
	1	HHW Boiler		Lochinvar					
UH	1	Unit heater	Loading dock	Sterling					
	1	Domestic water heater							2017
	1	Air compressor							
	1	Cooler Unit		Kolpak	410066448B	23'1x14'5x9'6.25	FT		2013
	1	Freezer Unit		Kolpak					
ACCU-1	1		Kitchen fridge						
ACCU-2	1		Kitchen freezer						
EF-1K	1	Exhaust fan		Greenheck	CUBE-220HP-20-G	1	HP		
EF-2K	1	Exhaust fan		Greenheck	CUBE-220HP-20-G	1	HP		
EF-3K	1	Exhaust fan		Greenheck	4HZ48G	0.25	HP		
EF-4K	1	Exhaust fan		Greenheck	4HZ4BG	0.125	HP		
EF-5K	1	Exhaust fan		Greenheck	4HZ41G	0.25	HP		

AECOM



AECOM

ASHRAE LEVEL II Energy Audit
Children's Village School
Oakland County Service Center
November 26, 2025

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

Prepared for:
OAKLAND COUNTY, MI Government

Prepared by:
AECOM

Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Children's Village School in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County Children's Village is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Wednesday April 16, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates four ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The three recommended measures represent a projected 22% annual energy cost savings with an aggregate simple payback of 7 years.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be "electrification-ready" to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE's prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Children's Village School Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M Cost and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	tCO2e	$/yr	$/yr	$	Years
1	Retro-Commissioning	MED	R	8,384	0	552	0	84	6.6	$0	$1,187	$10,547	9
2	LED Lighting Upgrade	MED	R	21,600	5	0	0	74	10	$1,006	$2,376	$19,950	8
3	VFDs on Pumps	HIGH	R	14,620	0	0	0	50	6	$0	$1,608	$4,500	3
Sum of Recommended Measures				44,605	5	552	0	207	23	$1,006	$5,172	$34,997	7
Overall % Reduction				26%	14%	7%	0%	15%	19%	--	22%	--	--
N/A	Upgrade Pneumatic Controls to DDC	N/A	NR	2,970	1	0	0	10	1	$0	$327	$52,734	NA

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Children's Village, a detention facility, functions as a residential center for juvenile detainees, offering a structured environment that supports their education during rehabilitation. The School Building within this complex was built in 1974. The concrete masonry unit (CMU) building features a beige brick veneer and is one story, with a concrete deck roofing. The insulation under the roof membrane is expected to be minimum R-20.

The school can accommodate up to 100 children who can continue their education during their detention period. The students have concluded their initial phase of treatment and are no longer required to remain in full detention. The building includes classrooms, office spaces, a dining room, a garage, and a kitchen that prepares them to reintegrate into social life seamlessly.

2.1 Building Systems

2.1.1 Building Envelope

The building has one above-grade level and a mezzanine level. The window/wall ratio is estimated to be about 10%. The windows appear to be in good condition; however, they are single-pane windows and are assumed to be original to the building.

The walls are CMU structures with brick veneer on the exterior. There is no insulation on the interior side. The concrete roof deck is covered with black tar roof membrane the insulation levels are unknown at this stage.

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	CMU structure with brick veneer	Good
Roof	Concrete insulation above deck	Good
Glazing	Single pane, aluminum frame, tinted windows are original, 10% window/wall ratio	Good

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

Two natural gas-fired condensing boilers having 1,440 MBH capacity each supply heating and reheat for the zones. The hot water is mixed with glycol to be able to serve rooftop units (RTUs). There are six RTUs, out of which three are decommissioned and three are at the end of their useful life. The decommissioned units are packaged heating and cooling units, and the newer units are fed from the boilers for heating. In addition, baseboard heating is used in some spaces, which is fed from hot water through the boilers.

Two 7.5 horsepower (HP) heating hot water circulation pumps are at the end of their useful life with 86% motor efficiency.

One 1-ton mini-split air conditioning unit serves the server room closet.

2.1.2.2 Plumbing

The domestic hot water is supplied by an AO Smith 40 MBH gas-fired 50-gallon water heater. The heater was installed in 2019 and is in good operating condition.

2.1.2.3 Building Controls

Pneumatic actuators control the air handling unit (AHU) dampers. The zone thermostats are at the end of their useful life and need replacement for a better integration with the building management system.

2.1.3 Lighting Systems

During the site visit, lighting fixtures were observed to vary based on room layout, including recessed, ceiling-mounted, and suspended types. Fluorescent fixtures are rated at 32W, while light emitting diode (LED) fixtures are rated at 12W.

Table 3: Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
LED Lights	60	2 lamps
Fluorescent	114	1 lamp

An approximate total of lighting fixtures per floor, includes 60 fixtures with 2 lamps, and 114 fixtures with 4 lamps. The approximate total wattage is 16,032 watts. The approximate area per drawing is 26,367 ft² with an calculated lighting density of approximately 0.6 W/ft².

2.1.4 Electrical Infrastructure

The facility is served by a 300 kVA, 208/120V transformer located outside the building. The meter associated with this service is number 30 124 670, and the main service rating is 600 amps at 120/208V, 3-phase. The meter does show demand; a spot measurement was taken, recording 0163 9200 kilowatt-hours. There is no backup power system in place, and no generator is installed. Although a 1000A switchboard exists on-site, it may be disconnected. The primary active service equipment appears to be the PP-1 panel, which is rated at 600A.

3 Utility Billing Analysis

3.1 Utility Type and Usage

The Children's Village School receives electric service, natural gas service, and is not connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

Table 4 summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

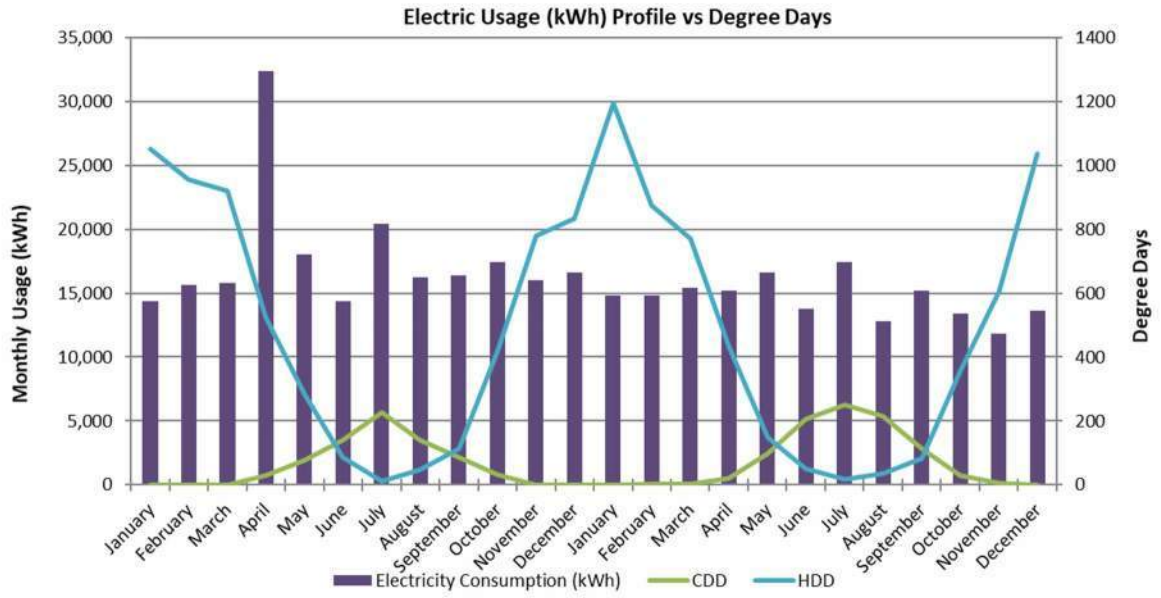
Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	174,800 kWh	596	$19,228	$0.11/kWh	0.0004427	77
Natural Gas	755 MCF	783	$3,758	$4.98/MCF	0.0549206	41
Total	**--**	**1,380**	**$22,985**	**--**	**--**	**119**

**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage is relatively flat throughout the year with a slight uptick during the summer months associated with summer cooling. An anomaly in April 2023 appears to be a data error, either due to metering or data transfer. The majority of usage appears to consist of baseload usage. This usage does not vary much from month to month and includes loads such as lighting, fans, and pump loads. The annual usage for the baseline 12-month period from January to December 2024 is 174,800 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

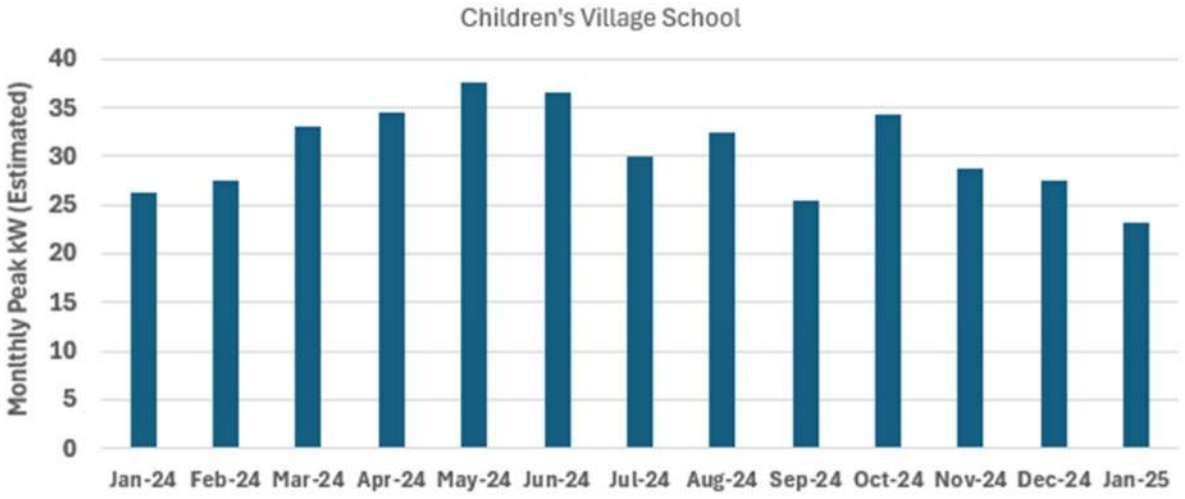
The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 5: Electric Capacity Results

Maximum Building Capacity at Service Transformer	300 kW
Maximum Capacity at Switchgear (A*V*Ph)	216 kW
Estimated Peak Demand	37.6 kW (estimated)
Remaining Capacity	**180 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to

each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge **$6.15/kW/Month**

Average Dollar per kWh Used in Calculations: **$0.11/kWh**

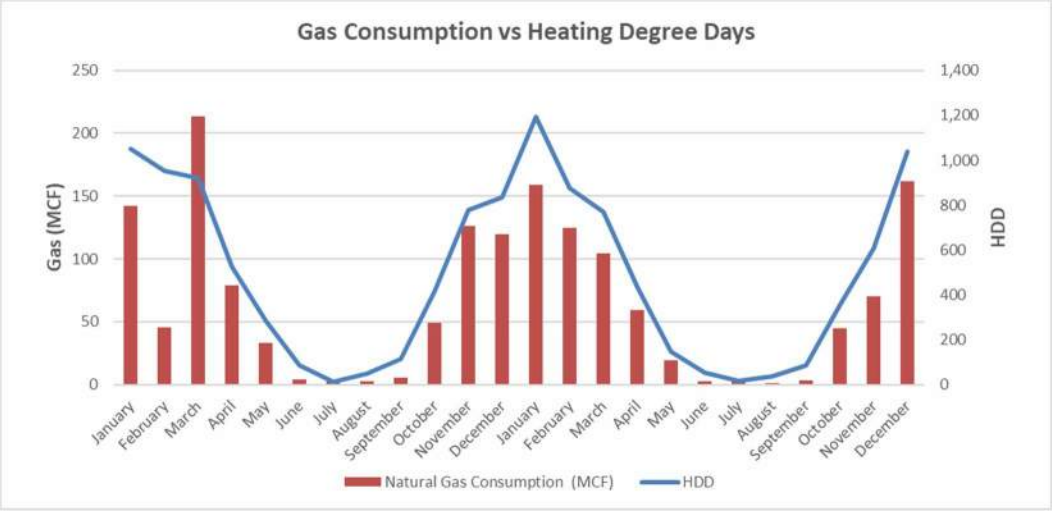
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows a direct correlation to weather data, as natural gas is primarily used for space heating. A small amount of natural gas is used for domestic hot water for bathroom use. The annual usage for the baseline 12-month period from January to December 2024 is 755 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): $3.48/dTh (decatherm, or 1.038 MCF)

Constellation NG Usage Charge (Day Gas): $5.29/dTh (decatherm, or 1.038 MCF)

Average Dollar per MCF Used in Calculations: $4.98/MCF

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter, and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$19,228
Natural Gas	$3,760
Total	$22,988
ECI $/yr/sf	$0.87

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each

emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

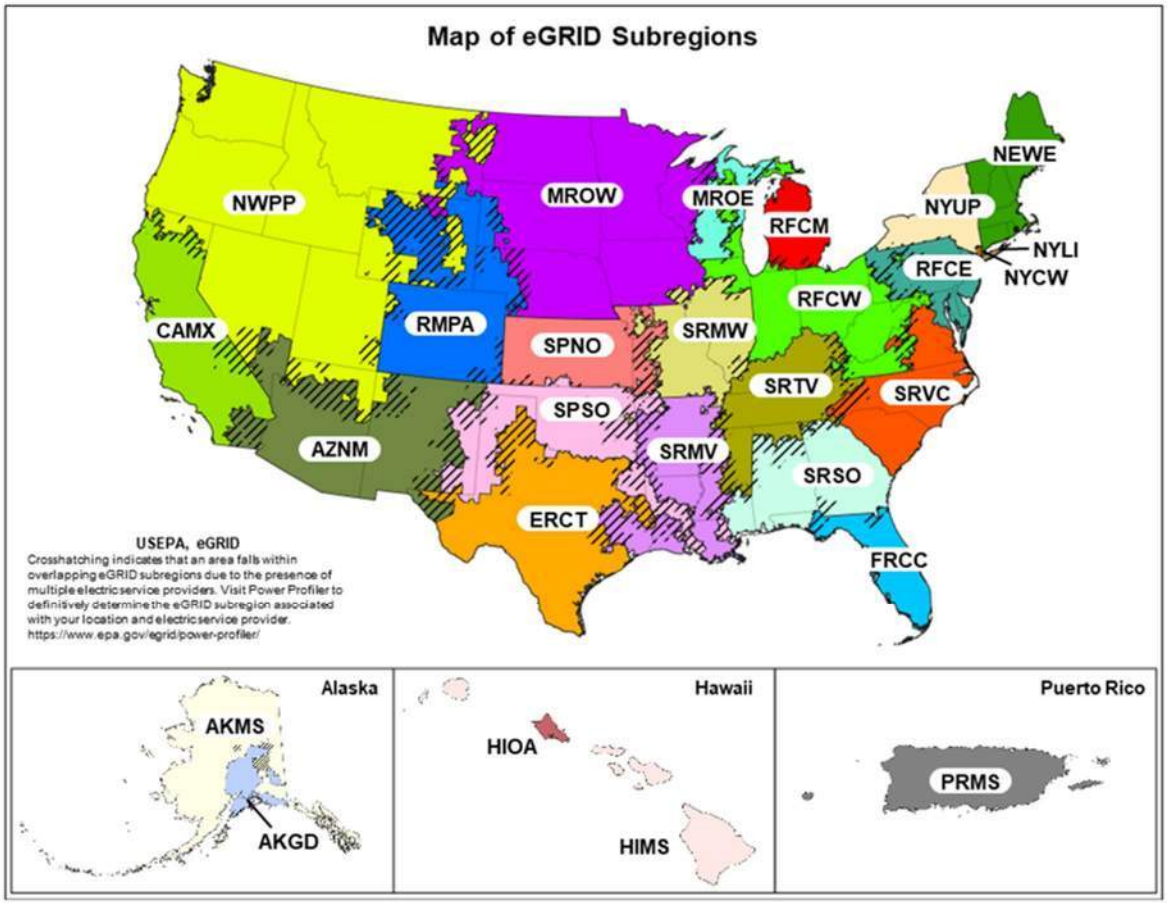
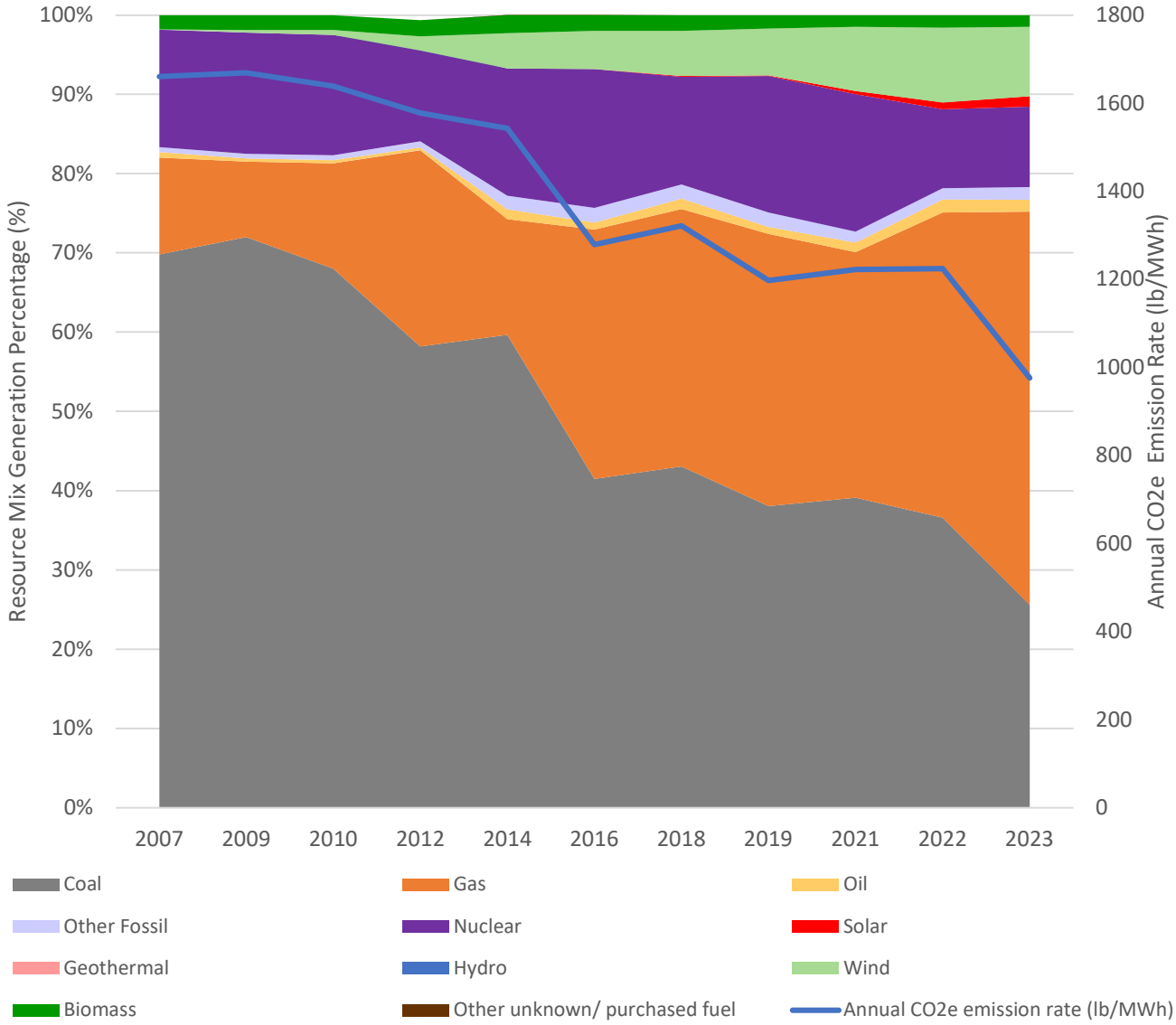


Figure 5 displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 35 percent of carbon emissions are attributed to natural gas and 65 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 41 tCO2e (campus-level Scope 1) and 77 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 119 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for the Children's Village School are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Children's Village School				**Electric EUI:**		23	kBTU/SF/yr
GFA:	26,367	SF			**Gas EUI:**		30	kBTU/SF/yr
eGRID Subregion:	RFCM				**Current EUI**		52	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	174,800	kWh	3.412	596	0.0004427	77	$19,228	84%
Natural Gas	755	MCF	1.038	783	0.0549206	41	$3,758	16%
		Totals		**1,380**		119	$22,986	100%

According to the US EPA, the average site energy use intensity for a school is 48.5 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 52 kBTU/SF, which is on par with the national benchmark. It's important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. While the EUI is near the national average, observations from the site visit indicate there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

U.S. National Median Reference Values for All Portfolio Manager Property Types

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Banking/Financial Services	Bank Branch *		209.9	88.3	CBECS - Bank/Financial
	Financial Office*		116.4	52.9	CBECS - Office & Bank/Financial
Education	Adult Education		110.4	52.4	CBECS - Education
	College/University		180.6	84.3	CBECS - College/University
	K-12 School*		104.4	48.5	CBECS - Elementary/Middle & High School
	Pre-school/Daycare		131.5	64.8	CBECS - Preschool
	Vocational School		110.4	52.4	CBECS - Education
	Other - Education				
Entertainment/Public Assembly	Convention Center		109.6	56.1	CBECS - Social/Meeting
	Movie Theater		112.0	56.2	CBECS - Public Assembly
	Museum				
	Performing Arts				
	Recreation	Bowling Alley	112.0	50.8	CBECS - Recreation
		Fitness Center/Health Club/Gym			
		Ice/Curling Rink			
		Roller Rink			
		Swimming Pool			
		Other - Recreation			
	Social/Meeting Hall		109.6	56.1	CBECS - Social/Meeting

3.8 End Use Distribution

Table 8 below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees and students. Table 8 and Figure 7 and Figure 8 show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	709	0	736,240	28	39
Space Cooling	17,427	0	0	59,460	2	8
Fans	60,172	0	0	205,306	8	27
Pumps	34,195	0	0	116,672	4	15
DHW	0	45	0	47,040	2	2
Conveyance	0	0	0	0	0	0
Lighting	40,500	0	0	138,185	5	18
Plug Loads	17,537	0	0	59,836	2	8
Process Loads	2,970	0	0	10,135	0	1
Refrigeration	2,000	0	0	6,824	0	1
Cooking	0	0	0	0	0	0
Information Technology	0	0	0	0	0	0
TOTAL	174,800	755	0	1,379,698	52	119
Historical Billing	174,800	**755**	0			
Percent of Actual	100%	100%	0%			
per sqft	6.6	**0.03**	0			

Figure 7: Existing Electricity End Use Distribution

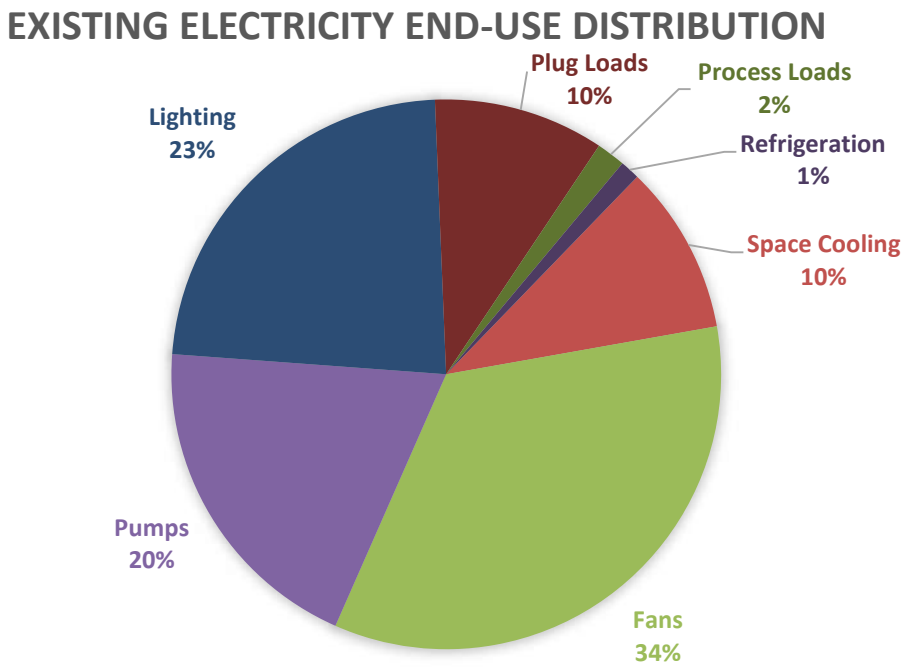
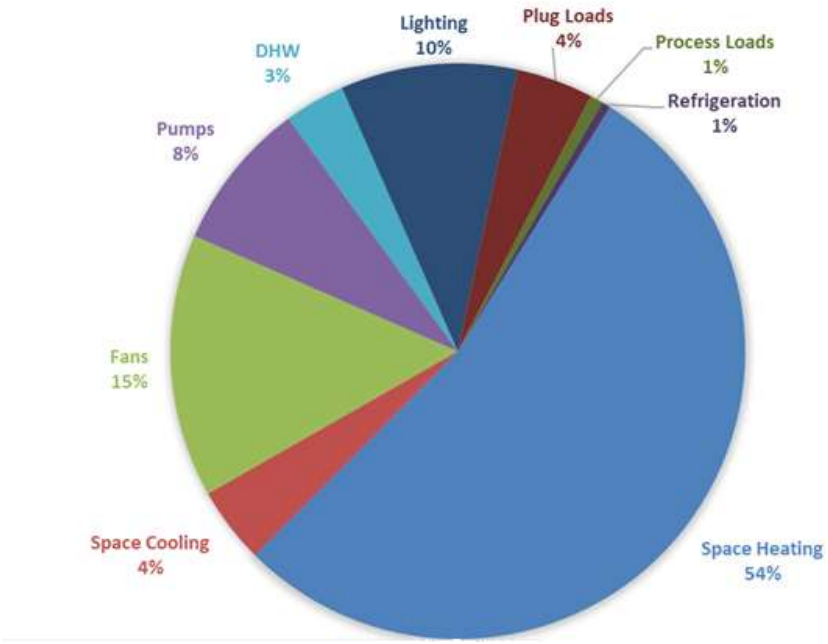


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 - Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent.

Observations from the site visit indicate that not all systems are operating optimally and can be modified or repaired to improve efficiency. A few examples include:

- The hot water system does not appear to have an outdoor air temperature reset sequence.
- RTUs do not have demand-controlled ventilation and occupancy varies from maximum design. CO2 sensors can be installed to reduce ventilation rates as needed to reduce fan, heating, and cooling energy.
- The HVAC systems have a combination of outdated pneumatic controls and local zone thermostats which can be upgraded to DDC controls and connected to the central BAS system to improve functionality and reduce energy use.

While each of these individual examples are minor concerns, these illustrate an opportunity to systematically evaluate all major systems to identify and resolve similar operational discrepancies to optimize system performance and reduce energy usage. The following list represents RCx opportunities that should be evaluated to validate operation, modify and/or repair if discrepancies identified if systems not scheduled for timely replacement. This effort will proactively improve building system operation and optimize energy usage.

- Optimize HVAC scheduling
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control

- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water supply reset
- Discharge air setpoint reset
- Outside air temperature lockouts
- Outside air damper control
- Duct static pressure reset
- Repair airside economizing
- Demand-controlled ventilation
- Repair/seal AHU air leaks
- Repair or replace missing or damaged insulation on hot water, steam, and/or condensate pipes
- Upgrade pneumatic controls to direct-digital controls (DDC) and integrate with BAS

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 7.5% reduction in estimated heating, cooling, and fan use end use energy consumption.
- Additional study of equipment capacity requirements could be performed as part of this measure.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: This measure proposes engaging a third-party contractor to determine if this building is eligible for the DTE RCx program and systematically evaluate and prioritize major HVAC and control systems and complete retro-commissioning to restore systems to their original design intent. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 9: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Annual O&M Costs Savings($)	Est Project Cost	Simple Payback (Yrs)
RCx	53	8,384	84	7	$1,187	$0	$10,547	9
Overall % Reduction	7%	5%	6%	6%	5%	--	--	--

4.2 ECM 2 – LED Lighting

This measure proposes upgrading all remaining fluorescent lighting to light-emitting diode (LED) lightbulbs with motion sensors and dimming functionality where appropriate to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements. The current lighting in the Children's Village Building School is mix of LED and fluorescent and the estimated wattage is approximately 0.6 W/ft².

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.

Figure 9: Example Fixture with Integrated Occupancy Controls



Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.

- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- O&M savings assume an average cost of $1.75/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- This measure assumes lighting savings of approximately 0.20 W/ft² and 30% reduction in lighting energy through implementation of controls.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 10: ECM 2 Savings and ROM Cost

	Savings Summary							
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**Annual O&M Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
LED Upgrade	0	21,600	74	10	$2,376	$1,006	$19,950	5.9
Overall % Reduction	0%	12%	5%	8%	10%	--	--	--

4.3 ECM 3 - Variable Frequency Drives for Pumps

Variable Frequency Drives (VFDs) on pumps will provide a dynamic and energy-efficient solution by allowing precise control of pump speed, optimizing performance, and reducing unnecessary energy consumption during periods of lower demand. The two existing 7.5 HP hot water pumps do not have VFDs and run at constant speed. This ECM proposes evaluating the heating hot water system pumps for feasibility to add a VFDs to reduce pump energy. This may be coupled with a routine upgrade of pumps as they near end of useful life to include premium efficiency motors and VFDs.

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- VFDs will be most effective when paired with a BAS to automatically control speeds.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed. VFDs will likely increase the service life of the equipment if properly selected and installed.
- The savings for this measure assume an average 20% reduction in equipment speed.
- If coupled with routine upgrades to include premium efficiency motors additional energy savings may be achieved.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the heating hot water system pumps for compatibility with a VFD and assess the usage pattern and energy consumption. Once this data is collected, select the appropriate type of VFD. Choose VFD based on compatibility with current systems, programmability, and reliability.

ECM Savings and ROM Cost:

Table 11: ECM 3 Savings and ROM Cost

Savings Summary								
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**Annual O&M Costs Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
VFDs for Pumps	0	14,620	50	6	$1,608	$0	$4,500	3
Overall % Reduction	0%	8%	4%	5%	7%	--	--	--

5 Measure Requiring Additional Consideration

This section provides details on measures that were analyzed but are not recommended for immediate implementation at this time. This includes measures that require further study, such as capital-intensive replacements of existing equipment, but are not justified through energy savings alone. This section may also include measures that conflict with building electrification plans, or projects that are simply not recommended due to being financially impractical or not being technically feasible.

5.1 Upgrade Pneumatic Controls to DDC

Pneumatic controls upgrades refers to the process of upgrading antiquated pneumatic control systems and components to direct digital controls (DDC) and integrating it with a centralized control system. Pneumatic controls use compressed air to operate valves and dampers and are prone to operational and maintenance issues. Upgrading these antiquated controls to DDC will enhance the overall efficiency, functionality, and manageability of HVAC system operation. This measure directly produces electricity savings by eliminating the need for a compressed air system, but also indirectly contributes additional energy savings by enabling better control and functionality such as scheduling and optimization. The RTUs systems in this building have outdated pneumatic controls for all components, however 3 of the RTUs were recently decommissioned and the others are near end of useful life as well. A 2 HP air compressor provides compressed air to the system to control the AHU. This measure is not recommended as a standalone measure due to the age and condition of the existing equipment and need for a routine capital upgrade. Controls upgrades can be included in ECM 1 for isolated systems as identified in the recommended RCx project or upgraded when major systems are replaced to maximize benefits.

ECM Savings and ROM Cost:

Table 12: ECM 3 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Annual O&M Costs Savings ($)	Est Project Cost	Simple Payback (Yrs)
Upgrade Pneumatic Controls to DDC	0	2.970	10	1.3	$327	$0	$52,734	161
Overall % Reduction	0%	2%	0.7%	1.1%	1.4%	--	--	--

6 Appendix A

Table 13: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	142	$874	14,400	$1,545	19	26	1,051	0
Feb-23	46	$268	15,600	$1,469	23	29	955	0
Mar-23	213	$650	15,800	$1,417	21	34	918	0
Apr-23	79	$273	32,400	$2,851	45	73	525	28
May-23	33	$99	18,000	$1,420	24	40	283	76
Jun-23	4	$10	14,400	$1,079	20	31	86	139
Jul-23	3	$12	20,400	$1,651	27	38	11	227
Aug-23	3	$8	16,200	$1,287	22	32	48	141
Sep-23	6	$16	16,400	$1,510	23	37	113	85
Oct-23	49	$142	17,400	$1,416	23	37	415	31
Nov-23	126	$471	16,000	$1,229	22	37	779	0
Dec-23	120	$590	16,600	$1,178	22	28	834	0
Jan-24	159	$699	14,800	$342	20	26	1,194	0
Feb-24	125	$679	14,800	$1,514	22	28	874	1
Mar-24	105	$592	15,400	$1,242	21	33	771	2
Apr-24	60	$124	15,200	$1,333	23	38	437	21
May-24	19	$39	16,600	$1,196	22	37	148	98
Jun-24	3	$9	13,800	$1,268	19	30	51	207
Jul-24	4	$12	17,400	$1,550	23	32	18	251
Aug-24	1	$3	12,800	$1,177	17	25	37	215
Sep-24	3	$8	15,200	$1,219	21	34	84	112
Oct-24	44	$119	13,400	$1,273	18	29	356	31
Nov-24	70	$243	11,800	$1,273	16	28	607	4
Dec-24	162	$360	13,600	$1,144	18	23	1,037	0
2023 Sum	824	$3,413	213,600	$18,052			6,019	727
2024 Sum	755	$2,887	174,800	$14,531			5,614	942

7 Appendix B

Table 14. Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Units	Capacity 2	Approx Year Installed
AC-1	1	Rooftop air conditioning unit (HW, glycol)		McQuay	RPS-12B	4700	CFM	135.4 MBH	
AC-2	1	Rooftop air conditioning unit (HW, glycol)		McQuay	PRS-008B	3200	CFM	87.5 MBH	
AC-3	1	Rooftop air conditioning unit (HW, glycol)		McQuay	RPS-12B	4400	CFM	152.5 MBH	
AC-4	1	Rooftop air conditioning unit (HW, glycol)		McQuay	RPS-010C	3285	CFM	113 MBH	
AC-5	1	Rooftop air conditioning unit (HW, glycol)		McQuay	RPS-12B	4460	CFM	154.5 MBH	
	1	RTU		Bryant	580JP04A115A20AAA			115 MBH	
	1	Mini split AC unit	Server room closet			1	TON		
HHW Boiler 1,2	2	Gas fired heating boiler	Heat (AHU) and reheat (baseboards)	Mach	C-1500	1440	MBH		2010
	1	Domestic wter heater		AO Smith	GCG-50 400	40	MBH	50 Gal	2019
	1	Air compressor		Quincy		2	HP		2020
P-1,2	2	Baseboard pumps	HW heating			7.5	HP		

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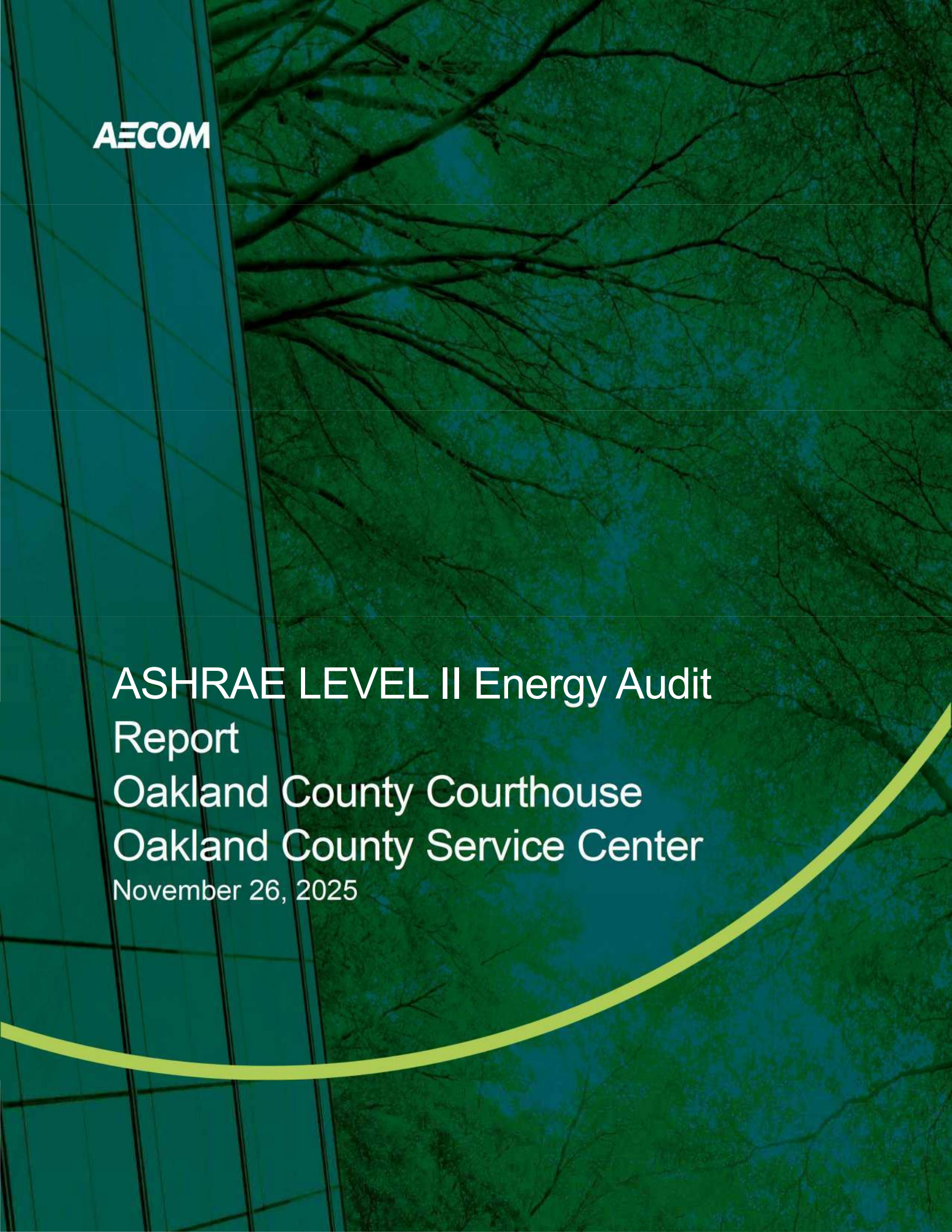

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ASHRAE LEVEL II Energy Audit Report
Oakland County Courthouse
Oakland County Service Center

November 26, 2025

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

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OAKLAND COUNTY, MI Government

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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Courthouse Building in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County Courthouse is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates 16 ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. Eight of the 16 measures are recommended for implementation, 5 additional measures recommended for further study. Three of the ECMs are not recommended at this time due to low payback or minimal impact. The 8 recommended measures represent a projected 38% annual energy cost savings with an aggregate simple payback of 10.7 years.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan Deliverable. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Proposed Energy Savings Summary

ECM #	Energy Conservation Measure Description	Priority	Measure Status	Year -1 Electricity Savings	Demand Reduction (kW)*	Year -1 Gas Savings	District Steam Savings	Total Energy Saved	Green House Gas Savings	O&M and Water	Year - 1 Cost Savings	Project Cost (Est)	Simple Payback Period
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	tCO2e	$/yr	$/yr	$	Years
ECM 1	Convert all pneumatic controls to electric controls.	HIGH	R	307,712	51	0	8,923	11,704	1,198	$15,000	$138,077	$1,245,300	9.0
ECM 2	Convert dual duct air distribution system to single duct VAV with reheat.	MED	R	278,051	69	0	14,277	17,995	1,822	$26,000	$199,352	$4,151,000	20.8
ECM 3	Install VFDs on heating hot water circulation pumps in the West Wing Extension	HIGH	R	65,350	9	0	0	223	29	$0	$7,188	$22,500	3.1
ECM 4	Install motion sensors in offices and in mechanical rooms	MED	R	100,639	13	0	0	343	45	$0	$11,070	$103,775	9.4
ECM 5	Retrofit fluorescent lighting in the office spaces	MED	R	201,277	64	0	0	687	89	$5,189	$27,329	$415,100	15.2
ECM 6	Replace three water-cooled AC units using city water with split cooling	HIGH	R	5,845	0	0	0	20	3	$79,471	$80,114	$116,160	1.4
ECM 7	Replace water-cooled refrigeration using city water with split cooling	MED	R	4,384	0	0	0	15	2	$59,603	$60,085	$210,600	3.5
ECM 8	Upgrade the lighting design in Auditorium.	LOW	R	25,160	5	0	0	86	11	$250	$3,018	$30,000	9.9
ECM 9	Building Retrocommissioning	HIGH	RS	379,799	30	0	6,262	8,772	913	$0	$104,395	$136,983	1.3
ECM 10	Upgrade windows	MED	RS	174,514	34	0	8,923	11,249	1,139	$0	$108,425	$1,600,000	14.8
			Sum	**988,416**	**211**	**0**	**23,200**	**31,073**	**3,198**	**$185,513**	**$526,233**	**$6,294,435**	**12.0**
			Overall % Reduction	26%	22%	0%	37%	35%	35%				

Measures Considered but not Recommended													
ECM #	Energy Conservation Measure Description	Priority	Measure Status	Year -1 Electricity Savings	Demand Reduction (kW)*	Year -1 Gas Savings	District Steam Savings	Total Energy Saved	Green House Gas Savings	O&M and Water	Year - 1 Cost Savings	Project Cost (Est)	Simple Payback Period
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	tCO2e	$/yr	$/yr	$	Years
ECM 11	Remove central domestic water heaters and install local under sink electric heaters in restrooms	MED	RS	-766,927	0	0	3,131	1,121	33	$0	-$53,054	$16,000	NA
ECM 12	Retrofit old VFDs at the end of their useful life	MED	RS	15,300	0	0	0	52	7	$0	$1,683	$52,500	31.2
ECM 13	Upgrade domestic water pressurization system with VFD driven pumps in West Wing Tower.	MED	RS	4,132	0	0	0	14	2	$0	$454	$12,500	27.5
ECM 14	Replace Absorption Chiller	HIGH	NR	0	0			0	0	$14,000	$14,000	$2,294,000	163.9
ECM 15	Replace the restroom faucets with motion activated low flow fixtures	MED	NR	0	0	0	0	0	0	$1,183	$1,183	$18,000	15.2
ECM 16	Replace the toilets and urinals with motion activated low flow fixtures	LOW	NR	0	0	0	0	0	0	$4,205	$4,205	$72,000	17.1

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Oakland County Courthouse complex houses the 6th Judicial Circuit Court, which is one of the busiest trial courts in the U.S. It includes divisions for civil, criminal, family, and probate matters. The courthouse also features specialized programs like the Adult Treatment Court and the Combat Veterans Treatment Court for rehabilitation-focused justice.

The Oakland County Courthouse complex consists of five interconnected blocks: the Tower, West Wing, East Wing, West Wing Extension, and the Auditorium. The Tower, built in 1960, is the main courthouse facility with six stories above grade, a mechanical penthouse, and one floor below grade. The West Wing (1963) and East Wing (1968) serve primarily as office space. The West Wing Extension (1994) also houses courtrooms and is the most recent addition. The Commissioners Auditorium (1964) and serves public-facing functions.

Table 2: Buildings Summary

Block Name	Gross Floor Area (ft2)	Construction Year
Tower	111,279	1960
West Wing	61,230	1963
Auditorium	14,770	1964
West Wing Extension	141,570	1994
East Wing	85,660	1968

Business hours for the courthouse complex are 6:00 AM to 5:00 PM on weekdays. Custodial staff typically remain on-site until midnight, after which lighting systems are shut off. Heating, ventilation, and air conditioning (HVAC) systems remain operational until midnight and resume between 5:00 to 6:00 AM, depending on outdoor conditions. The facility is fully conditioned and operates year-round.

2.1 Building Systems

2.1.1 Building Envelope

The envelope varies considerably between blocks. The West Wing is a fully glazed façade except for vertical columns. Glazing in the courthouse buildings is predominantly single-paned, which results in significant heat loss and exhibits substantial air leakage, particularly in the Tower, where thermal images show poor frame insulation. The West Wing Extension is the only portion of the complex with double-pane glazing.

Roof systems are flat, black-coated membranes installed above a concrete deck, with estimated insulation values of R-20 or less, particularly in older blocks. No active roof leaks were reported by the facilities team. Overall, envelope performance is consistent with the building ages, with notable potential for energy savings through fenestration and insulation upgrades.

Table 3: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Masonry, curtain wall in West Wing	Moderate to poor (air leakage, minimal insulation)
Roof	Flat roof with black membrane	Assumed R-20 or less (age-dependent)
Glazing	Single-pane (except West Wing Extension: double-pane)	Poor to moderate

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The building has one 1100-ton centrifugal variable speed electric York electric chiller and a 740-ton absorption chiller. The absorber is used as a redundancy and is not normally used as the absorber cannot keep up with the electric chiller. The electric chiller can provide cooling to the entire facility. The chiller is only used for comfort cooling and is turned off at night. The chiller's cut-in setpoint is 58°F and above. Between 45°F and 58°F, the facility utilizes air-side free cooling as the humidity levels allow.

The server rooms are cooled by mini-splits, and the chillers can be turned off during unoccupied mode and during cold weather. The absorber's Coefficient of Performance (COP) is lower than the electric chiller's, which typically ranges from 1.2 to 4.5. Using the central plant to produce steam for absorber cooling relies on natural gas combustion, thus increasing the County's Scope 1 emissions. The absorber's efficiency reduces further when factors including the boilers' combustion efficiency, stand-by losses, and distribution losses are considered. Overall, the chillers are in good condition.

Chilled water is distributed to the facility in a variable-primary chilled water loop configuration. The West Wing Extension, was integrated into the chilled water infrastructure upon its construction, and the chilled water flow is controlled by a three-way control valve for this block

Two variable frequency drive (VFD)-driven 100 horsepower (HP) chilled water pumps (CHWP) distribute chilled water to the entire facility. The CHWPs' speed is modulated based on the differential pressure setpoint of 18 PSI between the West Supply and the main return pipe. There is no control over the East supply branch. Three 75 HP condenser water pumps serve four cooling towers (CT). All pump and CT fan speeds are controlled by VFDs. Three 4-ton split air-conditioning (AC) units serve the server rooms of the West Wing Extension. One unit is on the roof, the second unit is near the air intake on the ground level, and the third unit is in the mechanical room.

Each block in the courthouse complex has its own steam-to-hot water shell and tube heat exchangers (HX). Each HX provides hot water for the perimeter and reheat distribution system. The heating hot water distribution systems are constant volume at each block. The steam flow is controlled based on the return water temperature. The steam trap on the exit side of the HXs hold the steam inside the HX and allow the condensation to flow and fill the condensate return tank. The pumps attached to the condensate return tank pump the water back to the boiler plant. Each heating system is equipped with a condensate return system, and it returns the condensation to the CUP separate piping. The vents on the condensate tanks are piped to the roof. This is convenient for protecting the equipment in the mechanical rooms; however, steam

blowing through these vents is an indication of malfunctioning steam traps. According to the facility operators, the steam escape from the venting system through the roof is significant in the winter, which is an indication of leaky steam traps.

In the Tower, the AHUs are equipped with preheating steam coils. The steam trap piping serving these coils is equipped with three isolation valves for enabling service without disrupting the heating. The valves appeared to be old and they also require testing and service for leakage.

All heating systems per block have similar layout with varying sizes. In the West Wing Extension, like all other HXs in other blocks, the facility receives steam at 120 pounds per square inch (PSI) from the central plant. The underground steam supply and return piping within the tunnel bring steam from the central plant for heating and domestic water heating. The smaller pipe is the condensate return pipe. The insulation of underground pipes is observed to be in good condition. Reheat pumps are 15 HP, and the baseboards are 10 HP pumps. 15 HP pumps are rated as 91% efficient with 85.5% power factor (PF). 10 HP pumps are rated as 89.5% efficient with 83% PF. These pumps are constant speed, and VFD installation is recommended. The constant volume perimeter heating system at the West Wing Extension causes issues between the perimeter fin tube radiator valves. The pipe dimensions that these valves are on are reduced from the main pipes and causing high velocity on the valves' back pressure. During low heating load conditions, when the valves close, the velocities increase. The high velocity low pressure water flow cause cavitation and causes significant hammering noise, which is damaging the piping infrastructure. Furthermore, the noise is a nuisance for the employees and visitors of the West Wing.

In addition to the steam and hot water heating systems, there are electric unit heaters that provide heating for the stairwells.

There are 19 air handling units (AHUs) throughout the facility. The older AHUs are a dual duct system with a single fan supply. Hot deck supply temperature setpoints are adjusted according to the heating calls from each floor. The heating coils are in the duct branches serving each floor. The AHUs are equipped with chilled water coils and economizers. Nearly all AHU fans have VFDs; however, most AHU fan VFDs need replacement due to their age. All fan speeds are modulated by the duct static pressure setpoint and seem to be functioning properly. A detailed trend data analysis is needed to better understand the operations.

The efficiency rating labeling for electric motors began in the United States with regulations set by the Department of Energy (DOE). The labeling requirements were established to ensure that electric motors display their nominal full-load efficiency on the nameplate. This regulation was first implemented in October 2004. Many AHU motors do not include efficiency ratings on their labels. For example, one AHU is equipped with a 40 HP supply fan (SF) motor and a 25 HP return fan (RF) motor. These motors do not have efficiency ratings on their nameplates, indicating they are at least 22 years old. The efficiency ratings of these motors are expected to range between 85% to 90%. The new motors manufactured after 2023 have an efficiency range between 93% and 95%. On average, new motors will have a 5% improvement potential.

The AHU system, except for the units serving the West Wing and West Wing Extension, is in poor condition. The copper coils are corroded, and the floor and wall surfaces are torn apart, which may pose health issues for the occupants. Additionally, the ducts are deteriorating and have significant air leakage problems. The West Wing AHUs are in better condition and are mostly controlled by Siemens electric actuators. The supply fans are mostly large and belt-

driven. These fans typically use a belt and pulley system to drive the fan blades, allowing for variable speed control and efficient air movement. Most of the fans are original to the building and have exceeded their useful lifespan. The motors are equipped with VFDs to modulate the air volume.

2.1.3 Lighting Systems

During the site visit, lighting fixtures were found to be recessed, ceiling-mounted, or suspended, depending on the room layout and function. The building currently has a mix of lighting, with approximately 50% of fixtures replaced by 12W light emitting diode (LED) and the remaining 50% still use 32W, 34W, 40W fluorescent lamps.

The lighting fixture count is based on the drawings that were provided.

Table 4: Lighting Summary

East Wing	
Total Fixtures	Lamps per Fixture
182	1 lamp
170	2 lamps
Tower	
Total Fixtures	Lamps per Fixture
84	1 lamp
210	2 lamps
West Wing	
Total Fixtures	Lamps per Fixture
~300	Unavailable

The East Wing is a two-story building with an approximate total of 352 lighting fixtures per floor. The total per two floors is 704 lighting fixtures. The approximate total wattage for two floors is 22,824 watts. The approximate area per drawing for two floors is 85,660 ft2. The lighting density is calculated as 0.26 W/ft².

The Tower is a five-story building with an approximate total of 296 lighting fixtures per floor. The total per five floors is 1,480 lighting fixtures. The approximate total wattage for five floors is 57,640 watts. The approximate area per drawing for five floors is 111,270 ft2. The lighting density is calculated as 0.518 W/ft².

The West Wing is a two-story building. Lighting floor plan drawings are not available; the design team assumes approximately 300 fixtures and a total wattage of 19,000 watts. The approximate area is 61,730 ft2. The lighting density is calculated as 0.3 W/ft².

Table 5: West Wing Lighting Summary

Lighting	West Wing Extension	
	Total Fixtures	Lamps per Fixture
Fluorescent Lights	133	2 lamp
LED Lights	157	2 lamp

The West Wing Extension is a five-story building with an approximate total of 290 lighting fixtures per floor. This includes 133 fluorescent fixtures with two lamps and 157 LED fixtures with two lamps. The total per five floors is 1,450 lighting fixtures. The approximate total wattage for 5 floors is 67,640 watts. The approximate area per drawing for five floors is 141,570 ft2. The lighting density is calculated as 0.477 W/ft².

2.1.4 Plumbing

Domestic hot water is generated via steam-to-hot-water heat exchangers, with a supply temperature set to 107°F. Water circulation is managed by 7.5 HP constant-speed domestic water pumps. These pumps are rated at 85.3% efficiency, which is low by modern standards. Their operation was not observed during the site visit, likely due to sufficient city water pressure. No significant plumbing deficiencies were noted.

2.1.5 Building Controls

The courthouse is transitioning from a legacy building management system (BMS) by Kors Engineering to a newer platform provided by Limbach. The new system is designed to monitor global conditions (dry bulb, wet bulb, humidity), building pressures, and main steam pressure. Although the Limbach interface is more user-friendly, some unresolved control issues remain. The full system transition is expected within a year.

Currently, the building operates on a hybrid control architecture with a mix of pneumatic and electric actuators. Pneumatic systems are supported by compressors equipped with dual 7.5 HP motors. No major air leakage issues were identified in the pneumatic distribution system. The West Wing Extension uses modern Siemens electric actuators for its AHUs and outside air dampers.

2.1.6 Air Compressors

The courthouse pneumatic control systems are supported by air compressors equipped with dual 7.5 HP motors, located in the central mechanical spaces. These compressors provide control air to a significant portion of the building’s legacy HVAC infrastructure, particularly in older blocks such as the Tower and East Wing.

The pneumatic distribution system was observed to be in good condition, with no major air leakage reported during the site visit. In contrast, newer areas such as the West Wing Extension have been upgraded to electric actuators, indicating a gradual transition away from pneumatics.

As the County continues to modernize its building automation systems, replacement of pneumatic controls with digital direct digital control (DDC) systems may offer improvements in energy efficiency, responsiveness, and integration

2.1.7 Electrical Infrastructure

The East Wing of the facility is powered by a 500 kVA transformer located in Room E93, with a main electrical service rated at 208/120V, 1600A, 3-phase. A single line diagram is available. The meter measurement indicates a peak load of 27.7 kW on Feeder F for the East Swing. Note that the meter on Feeder E is broken and should be repaired or replaced to ensure accurate monitoring. There is no backup generator serving this section.

Additional electrical infrastructure includes a 1500 kVA chiller substation at 480/277V with a 3200A main bus, a tower section with a 750 kVA transformer at 208V and a peak load of 290.21 kW on a 3000A service, a 300 kVA transformer serving the West Wing at 280Y/120V with a recorded usage of 991,078 watt-hours, and the West Wing extension, which is served by a 1000 kVA transformer with a 480V main bus rated at 2000A and a 1200A service.

3 Utility Billing Analysis

3.1 Utility Type and Usage

The Courthouse receives electric service, natural gas service, and is connected to the steam network. Utility billing is managed through separate arrangements for all fuels. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

Steam usage is metered and billed to the building based on the cost to generate the utility. Steam is the primary heating source for the building.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)
- **Steam:** Oakland County Internal Tracking

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 6: Total Energy Usage and GHG Emissions (2024)

Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	3,797,986 kWh	12,959	$417,778	$0.11/kWh	*0.0004427*	1,681
Natural Gas	317 MCF	329	$1,579	$4.98/MCF	*0.0549206*	17
Steam	62,617 klbs	74,764	$626,167.67	$10.00/klb	*0.119*	7,451
Total		**88,052**	**$1,045,524.85**	**--**	**--**	**9,150**

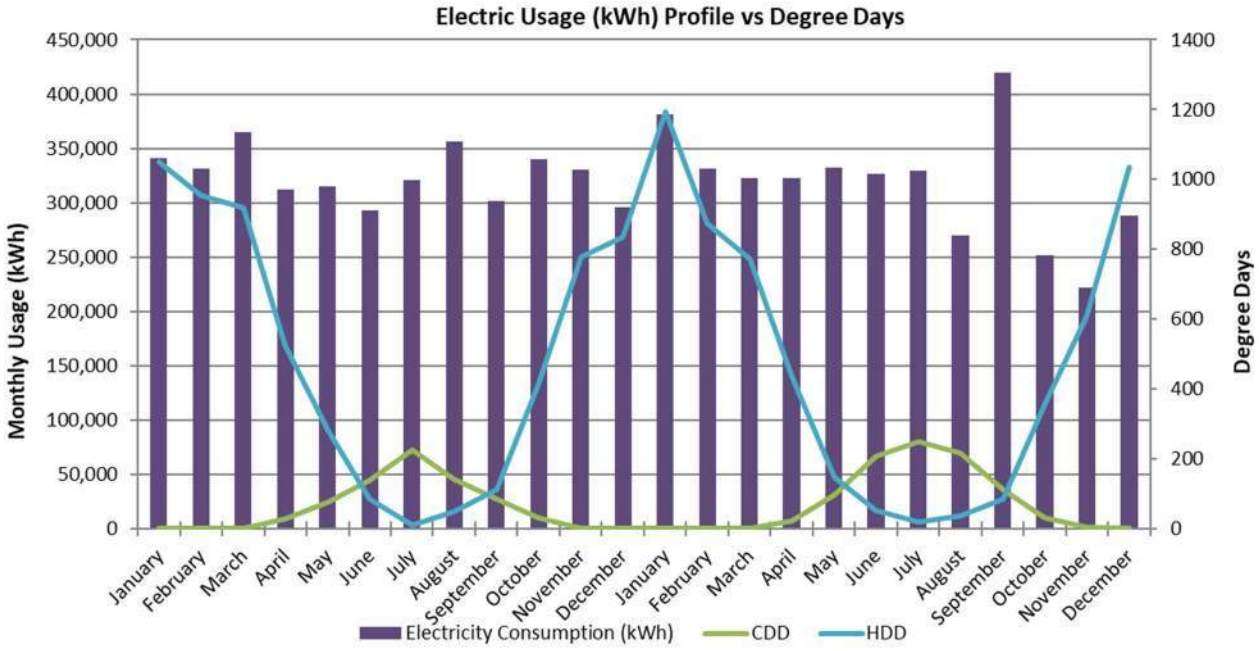
**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage does not show a strong correlation to weather data, indicating the majority of electricity usage consists of baseload usage. This usage does not vary much from month to month and includes loads such as lighting, fans, and pump loads. The annual usage for the

baseline 12-month period from January to December 2024 is 3,797,000 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

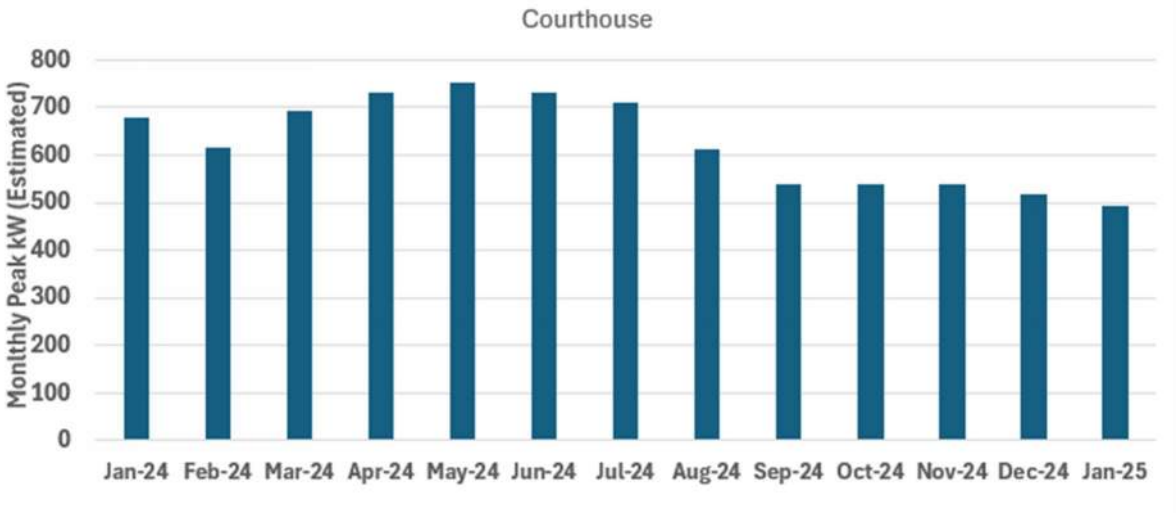
The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 7: Electric Capacity Results

Maximum Building Capacity at Service Transformer	1500 kW (Chiller Sub), 750 kW (Tower), 300 kW (West), 1000 kW (West Extension)
Maximum Capacity at Switchgear	NA
Estimated Peak Demand	753 kW (Estimated)
Remaining Capacity	**1500 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge: **$6.15/kW/Month**

Average Dollar per kWh Used in Calculations: $0.11/kWh

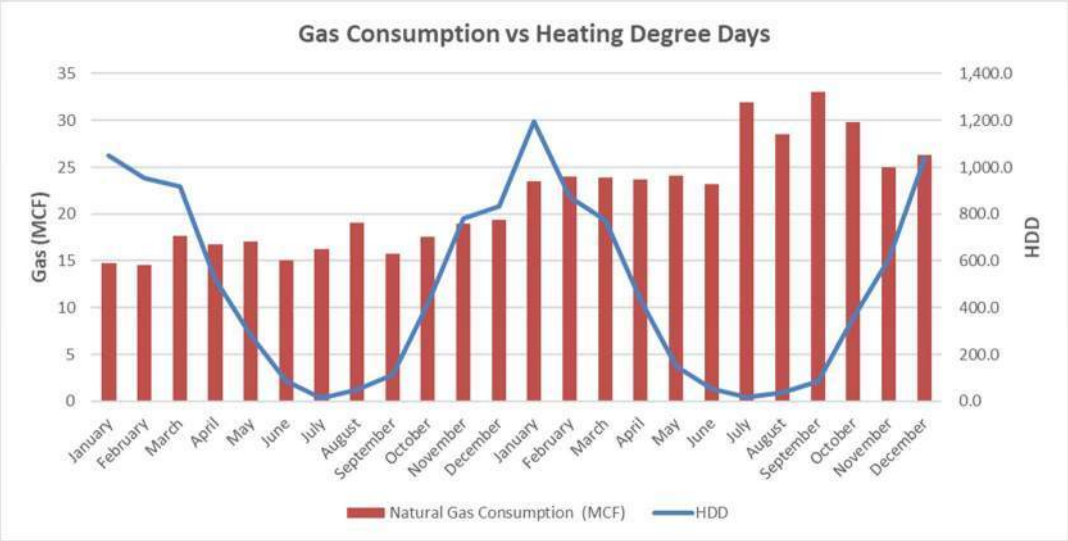
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows no correlation to weather data, as natural gas is primarily used for cooking. The annual usage for the baseline 12-month period from January to December 2024 is 317 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): $3.48/dTh (decatherm, or 1.038 MCF)

Constellation NG Usage Charge (Day Gas): $5.29/dTh (decatherm, or 1.038 MCF)

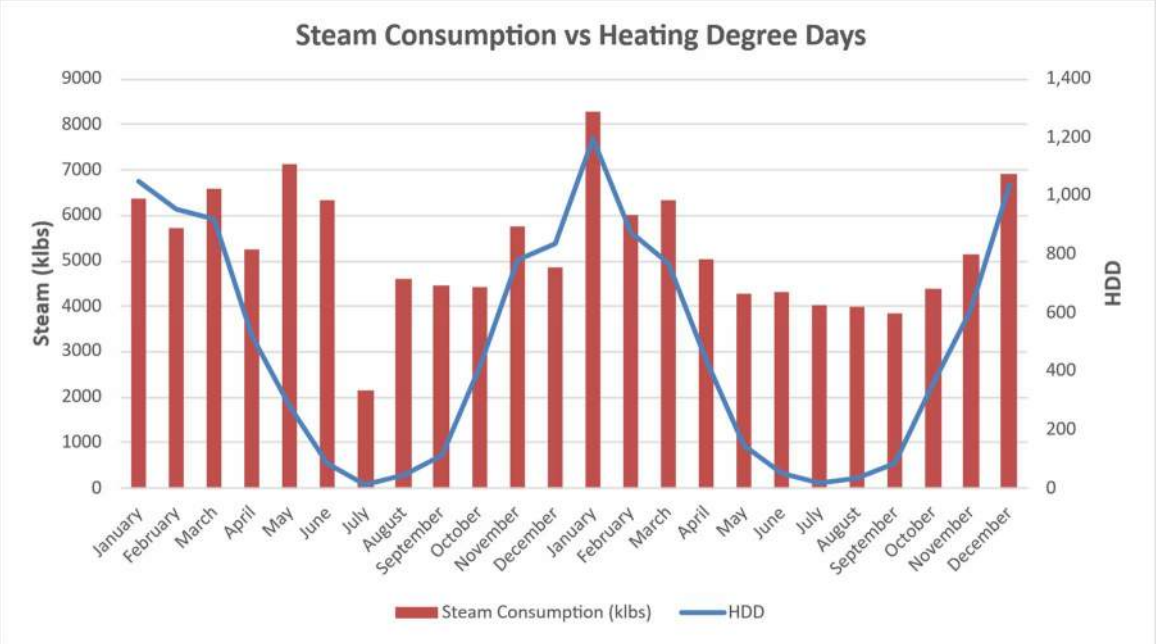
Average Dollar per MCF Used in Calculations: $4.98/MCF

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

3.5 Steam Usage Profile

Figure 4 shows the monthly steam usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Steam usage shows a direct correlation to weather data, as steam is primarily used for space heating. The annual usage for the baseline 12-month period from January to December 2024 is 62,617 klbs. Detailed monthly steam usage and costs are in Appendix A.

Figure 4: Steam Usage Profile (January 2023 to December 2024)



3.5.1 Steam Rate Structure

Unlike electricity and natural gas, which are billed directly by external utilities, steam is an internal utility produced on campus. The cost allocation for steam is derived from the total natural gas cost at the central steam plant, as well as costs to operate the plant. Each steam-served building is billed proportionally based on its metered steam usage relative to the campus total. As a result, there are no separate delivery, demand, or third-party charges; the unit cost of steam reflects the cost of natural gas, plant operating cost and efficiency, and distribution system performance.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings.

Average Dollar per klb Used in Calculations: $10.00/thousand lbs

3.6 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 8 below.

Table 8: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$417,778
Natural Gas	$1,579
Steam	$626,168
Total	$1,045,525
ECI $/yr/sf	$2.52

3.7 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 5. Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 5: Map of eGRID Subregions

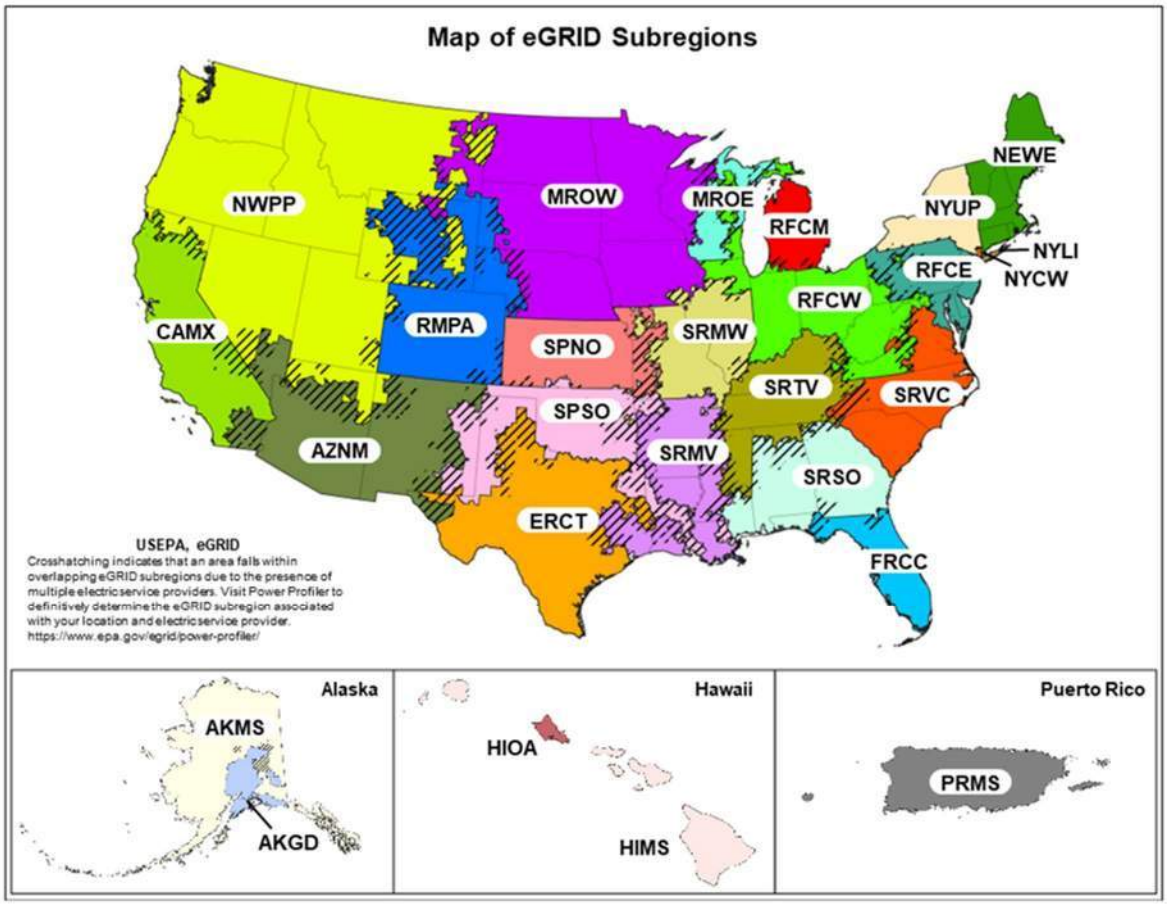
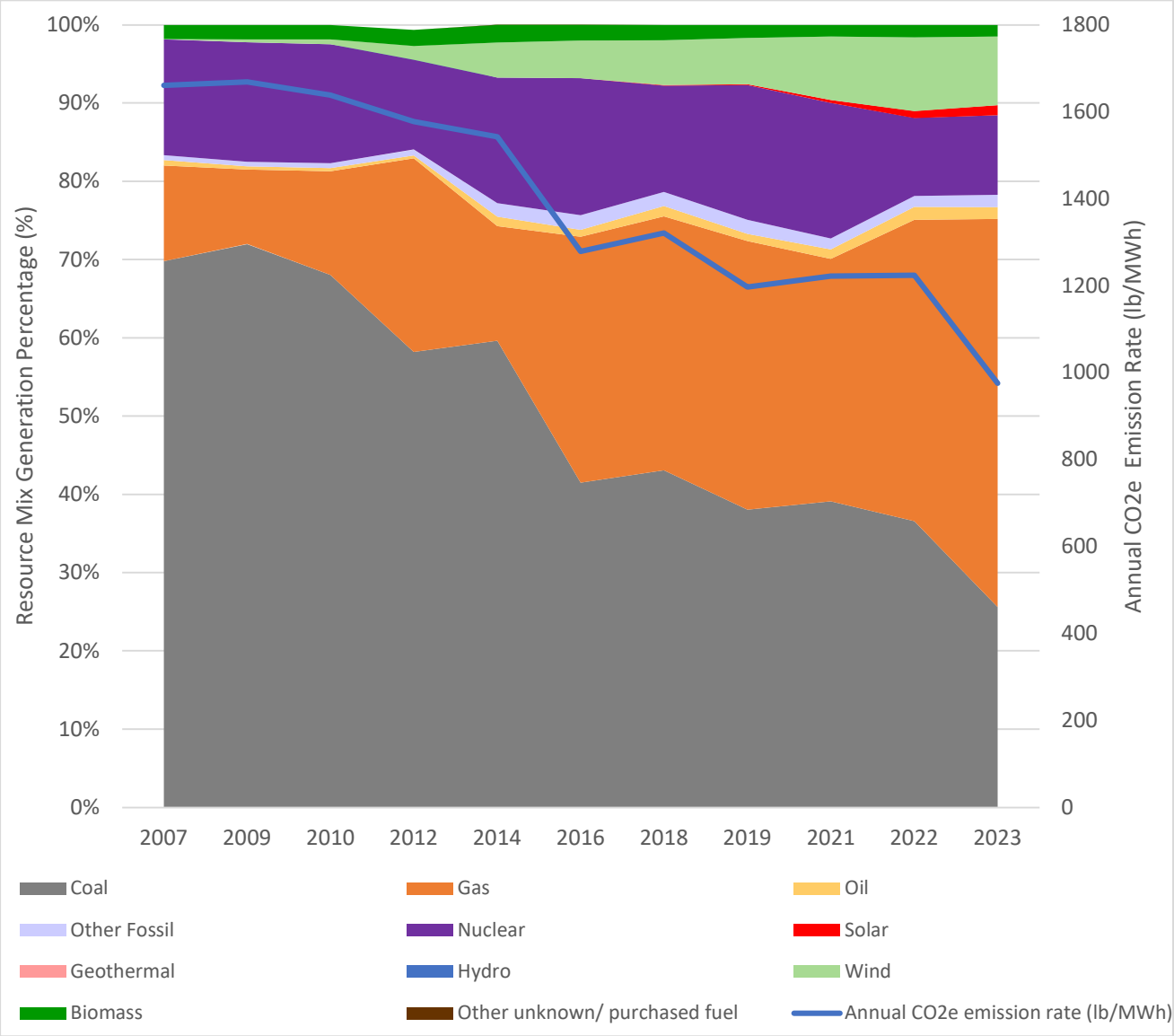


Figure 6 displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 6: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 83 percent of carbon emissions are attributed to steam and 16 percent are associated with electricity, with trace amounts associated with natural gas. Steam, natural gas combustion and imported electricity resulted in 7,468 tCO2e (campus-level Scope 1) and 1,681 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 9,150 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.8 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for the Courthouse Building are converted to kBTUs units, summed, and divided by the total square footage.

Table 9: Annual Utility Summary (2024)

Building:	Courthouse					**Electric EUI:**	31	kBTU/SF/yr
GFA:	415,100	SF				**Gas/steam EUI:**	181	kBTU/SF/yr
eGRID Subregion:	RFCM					**Current EUI**	212	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	3,797,986	kWh	3.412	12,959	0.0004427	1,681	$417,778	40%
Natural Gas	317	MCF	1.038	329	0.0549206	17	$1,579	0%
Steam	62,617	klbs	1194	74,764	0.119	7,451	$626,168	60%
Totals				**88,052**		**10,623**	**$1,045,525**	100%

According to the US EPA, the average site energy use intensity for a courthouse is 101.2 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 212 kBTU/SF, which is significantly higher than the national benchmark. It’s important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison indicates there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 7: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Parking	Parking		N/A	N/A	None Available
Public Services	Courthouse*		211.4	101.2	CBECS - Courthouse
	Drinking Water Treatment & Distribution (Average EUI presented in Energy per Flow in gallons per day)		5.90	2.27	AWWA - Water Treatment Plant
	Fire Station		124.9	63.5	CBECS - Fire Station/Police Station
	Library		143.6	71.6	CBECS - Library
	Mailing Center/Post Office		96.9	47.9	CBECS - Service
	Police Station		124.9	63.5	CBECS - Fire Station/Police Station
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Social/Meeting Hall		109.6	56.1	CBECS - Social/Meeting
	Transportation Terminal/Station		112.0	56.2	CBECS - Public Assembly
	Wastewater Treatment Plant* (Average EUI presented in Energy per Flow in gallons per day)		7.51	2.89	AWWA - Wastewater Plant
	Other - Public Services		89.3	40.1	CBECS - Other
Religious Worship	Worship Facility*		58.4	30.5	CBECS - Religious Worship
Retail	Convenience Store*	Convenience Store with Gas Station	883.5	350.9	Industry Survey
		Convenience Store without Gas Station			
	Mall	Enclosed Mall	170.7	65.7	CBECS - Enclosed Mall
		Lifestyle Center	228.8	103.5	CBECS - Strip Shopping Mall
		Strip Mall			
		Other - Mall	225.3	101.6	CBECS - Enclosed Mall and Strip Shopping Mall
	Retail Store*		120.0	51.4	CBECS - Retail Store
	Supermarket/Grocery Store*		444.0	196.0	CBECS - Grocery Store/Food Market
	Vehicle Dealership*		138.2	71.9	Industry Survey

3.9 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and estimated daily occupancy.

Table 10 and Figure 7 and Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 10: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	0	59,486	71,026,199	**171.1**	**4,496.3**
Space Cooling	1,419,549	0	0	4,843,501	**11.7**	**826.2**
Fans	510,016	0	0	1,740,174	**4.2**	**296.8**
Pumps	141,166	0	0	481,660	**1.2**	**82.2**
DHW	0	0	3,131	3,738,221	**9.0**	**0.0**
Conveyance	53,712	0	0	183,265	**0.4**	**31.3**
Lighting	1,006,387	0	0	3,433,793	**8.3**	**585.7**
Plug Loads	400,910	0	0	1,367,905	**3.3**	**233.3**
Process Loads	23,622	0	0	80,600	**0.2**	**13.7**
Refrigeration	61,320	0	0	209,224	**0.5**	**35.7**
Cooking	46,080	317	0	486,125	1.2	**28.6**
Information Technology	140,160	0	0	478,226	1.2	**81.6**
TOTAL	3,802,923	317	62,617	88,068,892	212	6,711
Historical Billing	**3,797,986**	**317**	**62,617**			
Percent of Actual	100%	100%	100%			
per sqft	**9.15**	**0.001**	**0.15**			

Figure 8: Existing Electricity End Use Distribution

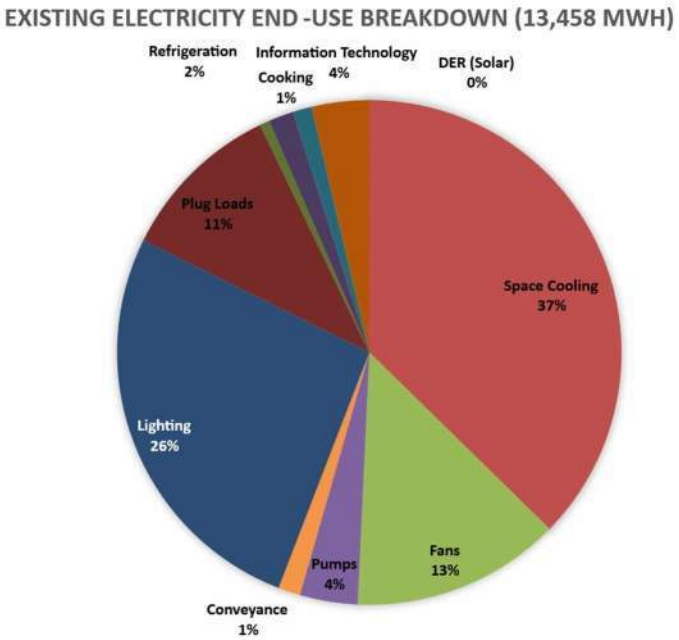
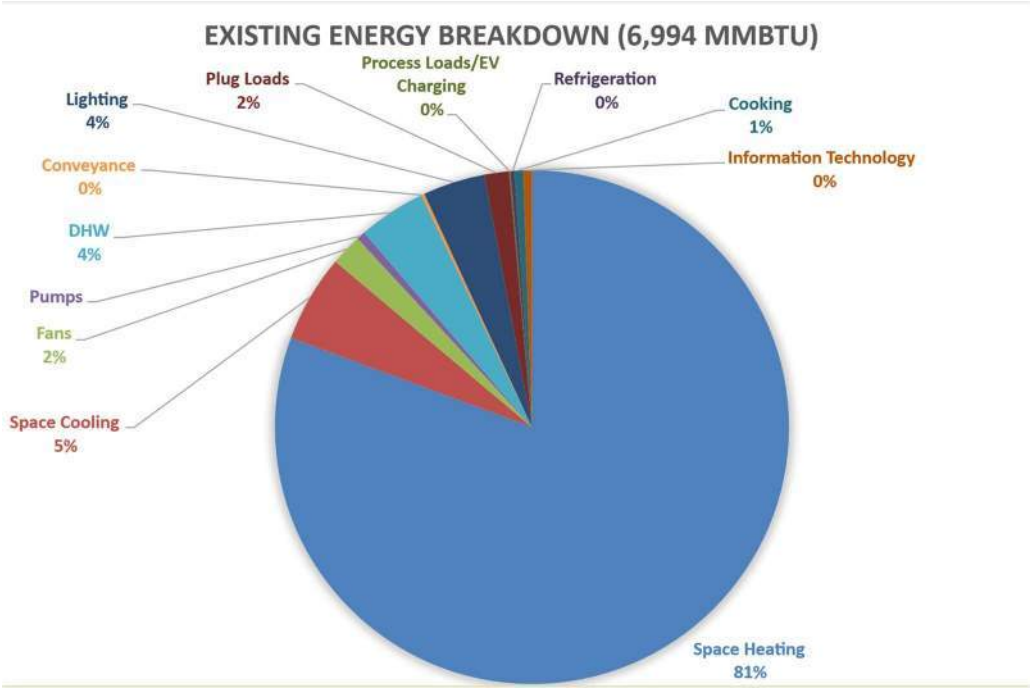


Figure 9: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 - Upgrade Pneumatic Controls to DDC

Pneumatic controls upgrades refers to the process of upgrading antiquated pneumatic control systems and components to direct digital controls (DDC) and integrating it with a centralized control system. Pneumatic controls use compressed air to operate valves and dampers and are prone to operational and maintenance issues. Upgrading these antiquated controls to DDC will enhance the overall efficiency, functionality, and manageability of HVAC system operation. This measure directly produces electricity savings by eliminating the need for a compressed air system, but also indirectly contributes additional energy savings by enabling better control and functionality such as scheduling and optimization. The building has many different vintages of equipment, all with varying levels of deferred maintenance issues. This measure is recommended to be paired with an upgrade to the overall HVAC system to optimize the energy consumption of the existing systems.



Image 1: Pneumatic control board

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- Upgrading pneumatic controls to DDC will improve existing control functionality.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed and improved.
- Energy savings assume significant increase in building efficiency through controls optimization measures, as well as the removal of the compressed air system and approximately 4 hours of daily operation to maintain system pressure.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.
- Implementation costs assume $3/sqft to install controllers, networking, actuation, and to provide required programming. This cost can vary greatly between implementation strategies and should be investigated further if implementation is considered.
- O&M Savings assume $15,000 of internal labor/per year avoided as part of the DDC conversion.

Next Steps: Identify equipment to be connected to the central control system and engage a building controls integration company to plan and price the system integration. Coordinate with planned capital upgrades and renovations where possible to optimize benefits. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 11: ECM 1 Savings and ROM Cost

Savings Summary									
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Convert all pneumatic controls to electric controls.	0	307,712	8,293	11,704	1,198	$15,000	$138,077	$1,245,300	9.0
Overall % Reduction	**0.00%**	**8.1%**	**14.25%**	**13.29%**	**13.09%**		**13.2%**	--	--

4.2 ECM 2 – Convert Dual-Duct Air Distribution System to Single Duct VAV with Reheat

Many of the building air handling systems were designed as dual-duct, hot deck/cold deck systems. These systems allow for both hot and cold air to be available at all times to the zones of the building, which can be advantageous when zone heating and cooling loads are not consistent. These systems also also allow for heating and cooling equipment and piping distribution to be centralized in mechanical rooms, with only ductwork being installed through the building. These systems, however, are inherently inefficient because they are constantly heating and cooling simultaneously, with the two temperature, constant volume air steams being mixed together if space temperatures are satisfied. This measure suggests removing or modifying the dual duct HVAC systems in the building with variable air volume (VAV) terminal units, and using reheat coils to maintain space temperatures. VAV systems can reduce energy consumption by as much as 40% compared to dual duct systems, reducing fan energy, steam heat, and cooling energy required to maintain temperatures.

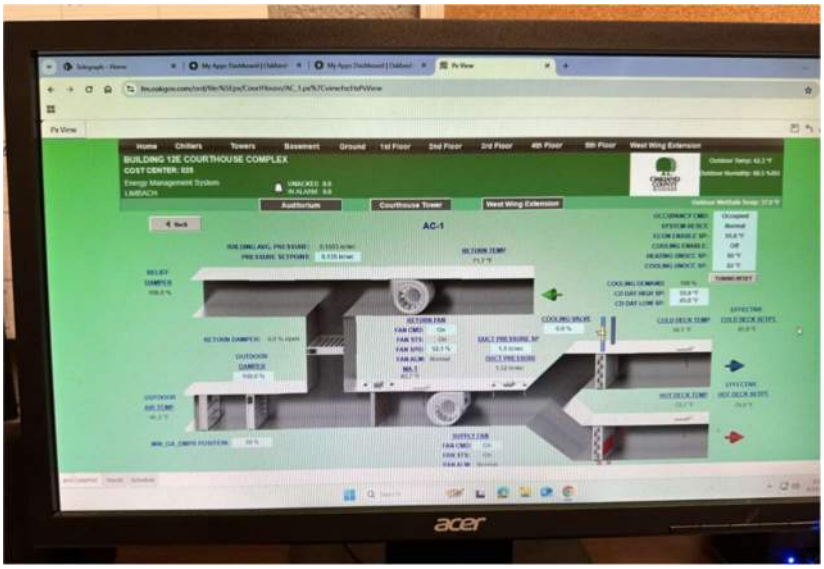


Image 2: BAS Graphic of Dual Duct System

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- This measure assumes energy savings due to reduced airflow to spaces, which reduces the total fan energy, heating energy, and cooling energy required to condition the space.
- Implementation costs assume conversion of existing ductwork to VAV-type controls. This cost does not consider additional implementation expenses such as abatement, demolition, and irregular construction hours.
- Implementation costs assume $6/CFM and $1,500/ton.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.
- O&M Savings assume approximately $26,000/year of avoided maintenance costs with the existing systems.

Next Steps: Conduct an ASHRAE Level 3 audit of the air supply systems to understand implementation options and develop costs to implement measure and achieve savings.

ECM Savings and ROM Cost:

Table 12: ECM 2 Savings and ROM Cost

Savings Summary									
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Steam Savings (klbs)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
Convert dual duct air distribution system to single duct VAV with reheat.	0	278,051	14,277	17,995	1,822	$26,000	$199,352	$4,151,000	20.8
Overall % Reduction	**0%**	**7.32%**	**22.8%**	**20.44%**	**19.91%**		**19.06%**	**--**	**--**

4.3 ECM 3 – Install VFDs on Heating Hot Water Pumps

Variable Frequency Drives (VFDs) on pumps will provide a dynamic and energy-efficient solution by allowing precise control of pump speed, optimizing performance, and reducing unnecessary energy consumption during periods of lower demand. The existing hot water pumps do not have VFDs and run at constant speed. This ECM proposes evaluating the heating hot water system pumps for feasibility to add a VFDs to reduce pump energy. This may be coupled with a routine upgrade of pumps as they near end of useful life to include premium efficiency motors and VFDs.



Image 3: Heating Hot Water Pumps

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- VFDs will be most effective when paired with a BAS to automatically control speeds.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed. VFDs will likely increase the service life of the equipment if properly selected and installed.
- The savings for this measure assume an average 30% reduction in equipment speed.
- If coupled with routine upgrades to include premium efficiency motors additional energy savings may be achieved.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the heating hot water system pumps for compatibility with a VFD and assess the usage pattern and energy consumption. Once this data is collected, select the appropriate type of VFD. Choose VFD based on compatibility with current systems, programmability, and reliability.

ECM Savings and ROM Cost:

Table 13: ECM 3 Savings and ROM Cost

Savings Summary									
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Install VFDs on heating hot water circulation pumps in the West Wing Extension	0	65,350	0	223	29	$0	$7,188	$22,500	3.1
Overall % Reduction	**0%**	**1.7%**	**0%**	**0.2%**	**0.3%**		**0.6%**		

4.4 ECM 4 – Install Motion Sensors in Offices and Mechanical Rooms

During the site audit, it was observed that lighting was left on in many unoccupied offices and back-of-house areas. This measure suggests adding lighting control through motion sensors in spaces that are not regularly occupied. Motion or occupancy sensors detect activity in spaces and automatically turn lighting on when needed. If no activity is detected, the sensors shut off the lighting to save energy. These controls can be easily integrated into the current lighting control circuits or fixtures.

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- Implementation is assumed to be one sensor per 1000 square feet of building area.
- There will be no impact on the lighting equipment useful life.
- The savings for this measure assume a 10% reduction in lighting energy
- Implementation costs assume $500/zone for sensor installation.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the lighting system and determine the most cost-effective sensor locations for each zone. Install sensors in place of existing wall switches, or in ceiling panels with wiring connected to the lighting control circuit.

ECM Savings and ROM Cost:

Table 14: ECM 4 Savings and ROM Cost

Savings Summary									
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Install motion sensors in offices and in mechanical rooms	0	100,639	0	343	45	$0	$11,070	$103,775	9.4
Overall % Reduction	**0%**	**2.7%**	**0%**	**0.3%**	**0.49%**		**1.06%**	--	--

4.5 ECM 5 – Install LED Lighting in Office Spaces

This measure proposes upgrading all remaining fluorescent lighting to Light-emitting diode (LED) lightbulbs with motion and/or daylight sensors to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements. This measure is considered for the office spaces of the building, which is conservatively estimated at 50% of the total square footage.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.

Figure 10: Example Fixture with Integrated Occupancy Controls



Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture. Lighting controls that include dimming will likely require full fixture replacement, which drive up the total cost of implementation for the measure.
- Interior lights operate 18 hours per day for 252 business days per year, which averages the different occupancy schedules for different parts of the building (24/7 and normal business hours).
- Exterior lights, assumed to consist of four 28W fixtures, operate 24 hours per day due to the faulty photocell sensors.

- O&M savings assume an average cost of $3.81/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- This measure assumes a 30% reduction in interior lighting power and a 50% reduction in power for the exterior lights through implementation of controls.
- LED upgrades cost $215/fixture, which include integrated control sensors and no additional wiring and control circuits. Low-cost fixtures and external controls can be used as an alternative to this implementation method. The costs have been split out between the fixtures and controls in the summary table below.
- This measure indirectly supports electrification readiness by realizing a potential kW demand reduction that can be deployed elsewhere for new electric loads.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, if integrated controls are not included in each fixture, subsequent steps are required that may consist of conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. Following this assessment, a controls contractor can be engaged to install the lighting controls and assist building engineers in configuring the schedule to optimize lighting usage.

ECM Savings and ROM Cost:

Table 15: ECM 5 Savings and ROM Cost

Savings Summary									
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Retrofit fluorescent lighting in the office spaces	0	201,277	0	687	89	$0	$27,329	$415,100	15.2
Overall % Reduction	**0%**	**5.3%**	**0%**	**0.7%**	**0.97%**		**2.61%**	--	--

4.6 ECM 6 – Replace Water Cooled AC Units with Split Systems

There are three air conditioning units in the basement of the building which use metered domestic cold water as the condensing medium for removing heat. Once heat is added to the water, it is sent to the sewer to be removed from the building. While not inefficient in terms of energy, these system use significant amounts of water which increase operating costs for both water and sewer charges. Replacing the water cooled condenser systems with modern air cooled HVAC split systems will reduce water consumption, while also slightly reducing energy consumption due to improvements in cooling system efficiency.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Water savings assumes $0.021/gallon
- Energy savings are calculated based on an assumed increase in system COP, which overcomes the added energy to run an outdoor unit fan.
- Implementation costs assume demolition and patching of existing domestic water system.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Engage a design/build contractor to identify cost-effective implementation strategy.

ECM Savings and ROM Cost:

Table 16: ECM 6 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Replace three water-cooled AC units using city water with split cooling	0	5,845	0	20	3	$80,114 (98% Water)	$116,160	1.4
Overall % Reduction	**0%**	**02%**	**0%**	**0.02%**	**0.03%**	**6.9%**	**--**	**--**

4.7 ECM 7 – Replace Water Cooled Refrigeration Units

There are two walk-in refrigerators/freezers that have conditioning units which use metered domestic cold water as the medium for removing heat. Once heat is added to the water, it is sent to the sewer to be removed from the building. While not inefficient in terms of energy, these systems use significant amounts of water which increase operating costs for both water and sewer charges. Replacing the water-cooled condenser systems with modern air-cooled condensers will reduce water consumption, while also slightly reducing energy consumption due to improvements in cooling system efficiency.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Water savings assumes $0.021/gallon
- Energy savings are calculated based on an assumed increase in system COP, which overcomes the added energy to run an outdoor unit fan.
- Implementation costs assume demolition and patching of existing domestic water system.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Engage a design/build contractor to identify cost-effective implementation strategy.

ECM Savings and ROM Cost:

Table 17: ECM 7 Savings and ROM Cost

ECM	Savings Summary							
	Gas Savings (MCF)	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Replace water-cooled refrigeration using city water with split cooling	0	4,384	0	15	2	$60,085 (98% Water)	$210,600	3.5
Overall % Reduction	**0.00%**	**0.1%**	**0%**	**0.02%**	**0.02%**	**5.75%**	--	--

4.8 ECM 8 – Upgrade the Lighting Design in the Auditorium

The current lighting in the auditorium area of the building uses CFL recessed lighting and can only be controlled by operators with wall switches. The area has significant natural lighting, however all fixtures operate on the same control method. Redesigning the lighting can reduce the overall lighting power density, through both a reduction in total fixtures and an increase in lighting efficiency through LED lights, as well is improve the control of the lighting occupancy, daylighting, and dimming features that sense ambient light and adjust the light levels automatically.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Sensors can be incorporated into the new fixtures, reducing the need for complex control systems.
- This measure assumes lighting savings of approximately 0.3 W/ft² and a reduction in hours of 25%.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 18: ECM 8 Savings and ROM Cost

ECM	Savings Summary								
	Gas Savings (MCF)	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Upgrade the lighting design in Auditorium.	0	25,160	0	86	11	$250	$3,018	$30,000	9.9
Overall % Reduction	**0%**	**0.66%**	**0%**	**0.1%**	**0.12%**		**0.29%**	--	--

4.9 ECM 9 - Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent. The Courthouse building has a robust building automation system that can be leveraged to improve efficiency, however, capital investment into HVAC and replacement of existing pneumatic controls can further improve the impact of building optimization on the overall energy. In the short term, RCx is an extremely valuable measure that should be implemented to its fullest extent to ensure systems are operating effectively and efficiently. This can be completed for existing systems connected to the BAS or delayed until the remaining systems are upgraded and connected to the BAS system.



Image 4: RCx Deficiencies observed at site visit

The following list represents RCx opportunities that should be evaluated to validate operation, modify and/or repair if discrepancies identified if systems not scheduled for timely replacement. This effort will proactively improve building system operation and optimize energy usage.

- Calibrate chilled water flow meter
- Update O&M protocols
- Service cooling tower drifters
- Service AHU access doors and apply sealants to reduce air leakage on older AHU equipment.
- Test and service all steam traps.
- Install PRVs on the steam distribution system serving the coils in the AHUs and reduce the pressure setpoint from 8 PSI to 1.5 PSI.
- Cover and seal the cooling coils on the AHUs located in the roof mechanical room in the Tower
- Clean all AHU coils and resurface the air mixing boxes for health concerns.
- Reset Auditorium winter setback setpoint from 68 F to 60 F.
- Reset Auditorium summer setback setpoint from 60 F to 78 F.
- Reset East Wing winter setback setpoint from 70 F to 60 F.

- Reset West Wing winter setback setpoint from 68 F to 60 F.
- Reset West Wing summer setback setpoint from 60 F to 78 F.
- Calibrate the baseboard heating supply and return temperature sensors on the Niagara System.
- Install a temperature sensor on the baseboard HX condensate return pipe downstream of the steam trap.
- Calibrate the outdoor air reset feature on the hot water distribution system on the Niagara System.
- Verify the global and AC-1 outside air temperature sensor readings' accuracy and calibrate as necessary. Ensure that the AC-1 sensor is not exposed to direct sunlight at any time of the day.
- Update the AHU economizer control algorithm.
- Repair actuator arms at AC-9 serving West Wing

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 10% reduction in estimated heating and overall building electricity. RCx savings can range from 3%-25% of total building energy use.
- Implementation costs assume both investigations to uncover opportunities, and implementation costs to correct deficiencies.
- Additional study of equipment capacity requirements could be performed as part of this measure.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: This measure proposes engaging a third-party contractor to determine if this building is eligible for the DTE RCx program and systematically evaluate and prioritize major HVAC and control systems and complete retro-commissioning to restore systems to their original design intent. This measure is recommended for implementation. This measure also suggests that Oakland County increase their in-house capabilities to identify, correct, and maintain existing equipment to extend service life, maintain optimum cost of operation, and to reduce implementation costs for routine building improvements.

ECM Savings and ROM Cost:

Table 19: ECM 9 Savings and ROM Cost

	Savings Summary							
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Building Retrocommissioning	0	379,799	6,262	8,772	913	$104,395	$136,983	1.3
Overall % Reduction	**0.00%**	**10.00%**	**10.00%**	**9.96%**	**9.98%**	**9.98%**	--	--

4.10 ECM 10 – Window Upgrades

The windows of the building are outdated technology and beyond the expected useful life. Thermal imaging and in-person observations of air infiltration suggest that a window replacement should be considered for the old areas of the building. This measure suggests replacing the windows with high efficiency and low heat and radiation transfer units to reduce the heating and cooling loads of the building. The EUI analysis in this report show that steam heating represents over 80% of the total energy use, which is more than double the national average for a similar building. Replacing the windows, along with other envelope sealing and improvements, can help to minimize the operating costs of the building.

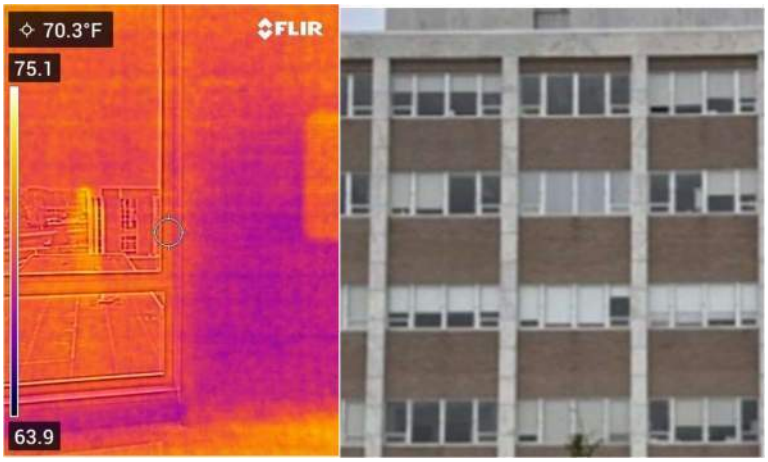


Image 5: Thermal Imaging Showing Air Leakage and Poor Insulation

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- This measure assumes energy savings due to improved R-value and thermal performance. R-values were assumed based on observations and building age.
- It is assumed that there are 800 windows that require replacement. The cost to replace each window was assumed to be $2,000/unit, which assumes bulk pricing to complete the entire building in one purchase.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Conduct a comprehensive survey to confirm the type and quantity of window required to meet modern energy code requirements, and/or areas requiring air sealing. This measure is recommended for implementation once implementation pathways are identified.

ECM Savings and ROM Cost:

Table 20: ECM 10 Savings and ROM Cost

	Savings Summary							
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Steam Savings (klbs)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
Upgrade windows	0	174,514	8,293	11,249	1,139	$108,425	$1,600,000	14.8
Overall % Reduction	**0.00%**	**4.6%**	**14.25%**	**12.78%**	**12.45%**	**10.37%**	--	--

5 Measure Requiring Additional Consideration

This section provides additional information about projects that have been evaluated but are not currently recommended for implementation due to poor economics, feasibility issues, conflicts with other projects already recommended, or requirements for additional study that may impact feasibility. Equipment electrification projects, which have longer paybacks, may be listed here but will be expanded upon in the final Electrification Plan for each building. All electrification projects that are required for campus electrification are not included in the energy audit reports. This report includes six measures that are included in the Not Recommend Category. The measure summaries are given below:

Table 21: Proposed Energy Savings Summary

ECM #	Energy Conservation Measure Description	Year -1 Electricity Savings	Year -1 Gas Savings	District Steam Savings	O&M and Water	Year - 1 Cost Savings	Project Cost (Est)	Simple Payback Period
No	Description	kWh/yr	MCF/yr	Mlbs/y	$	$/yr	$	Years
ECM 11	Remove central domestic water heaters and install local under sink electric heaters in restrooms	-766,927	0	3,131	$0	-$53,054	$16,000	NA
ECM 12	Retrofit old VFDs at the end of their useful life	15,300	0	0	$0	$1,683	$52,500	31.2
ECM 13	Upgrade domestic water pressurization system with VFD driven pumps in West Wing Tower.	4,132	0	0	$0	$454	$12,500	27.5
ECM 14	Replace Absorption Chiller	0			$14,000	$14,000	$2,294,000	163.9
ECM 15	Replace the restroom faucets with motion activated low flow fixtures	0	0	0	$1,183	$1,183	$18,000	15.2
ECM 16	Replace the toilets and urinals with motion activated low flow fixtures	0	0	0	$4,205	$4,205	$72,000	17.1

Project Descriptions:

- ECM 11 – Remove Central Water Heaters: This project will be included in the final Electrification Plan, but is not included at this time due to negative payback associated with fuel switching from steam to electric as the source of hot water energy.
- ECM 12 – Retrofit Existing VFDs: This measure has a long payback and is not recommended for immediate implementation. It is recommended that the old equipment is systematically replaced to avoid failure and stoppage of service, but energy savings do not justify immediate replacement.
- ECM 13 – Upgrade Domestic Water Pressurization System: Due to the buildings low consumption of domestic water, the savings associated with this measure don't support

the implementation at this time. This should be implemented when water pumping systems are at the end-of-useful life.

- ECM 14 – Replace Absorption Chiller: Absorption chillers are inefficient and high maintenance. Replacement of this system is required for full building electrification, but there is no current need to replace this system because it is not currently being used, so no savings are available to help cover the cost of implementation. The electrification plan will likely recommend replacing with a heat recovery chiller unit that can generate hot water as a waste-product of the cooling process.
- ECM 15 – Replace the Restroom Faucets: This measure can save a nominal amount of hot water energy, however the cost to replace is significant. It is recommended that all new fixtures be installed with hands free controls and low flow aerators.
- ECM 16 – Replace the Toilets and Urinals with Low Flow Fixtures: Similar to ECM 15, this measure saves a nominal amount of energy (pumping in this case), but should be implemented as fixtures require replacement.

6 Appendix A

Table 22: Monthly Utility Data (2023 to 2024)

Month	Steam Consumption (kBtu)	Electricity Consumption (kWh)	Natural Gas Consumption (MCF)	Total Cost
Jan-23	7,600,237	341,271	15	$101,267
Feb-23	6,831,586	331,382	15	$93,740
Mar-23	7,864,280	365,106	18	$106,114
Apr-23	6,286,536	311,889	17	$87,042
May-23	8,501,530	315,129	17	$105,951
Jun-23	7,561,277	292,964	15	$95,628
Jul-23	2,572,279	320,861	16	$56,919
Aug-23	5,497,969	356,521	19	$85,359
Sep-23	5,344,021	301,363	16	$77,985
Oct-23	5,292,026	339,722	18	$81,779
Nov-23	6,871,500	330,146	19	$93,961
Dec-23	5,794,814	295,644	19	$81,150
Jan-24	9,910,500	381,033	24	$114,328
Feb-24	7,180,138	330,992	24	$88,908
Mar-24	7,581,674	322,643	24	$90,918
Apr-24	6,005,591	322,766	24	$79,433
May-24	5,110,956	332,289	24	$73,956
Jun-24	5,170,333	326,643	23	$73,764
Jul-24	4,808,707	329,663	32	$71,501
Aug-24	4,783,076	270,248	29	$64,762
Sep-24	4,581,059	420,123	33	$79,797
Oct-24	5,218,173	251,631	30	$65,894
Nov-24	6,144,559	221,557	25	$69,320
Dec-24	8,269,654	288,398	26	$92,182
2023 Sum	76,018,055	3,901,998	203	$1,066,897
2024 Sum	74,764,420	3,797,986	317	$1,045,525
2024 Sum (kBtu)	74,764,420	12,959,269	328,900	

7 Appendix B

Table 23: Building Equipment List

Unit Tag	No of Units	Unit Name	Make	Model	Capacity 1	Efficiency	Capacity 2	Approx Year Installed
AC1	1	AHU w/ economizer, dual duct	Buffalo	N/A	42,000		60	
AC2	1	AHU w/ economizer, VAV	Buffalo		63,500		75	
AC3	1	AHU w/ economizer, VAV	Buffalo		1,800		20	
AC4	1	AHU w/ economizer, VAV	Buffalo		25,200		25	
AC5	1	AHU w/ economizer, dual duct	Buffalo		24,200		30	
AC6	1	AHU w/ economizer	Buffalo		72,000		75	
AC7	1	AHU w/ economizer	Carrier	39NXH323	10,000		5	
AC8	1	AHU w/ economizer	Buffalo		1,400		1	
AC9	1	AHU w/ economizer	Buffalo		1,400		1	
AC10	1	AHU w/ economizer, VAV	Trane	UCCAF10A0FOFR06	4,100		5	
AC11	1	AHU w/ economizer, dual duct	Trane	UCCAF08A0F0FR06	3,260		5	
AC12	1	AHU w/ economizer, dual duct	Carrier	39TS13K—CER----B	3,800		2	
AC13	1	AHU w/ economizer, VAV	Carrier	39THH-------LGU-AB	16,000		15	
AC14	1	AHU w/ economizer	Buffalo		58,000		30	
AC15	1	AHU w/ economizer	Buffalo		16,000		10	
AC16	1	AHU w/ economizer	Buffalo		7,000		5	
AC17	1	AHU w/ economizer	Buffalo		34,000		20	
AC18	1	AHU w/ economizer, VAV, electric actuators			61,270		100	
AC19	1	AHU w/ economizer, VAV, electric actuators			61,270		100	
AC20	1	AHU w/ economizer, VAV, electric actuators			6,500		10	
MER044	1	SF			9,000		5	
N/A	1	Centrifugal chiller (air side free cooling)	York	YKMQMRK2-DAGS	1,100			
N/A	1	Adsorption chiller (backup, infrequent use)			740			
TWR-EFF	4	Cooling tower						1992
N/A	3	Mini-split AC units	Carrier	38MGRQ48E	4			
HX		Steam to hot water shell and tube heat exchangers, no storage						
CHWP-1,2	2	Chilled water pumps, VFD			100			
Unit Tag	**No of Units**	**Unit Name**	**Make**	**Model**	**Capacity 1**	**Efficiency**	**Capacity 2**	**Approx Year Installed**

CWP-3 (and 1, 2?)	3	Condenser water pumps for CT, VFD			75	91.7		
Reheat P5 & P6	2	Reheat pumps, constant speed			15	91	85.5% PF	
Baseboard P3 & P4	2	Baseboard pumps, constant speed			10	89.5	83.1% PF	
N/A		Domestic water pumps, constant flow			8	85.3		
N/A	3 passenger, 1 freight	Elevator	Detroit Elevator		25			2012
N/A	4	Elevator	Otis		26			
N/A	1	Walk in refrigerator (condensor cooling, city water)						
N/A	1	Walk in freezer (condensor cooling, city water)						
N/A		Ovens			9			
N/A		Supply fans				85-90		Original to the building
N/A		Return fans				85-90		Original to the building
N/A	1	Air compressor	Quincy		8			
HC-1	1	Heated Ventilation						
HC-2	1	Heated Ventilation					5 HP	
UH	10	Unit heaters					1.5 HP	

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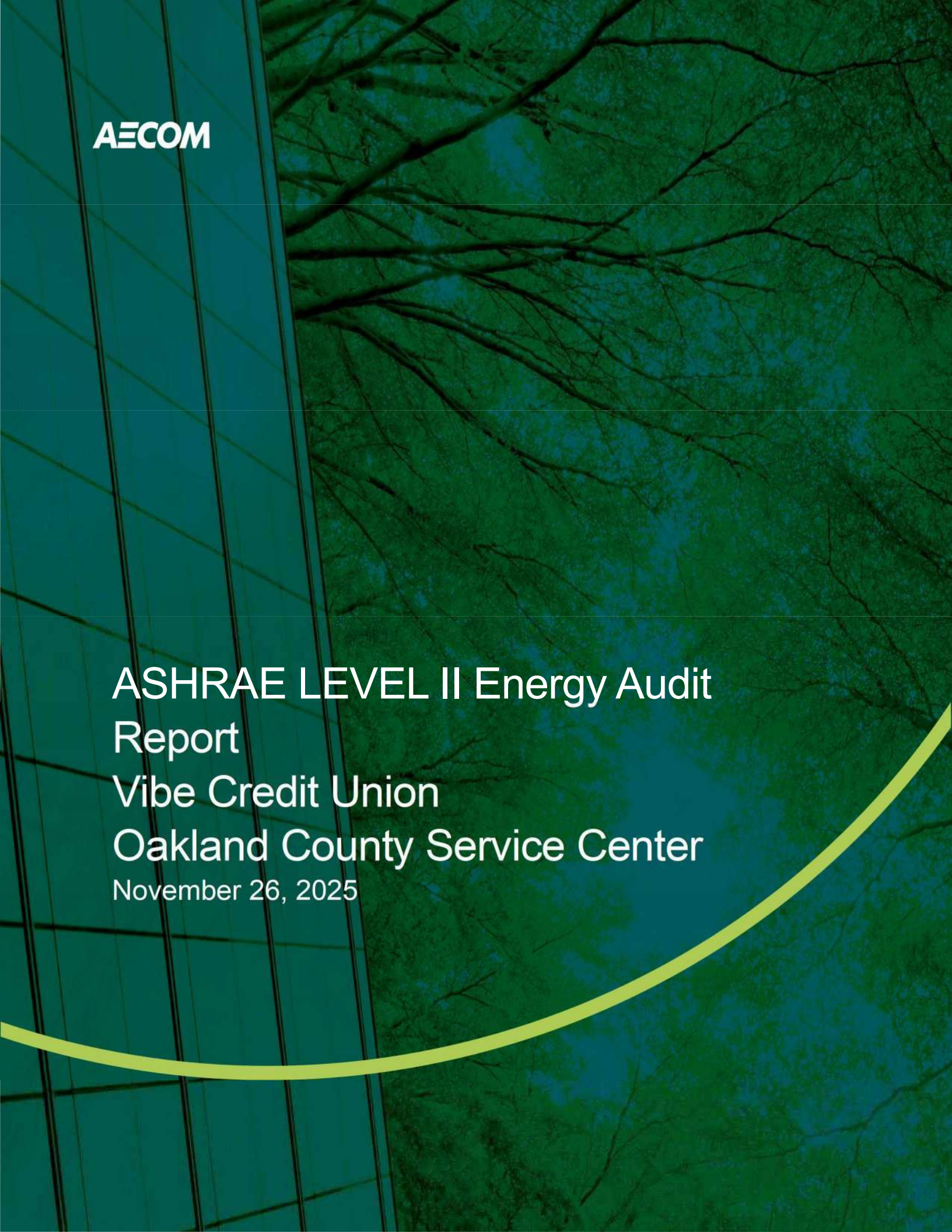

AECOM

ASHRAE LEVEL II Energy Audit Report
Vibe Credit Union
Oakland County Service Center

November 26, 2025

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

Prepared for:
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Prepared by:
AECOM

Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Credit Union in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County Credit Union is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Wednesday April 9, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates five ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The five listed measures represent a projected 25% annual energy cost savings with an aggregate simple payback of 7.4 years. All seven measures are prioritized as "Recommended" for implementation.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be "electrification-ready" to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE's prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Credit Union Energy Savings Summary

ECM #	Measure Description	Priority	Measure Status	Year -1 Electricity Savings	Demand Reduction	Year -1 Gas Savings	Total Energy Saved	Year - 1 GHG Savings	O&M and Water Savings	Year - 1 Cost Savings	Project Cost (Est)	Simple Payback Period
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	MMBTU	tCO2e	$/yr	$/yr	$	Years
1	Replace fluorescent and CFL bulbs with LED equivalents	HIGH	R	17,959	5	0	61.3	7.0	$533	$2,509	$19,788	7.9
2	Implement temperature setbacks during unoccupied hours	HIGH	R	0	0	2,909	290.9	15.4	$0	$1,399	$1,500	1.1
Sum of Recommended Measures				**17,959**	**5**	**2,909**	**352**	**23**		**3,375**	**$24,483**	**6.3**
Overall % Reduction				**20%**	**-**	**46%**	**38%**	**32%**	**--**	**26%**	--	--
Measures Considered but not Recommended												
3	Complete building retro-commissioning	HIGH	R	2,643	0	619	71.0	4.4	$0	$589	$34,665	58.9

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed
**N/A indicates a negative payback period which results from negative cost savings due to the higher cost of electricity relative to the cost of natural gas, common for electrification measures

2 Existing Conditions and Observations

The Vibe Credit Union is a facility that is occupied and maintained by an independent organization within the Oakland County Campus. The building is estimated to be 10,000 square feet and was renovated in 2013. The original year of construction was not known.

2.1 Building Systems

2.1.1 Building Envelope

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Masonry construction	Good from visual inspection
Roof	Black membrane, mostly flat with shingled exterior angled	Good from visual inspection
Glazing	Double Glaze	Good

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The building is served by six (6) RTU's that serve different zones in the office, three 2013 manufactured Trane RTUs with heating capacity of 64,000 BTUh and three newer Bryant and Carrier rooftop units with heating capacity of 93,000 BTUh. RTU-1 has cooling capacity of six (6) tons, RTU-2 four (4) tons, RTU-3 six (6) tons, RTU-4 five (5) tons, RTU-5 three (3) tons, and RTU-6 three (3) tons. The conference room has an exhaust fan with two additional exhaust fans serving the men/women's bathrooms on the main level and one for the basement toilets. A one (1) ton mini split unit serves the data closet with the condensing unit on the roof.

2.1.2.2 Plumbing

Domestic hot water is generated by one (1) Rheem natural gas fired domestic hot water heater with a 40 gallon capacity and 38,000 BTUh input capacity. No significant plumbing deficiencies were noted.

2.1.2.3 Building Controls

This building does not have a BMS. The RTUs are controlled with local thermostats, and the observed Trane thermostat was set to 68°F and in "Permanent Hold" mode

2.1.3 Lighting Systems

The building lighting systems are a combination of linear T-8 fluorescent tubes and compact fluorescent can-lights. Lighting is controlled by manual switches in spaces. Using lighting drawings, approximations have been made to estimate the lighting load. It is estimated that there are 76 fixtures containing two 32 W T8 fluorescent tubes each and 16 fixtures containing

one lamp each. It was also estimated that there were approximately 121 fixtures with one 26 W CFL lamp each. Based on the office hours of operation, it was assumed these lights are on 10 hours per day for 252 business days per year and do not currently have controls.

2.1.4 Electrical Infrastructure

The building electrical service has a 600A 208/120V 3ph main distribution panel fed from a pad-mounted 500kVA transformer. The building has a 400kW backup power diesel generator located outside the building to provide emergency power. The main electrical service for the facility is fed from a 167/50 kVA open delta transformer, configured for 240/120 volts. This transformer is located outside and serves both the Credit Union and Easter Seals buildings. The meter number used for tracking electricity consumption has not been provided, and no data is available regarding peak electrical demand. Additionally, while it is known that a generator is present, specific details or capacity ratings for the generator are not available.

3 Utility Billing Analysis

3.1 Utility Type and Usage

Vibe Credit Union receives electric service, natural gas service, and is not connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 3: Total Energy Usage and GHG Emissions (2024)

Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	90,393 kWh	308	$9,943	$0.11/kWh	0.0004427	40
Natural Gas	606 MCF	629	$3,020	$4.98/MCF	0.05294	33
Total	**--**	**938**	**$12,963**	**--**	**--**	**73**

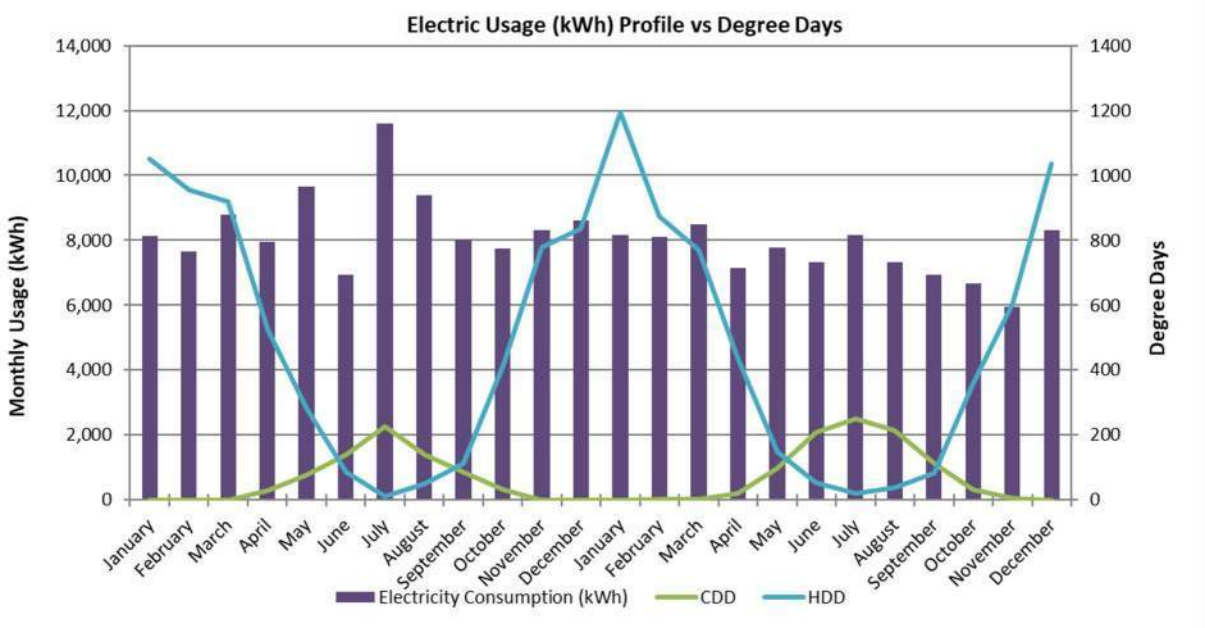
**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*

***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage does not show a strong correlation to weather data, indicating the majority of electricity usage consists of baseload usage. This usage does not vary much from month to month and includes loads such as lighting, fans, and pump loads. The annual usage for the baseline 12-month period from January to December 2024 is 90,393 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

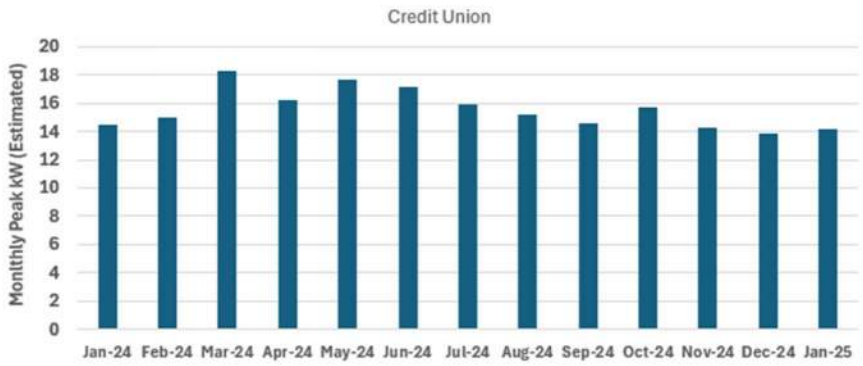
The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 4: Building Envelope Summary

Maximum Building Capacity at Service Transformer	500 kW
Maximum Capacity at Switchgear (A*V*Ph)	210 kW
Estimated Peak Demand	18 kW (estimated)
Remaining Capacity	**202 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge:	**$0.057/kWh**
DTE Electric Demand Charge:	**$6.15/kW/Month**
Average Dollar per kWh Used in Calculations:	**$0.11/kWh**

Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the

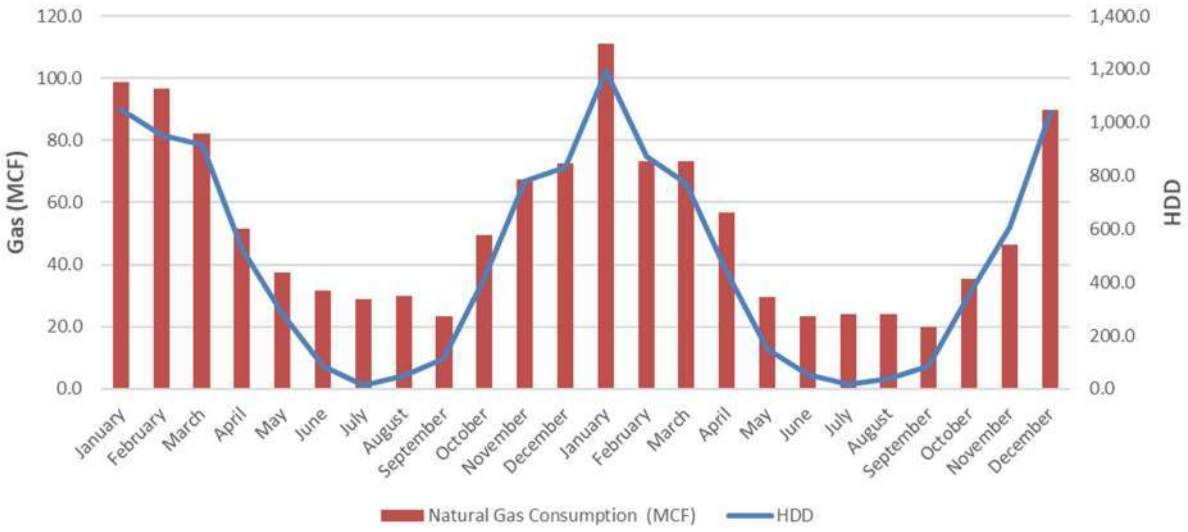
campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage was not available, so an estimation was made using the monthly profile of an Oakland County building with a similar use, the Executive Office Building (EOB). The natural gas energy use intensity and analogous cost intensity in MCF/SF and $/SF were found for each month then scaled to the size of the Credit Union, 11,555 SF. The resulting profile is shown below. shows a direct correlation to weather data, as natural gas is primarily used for space heating. However, there is baseload summer usage due to domestic hot water usage for bathrooms. The annual usage for the baseline 12-month period from January to December 2024 is 606 MCF. The detailed monthly natural gas usage and cost estimates based on the Executive Office Building are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water equipment that uses gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the

primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumers Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): $3.48/dTh (dekatherm - 1.038 MCF)

Constellation NG Usage Charge (Day Gas): $5.29/dTh (dekatherm - 1.038 MCF)

Average Dollar per MCF Used in Calculations: $4.98/MCF

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 5 below.

Table 5: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$9,943
Natural Gas	$3,028
Total	$12,971
ECI $/yr/sf	$1.12

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

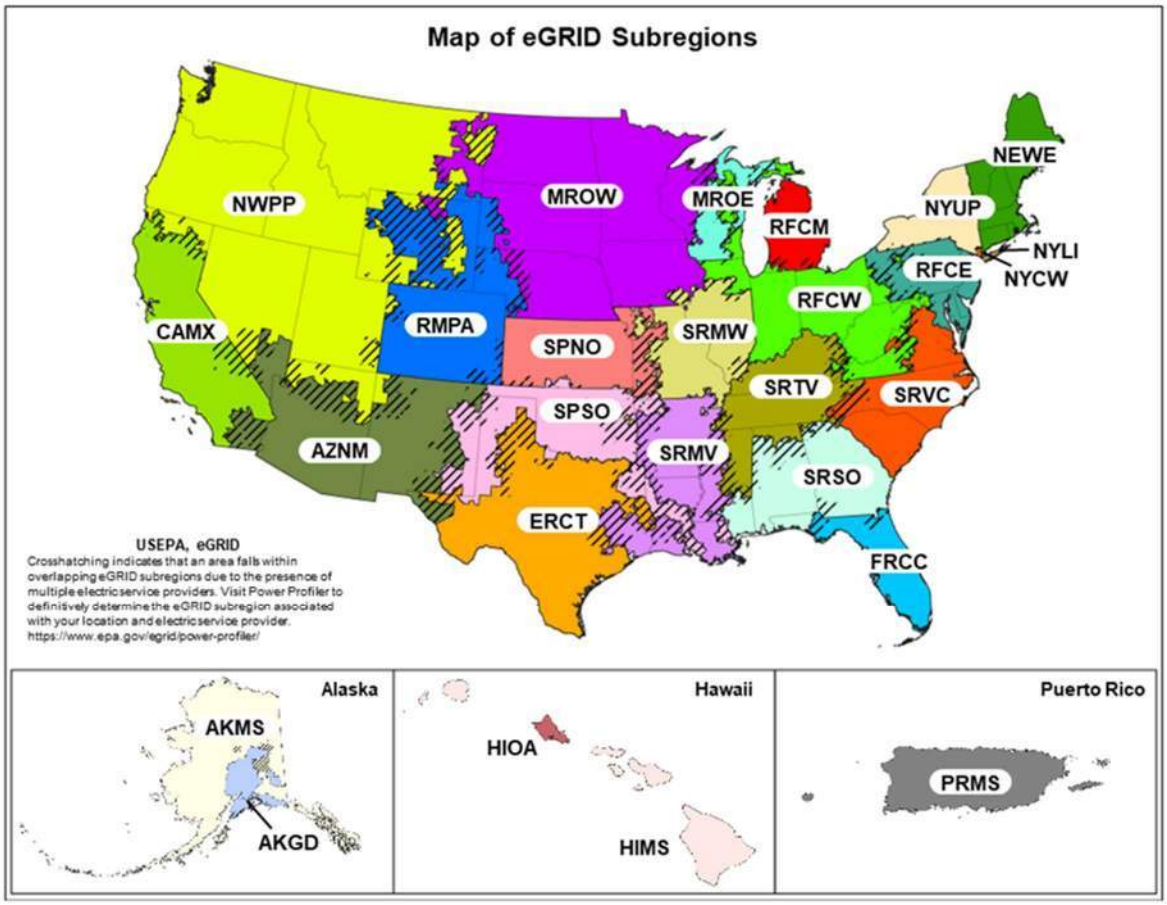
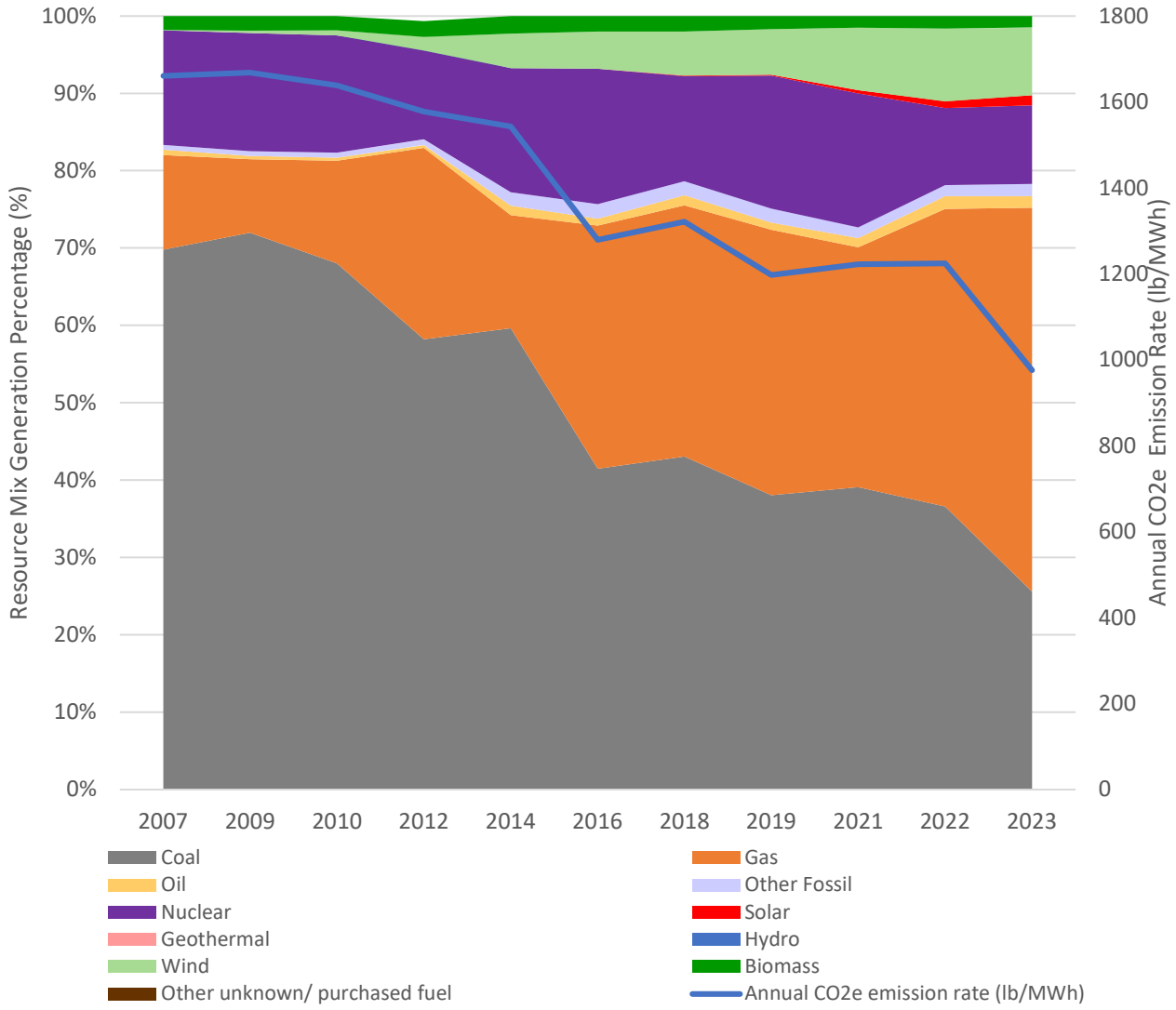


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 45 percent of carbon emissions are attributed to natural gas and 55 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 33 tCO2e (campus-level Scope 1) and 40 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 73 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for Vibe Credit Union are converted to kBTUs units, summed, and divided by the total square footage.

Table 6: Annual Utility Summary (2024)

Building:	Credit Union				**Electric EUI:**	27	kBTU/SF/yr
GFA:	11,555	SF			**Gas EUI:**	54	kBTU/SF/yr
eGRID Subregion:	RFCM				**Current EUI**	81	kBTU/SF/yr
Annual Utility Summary							
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	90,393	kWh	3.412	308	0.0004427	40	$9,943	77%
Natural Gas	606	MCF	1.038	629	0.0549206	33	$3,027	23%
		Totals		**938**		**73**	**$12,970**	**100%**

According to the US EPA, the average site energy use intensity for a bank branch facility is 89 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 81 kBTU/SF, which is approximately the same as the national benchmark. It’s important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. Nevertheless, there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

U.S. National Median Reference Values for All Portfolio Manager Property Types

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Banking/Financial Services	Bank Branch *		209.9	88.3	CBECS - Bank/Financial
	Financial Office*		116.4	52.9	CBECS - Office & Bank/Financial
Education	Adult Education		110.4	52.4	CBECS - Education
	College/University		180.6	84.3	CBECS - College/University
	K-12 School*		104.4	48.5	CBECS - Elementary/Middle & High School
	Pre-school/Daycare		131.5	64.8	CBECS - Preschool
	Vocational School		110.4	52.4	CBECS - Education
	Other - Education				
Entertainment/Public Assembly	Convention Center		109.6	56.1	CBECS - Social/Meeting
	Movie Theater		112.0	56.2	CBECS - Public Assembly
	Museum				
	Performing Arts				
	Recreation	Bowling Alley	112.0	50.8	CBECS - Recreation
		Fitness Center/Health Club/Gym			
		Ice/Curling Rink			
		Roller Rink			
		Swimming Pool			
		Other - Recreation			
	Social/Meeting Hall		109.6	56.1	CBECS - Social/Meeting

3.8 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees and visitors. Table 7 and Figure 6 and Figure 7 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 7: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	597	0	592,480	51.3	31.3
Space Cooling	15,563	0	0	53,100	4.6	6.9
Fans	10,871	0	0	37,091	3.2	4.8
Pumps	118	0	0	404	0.0	0.1
DHW	0	11	0	42,724	3.7	2.3
Conveyance	0	0	0	0	0.0	0.0
Lighting	23,623	0	0	80,602	7.0	10.5
Plug Loads	30,720	0	0	104,817	9.1	13.6
Process Loads	0	0	0	0	0.0	0.0
Refrigeration	0	0	0	0	0.0	0.0
Cooking	0	0	0	0	0.0	0.0
Information Technology	6,358	0	0	21,694	1.9	2.8
TOTAL	**87,253**	**608**	**0**	**932,910**	**81**	**72**
Historical Billing	**90,393**	**606**	0			
Percent of Actual	97%	100%	0%			
per sqft	**7.82**	**0.05**	0			

Figure 7: Existing Electricity End Use Distribution

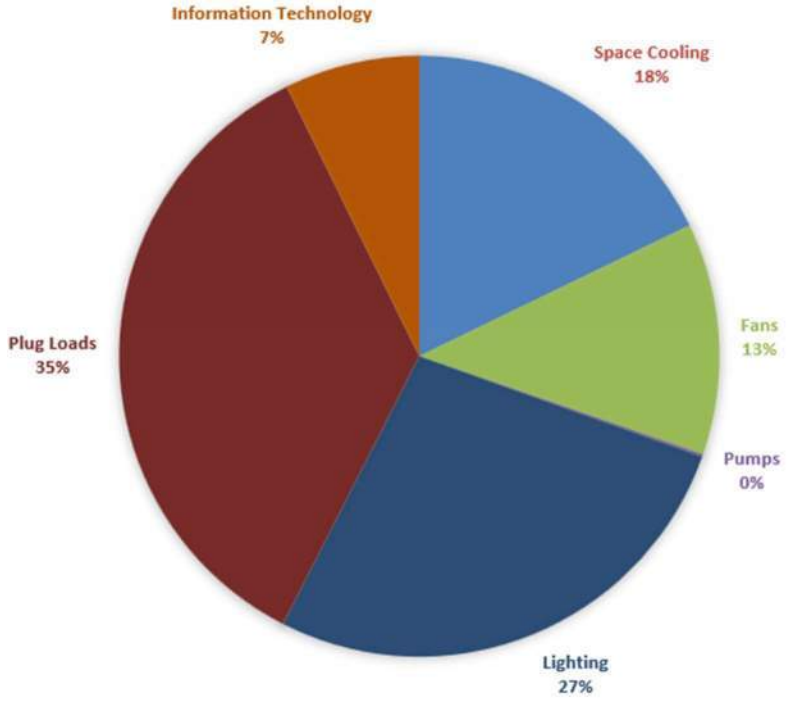
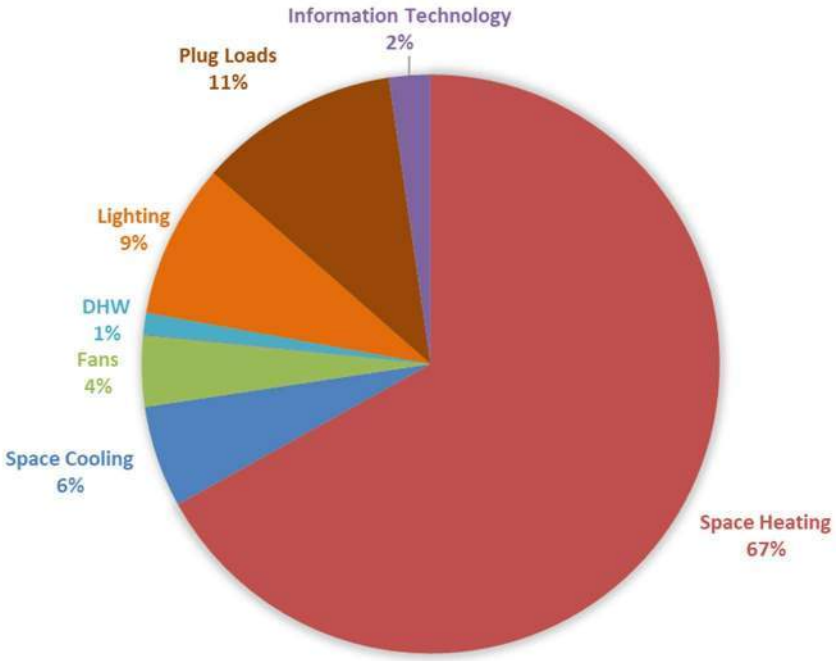


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure, but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – LED Lighting Upgrades

This measure proposes upgrading fluorescent lighting to light-emitting diode (LED) lightbulbs with sensors to reduce energy consumption and electrical demand. LEDs are highly energy efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements.

Incorporating lighting controls allows for better management and customization of lighting systems, leading to reduced energy consumption, and increased overall efficiency by limiting the time lighting is on to only when necessary. For indoor lighting, lighting controls consist of occupancy, daylighting, timers, scheduling, and dimming features to optimize light levels based on external lighting availability and usage of a space. For outdoor lighting, the lighting controls consist of motion sensors, photocells, and timers to turn the lighting ON/OFF.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.

Figure 9: Example Fixture with Integrated Occupancy Controls



The current lighting in the Credit Union is described in Section 2.1.3.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture. Lighting controls that include dimming will likely require full fixture replacement, which drive up the total cost of implementation for the measure.
- Lights operate 10 hours per day for 252 business days per year, based on office occupancy.
- This measure assumes a 30% reduction in lighting energy through implementation of controls.
- O&M savings assume an average cost of $2.12/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- LED upgrades cost $215/fixture and motion sensors, which includes lighting sensors.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, the subsequent steps would involve conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. Following this assessment, a controls contractor can be engaged to install the lighting controls and assist building engineers in configuring the schedule to optimize lighting usage.

ECM Savings and ROM Cost:

Table 8: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost ($)	Simple Payback (Yrs)
LED Upgrade	0	17,959	61	8		$1,975	$19,788	7.9
Overall % Reduction	**0%**	**20%**	**6%**	**11%**		**19%**	**--**	**--**

4.2 ECM 2 – Implement Temperature Setbacks for HVAC Systems

Implementing standardized setpoints and occupancy schedules for the HVAC system can reduce energy consumption to enhance energy efficiency in areas with regular weekly occupancy. By establishing consistent temperature setpoints and aligning HVAC schedules with actual occupancy patterns, the system avoids unnecessary heating or cooling during unoccupied hours such as evenings, weekends, and holidays. This can be done by enabling seasonal occupied and unoccupied setpoints and schedules on programmable thermostats or enabling these controls in a centralized BAS where only authorized individuals can adjust as needed. This allows the HVAC system to “coast” toward unoccupied setpoints when the spaces are unoccupied and minimizes the need for the HVAC system to run. The Credit Union is heated by six (6) RTU’s that serve different zones in the office, three 2013 manufactured Trane RTUs with heating capacity of 93,000 BTUh and three newer Bryant and Carrier rooftop units with heating capacity of 64,000 BTUh. Given that the building does not currently have a BAS, the units run 24/7. However, the building only operates during typical business hours, offering an opportunity to reduce the total HVAC operation time with setbacks to reduces energy consumption.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- The existing RTU runs 24/7 to maintain occupied setpoints due to the current BAS scheduling.
- This measure assumes heating season energy savings due to reduced HVAC operation hours. Cooling season savings are omitted due to Michigan’s climate.
- The occupied setpoint was assumed to be 72°F setback temperature was assumed to be 50°F for freeze protection.
- $1500 was used to estimate programming costs required to implement the setbacks.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Conduct a survey of existing control functionalities to determine any necessary upgrades and then establish seasonal setpoints (generally targeting 68-74°F when occupied and 55-60°F/80-85°F when unoccupied) and HVAC schedules that align with building

occupancy patterns. Following these steps, the centralized BMS HVAC schedule should be configured accordingly. Verify and monitor to ensure the system is operating as intended and adjust as needed. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 9: ECM 2 Savings and ROM Cost

Savings Summary								
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MMBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
HVAC Setbacks	280	0	290.9	15.4	$0	$1,399	$1,500	1.1
Overall % Reduction	**46%**	**0%**	**31%**	**21%**	**--**	**11%**	**--**	**--**

5 Measures Requiring Additional Consideration

This section provides details on measures that were analyzed but are not recommended for immediate implementation at this time. This includes measures that require further study, such as capital-intensive replacements of existing equipment, but are not justified through energy savings alone. This section may also include measures that conflict with building electrification plans, or projects that are simply not recommended due to being financially impractical or not being technically feasible.

5.1 ECM – BAS Controls Integration and Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent. This combined measure involves installing a building automation system (BAS) and completing RCx once the BAS is operational. Together, these steps enable centralized control, improve system coordination, and ensure building operations are optimized for efficiency and reliability.

BAS Integration

BAS integration refers to connecting and coordinating various building systems and components through a centralized control platform. The goal is to enhance the overall efficiency, functionality, and manageability of building operations. While BAS installation does not directly yield energy savings, it enables the optimization of other measures. In the Credit Union, BAS integration would allow centralized monitoring and optimization of the HVAC systems, which currently operate independently with minimal automation.

Commissioning

With a BAS installed, the Credit Union will have centralized visibility and control of major HVAC and pump systems for the first time. Commissioning is a critical follow-on activity to ensure the BAS is properly configured, sequences of operation are optimized, and long-standing inefficiencies are resolved. Commissioning includes systematically evaluating and fine-tuning HVAC, controls, and other energy-consuming systems to restore them to design intent and reduce energy waste.

The following list represents commissioning opportunities that should be evaluated to validate operation, repair if discrepancies identified or implement if not active and feasible for major HVAC systems. This effort will proactively improve building system operation and optimize energy usage.

- Optimize HVAC scheduling in non 24/7 occupied spaces
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control

- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water and chilled water supply reset
- Discharge air setpoint reset
- Outside air temperature lockouts

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing a BAS will have no change to existing controls capabilities and will increase customization of equipment.
- Commissioning will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 10% reduction in estimated heating and cooling end use energy consumption.
- Project cost is estimated at $3 per square foot of building area (11,555 SF).
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Identify equipment to be connected to the central control system and engage a building controls integration company to plan and cost the system integration. Coordinate with planned capital upgrades and renovations where possible to optimize benefits.

ECM Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
RCx + Install BAS	60	2,643	71.0	4.4	$0	$589	$34,665	58.9
Overall % Reduction	**10%**	**3%**	**8%**	**6%**	**--**	**5%**	**--**	**--**

6 Appendix A

Table 10: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)*	Natural Gas Cost *	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	98.7	$606	8,124	$872	11	14	1,051	0
Feb-23	96.6	$565	7,649	$721	11	14	955	0
Mar-23	82.1	$250	8,791	$789	12	19	918	0
Apr-23	51.4	$178	7,938	$698	11	18	525	28
May-23	37.6	$112	9,655	$761	13	21	283	76
Jun-23	31.5	$78	6,930	$519	10	15	86	139
Jul-23	28.9	$116	11,605	$939	16	22	11	227
Aug-23	29.8	$86	9,374	$745	13	19	48	141
Sep-23	23.5	$67	8,018	$738	11	18	113	85
Oct-23	49.5	$143	7,730	$629	10	17	415	31
Nov-23	67.5	$252	8,304	$638	12	19	779	0
Dec-23	72.4	$357	8,606	$611	12	15	834	0
Jan-24	111.1	$489	8,153	$188	11	15	1,194	0
Feb-24	73.3	$399	8,093	$828	12	15	874	1
Mar-24	73.3	$415	8,495	$685	11	18	771	2
Apr-24	56.7	$118	7,141	$626	11	18	437	21
May-24	29.5	$60	7,777	$615	10	17	148	98
Jun-24	23.3	$75	7,336	$674	10	16	51	207
Jul-24	23.9	$77	8,165	$727	11	15	18	251
Aug-24	23.9	$51	7,337	$675	10	15	37	215
Sep-24	20.0	$49	6,944	$557	10	16	84	112
Oct-24	35.4	$95	6,671	$634	9	14	356	31
Nov-24	46.2	$160	5,957	$643	8	14	607	4
Dec-24	89.9	$200	8,324	$700	11	14	1,037	0
2023 Sum	670	$2,809	102,724	$8,660			6,019	727
2024 Sum	606	$2,188	90,393	$7,552			5,614	942

*Estimated using the energy and cost intensity per square foot of the Executive Office Building as a comparable use type.

7 Appendix B

Table 11: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Efficiency	Capacity 2	Approx Year Installed
HVAC 1	1	Packaged gas rooftop unit							
HVAC 2	1	Packaged gas rooftop unit		Carrier	48TCEA05A2A5A0A0A0	115 in, 93 out (heat)	81	45 (cool)	
HVAC 4 - RTU	1	Packaged gas rooftop unit		TRANE	YSC060E3RMA	80 in, 64 out		58.878	2013
HVAC 5 - RTU	1	Packaged gas rooftop unit		TRANE	YSC036E3RMA019H	80 in, 64 out		35.62	2013
HVAC 6 - RTU	1	Packaged gas rooftop unit		TRANE	YSC036E3RMA1HD000A10000A0	80 in, 64 out		35.62	2013
RTU	1	Packaged gas rooftop unit		BRYANT	582KP07N110A3A0ACA	110 in, 88 out (heat)	80	70 (cool)	
HVAC 3	1	Mini split AC	Data closet	Sanyo	CL 1271	1			2010
DWH-1	1	Domestic water heater, NG	Entire building	RHEEM GUARDIAN SYSTEM	22V40F1 RHLN0210411669	38 in			
REF-1,2,3	3	Exhaust fans		GREENHECK	G-075-DGEX-QD; GB-081-4X-QD-R3; G-090-DGE117XQD				

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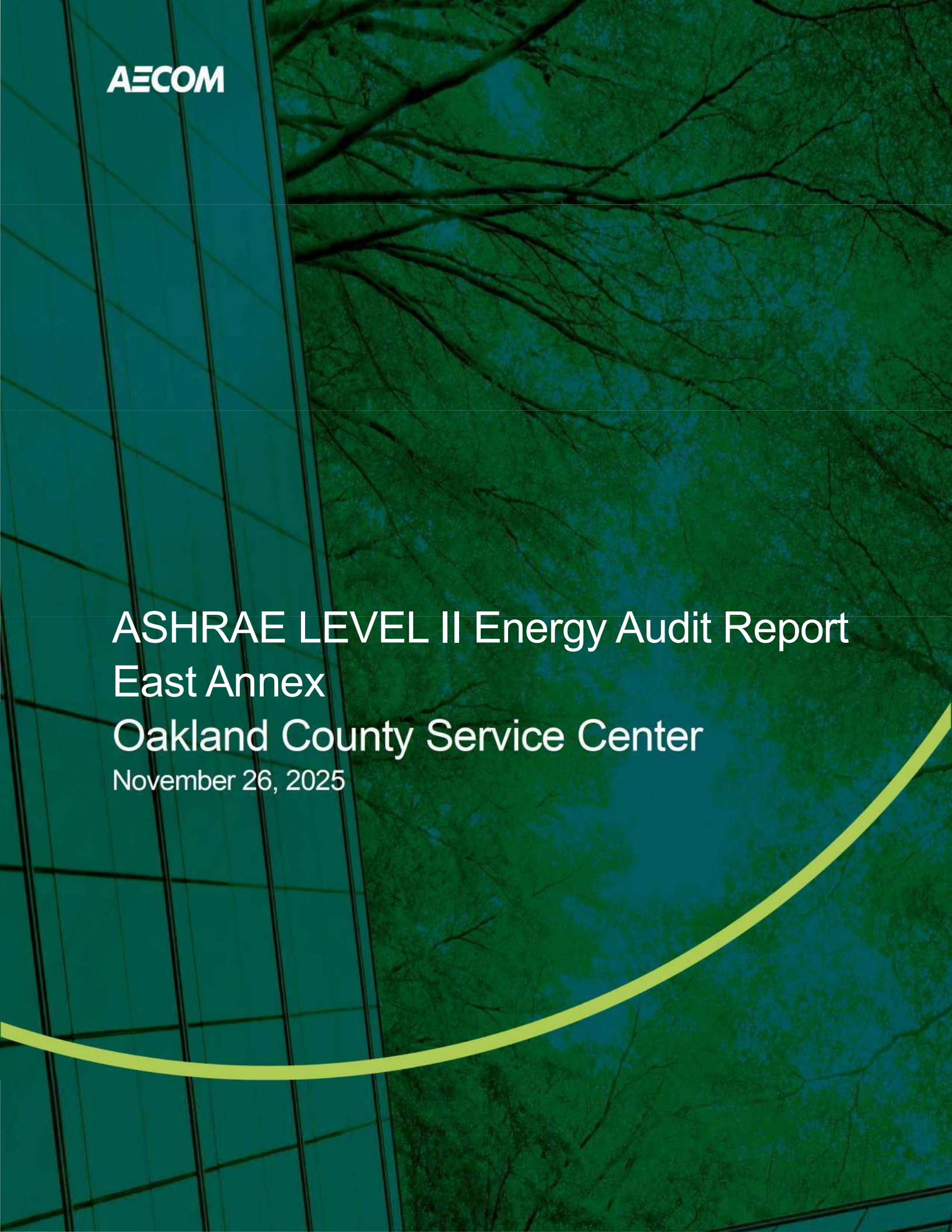

AECOM

ASHRAE LEVEL II Energy Audit Report
East Annex
Oakland County Service Center

November 26, 2025

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

Prepared for:
OAKLAND COUNTY, MI Government

Prepared by:
AECOM

Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County East Annex Building in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The East Annex Building is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Tuesday April 8, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates four ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The two recommended measures represent a projected 22% annual energy cost savings with an aggregate simple payback of 1.3 years. Two additional measures are considered and either not currently recommended or recommended for additional study.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: East Annex Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	tCO2e	$/yr	$/yr	$	Years
1	Retro-commissioning & HVAC Scheduling	HIGH	R	171,471	0	1,371	0	2,008	151	$0	$25,693	$30,569	1.2
2	VFDs on CHW Pumps	HIGH	R	26,863	0	0	0	91.7	12	$0	$2,955	$9,000	3.0
Sum of Recommended Measures				198,334	0	1,371	0	2,100	163	$0	$28,648	$39,569	1.3
Overall % Reduction				21%	0%	25%	0%	24%	23%	--	22%	--	--
Measures for Additional Consideration													
3	Lighting Upgrades	N/A	RS	5,774	10	0	0	19.7	2.6	$234	$635	$32,925	38
4	Upgrade Pneumatic Controls to DDC	N/A	RS	3,844	0	0	0	13.1	1.7	$0	$423	$110,048	260

Notes
Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The East Annex building is 61,138 ft^2 and is mostly abandoned except for occasional use by deputies as office space. This building was constructed in 2002 as a jail facility. An assessment of the Building Management System (BMS) indicated that heating and cooling is provided to the facility 24 hours per day, seven days per week. However, the building is mostly vacant with minimal occupancy. Staff reported the building is typically occupied approximately four days per month.

2.1 Building Systems

2.1.1 Building Envelope

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance
Exterior Wall	Brick faced with interior block construction	Unknown
Roof	Roof was not accessible during the site visit	Unknown
Glazing	Double pane	Unknown

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The HVAC systems in the East Annex building include air handling units (AHUs), a chiller, gas-fired boilers, and an air compressor. The building is conditioned 24 hours per day, with equipment installed per the original building drawings.

There are two primary AHUs and two MAUs that serve the building. AHU-1 and AHU-2 provide whole building ventilation and are rated at 525 MBH and 597 MBH heating capacity, respectively. These AHUs are manufactured by Trane and were installed in 2003. AHU-1 and AHU-2 have variable frequence drives (VFDs) on the supply and return fans which modulate fan speed based on the demand of the variable volume reheat (VVR) terminal boxes throughout the building. MAU-1 and MAU-2 are additional AHUs installed to serve specific areas such as the laundry and converted laundry spaces. These systems also have VFDs on the supply fan and utilize R134A refrigerant for cooling and are in good condition.

The building has an air-cooled chiller (ACC-1), which serves the two primary AHUs, AHU-1 and AHU-2. Manufactured by Trane and installed in 2003, this chiller provides cooling to the building and uses R-134A refrigerant. The chilled water distribution pumps appear to be constant volume and do not have VFDs. The building has two natural gas boilers manufactured by Weil-McLain (model 1588, installed in 2003) to provide heating for the entire building. Each boiler has a

4,762 MBH maximum and 2858 MBH minimum heating capacity. These units provide consistent heat throughout the building and operate year-round for reheat. The secondary hot water distribution pumps are equipped with VFDs. The building has an air compressor used for various pneumatic controls and equipment. This Speedaire compressor operates at 3 HP and has a capacity of 12 SCFM at 80 PSI. It does not run excessively and is observed to operate as needed, typically for building systems requiring compressed air.

2.1.2.2 Plumbing

The three building domestic water heaters were originally sized for large simultaneous shower service, laundry and kitchen use. The system maintains 140 °F hot water in two 1,500 gallon domestic water storage tanks and its assumed the tanks are still in use. The domestic hot water heaters (model Lockinvar PFN 2000PM) are powered by natural gas and serve the entire building, including the showers, kitchen, and laundry. According to the BMS, the hot water supply setpoint is 140°F to the kitchen and 110°F for other domestic purposes such as bathrooms. Each boiler has an input heating capacity of 2000 MBH. The system is in good condition but is noted to be missing some pipe insulation to the storage tank, which may reduce efficiency.

2.1.2.3 Building Controls

The BMS utilizes a combination of Aveva and Niagara platforms to monitor and control HVAC operations. Graphics screens for all major HVAC systems are available, with approximately 40% of control devices being direct digital control (DDC) and the remaining 60% pneumatic. The BMS incorporates an outdoor air temperature-based hot water supply temperature reset strategy and outdoor air lockouts currently set to 57°F for general space heating (reheat is year-round) and 75°F for cooling.

2.1.3 Lighting Systems

The lighting system is a mix of approximately 50% fluorescent and 50% light emitting diode (LED) fixtures, installed throughout the facility based on spatial and functional needs. Fixtures are recessed, ceiling-mounted, or suspended. LED fixtures are rated at 12W.

Table 3: Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
Fluorescent/LED Lights	180	3 lamp
Fluorescent/LED Lights	163	2 lamp
Downlights	96	-

Based on the drawings, the total number of lighting fixtures in this two-story building is 439. There are 180 fixtures of 3 lamps, 163 fixtures of 2 lamps, and 96 downlights.

The approximate total wattage is 22,568 watts. The approximate area per drawing is 61,138ft^2. The calculated lighting density is 0.35 W/ft^2.

2.1.4 Electrical Infrastructure

The facility is served by a 750 kVA transformer with a main service rated at 480/277V, 1200A, 3-phase. A single diagram is available. The meter peak load of approximately 417.5 kW has been identified. Backup power is available via a 350 kW Kohler generator.

3 Utility Billing Analysis

3.1 Utility Type and Usage

East Annex receives electric service, natural gas service, and is not connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed includes the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

Table 4 summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

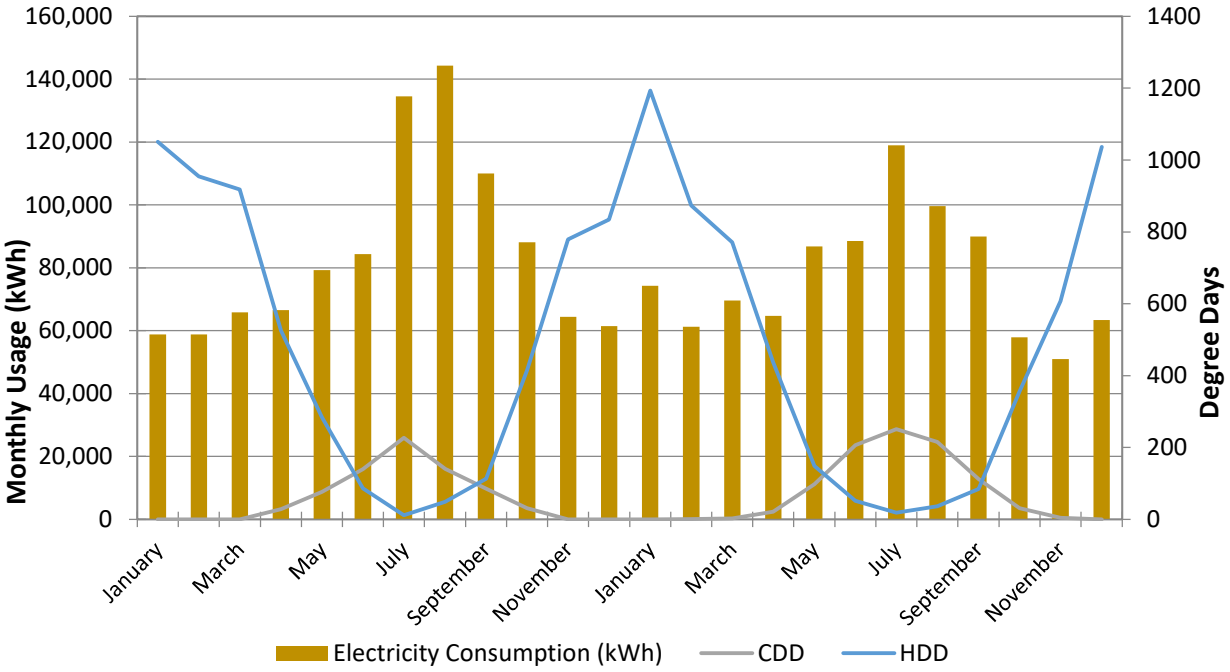
Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	926,158 kWh	3,160	$101,877	$0.11	0.0004427	410
Natural Gas	5,485 MCF	5,693	$27,326	$4.98	0.0549206	301
Total	--	**8,853**	**$129,204**	--	--	**711**

**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a strong correlation to weather data, indicating heavy air conditioning use during summer months. The annual usage for the baseline 12-month period from January to December 2024 is 926,158 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

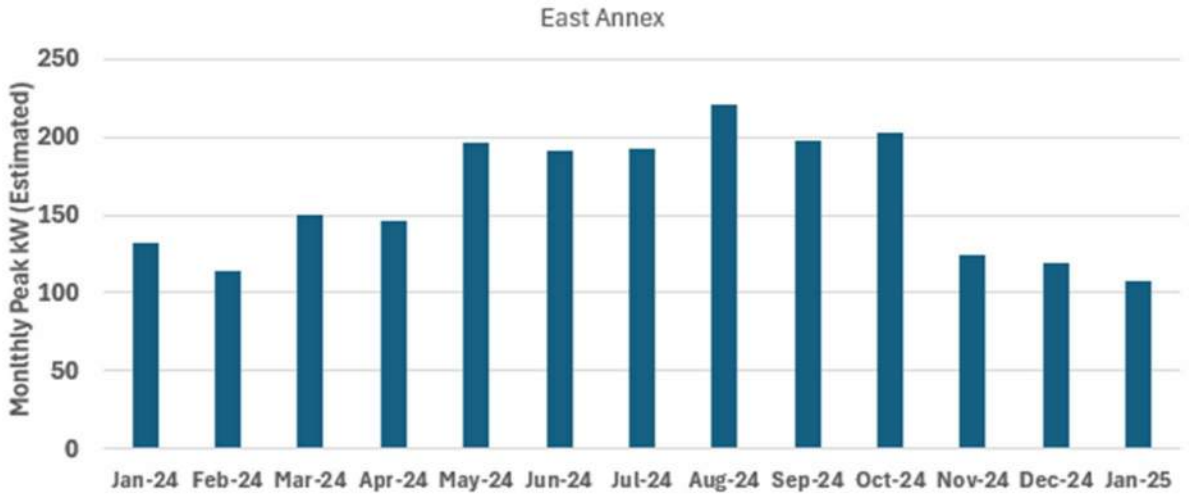
Note that the building is largely abandoned. It is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below. Because the building is mostly abandoned, current electricity consumption and the resulting demand estimates reflect unusually low operational loads.

Table 5: Electric Capacity Results

Maximum Building Capacity at Service Transformer	750 kW
Maximum Capacity at Switchgear (A*V*Ph)	1000 kW
Estimated Peak Demand	221 kW (estimated)
Remaining Capacity	**529 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge: **$6.15/kW/Month**

Average Dollar per kWh Used in Calculations: $0.11/kWh

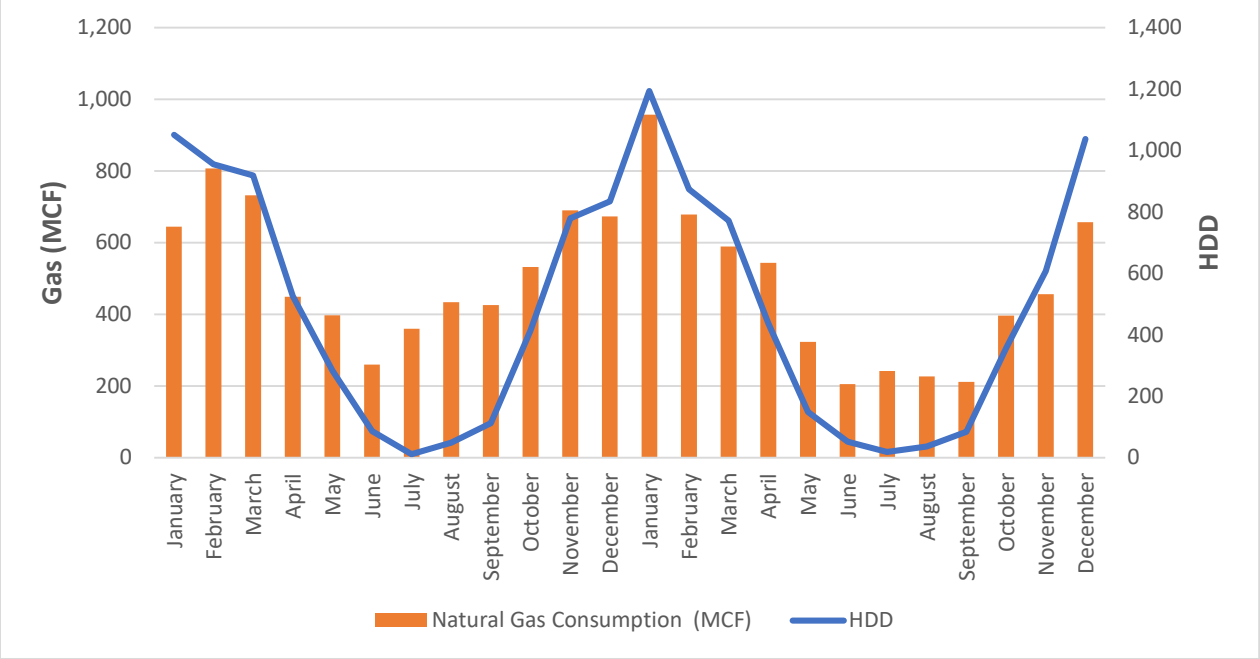
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows a direct correlation to weather data, as natural gas is primarily used for space heating. However, there is significant baseload summer usage which appears to be largely attributed to reheat and domestic hot water storage. The annual usage for the baseline 12-month period from January to December 2024 is 5,485 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also reheat, domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): $3.48/dTh (decatherm, or 1.038 MCF)

Constellation NG Usage Charge (Day Gas): $5.29/dTh (decatherm, or 1.038 MCF)

Average Dollar per MCF Used in Calculations: $4.98/MCF

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$101,877
Natural Gas	$27,326
Total	$129,204
ECI $/yr/sf	$2.11

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each

emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

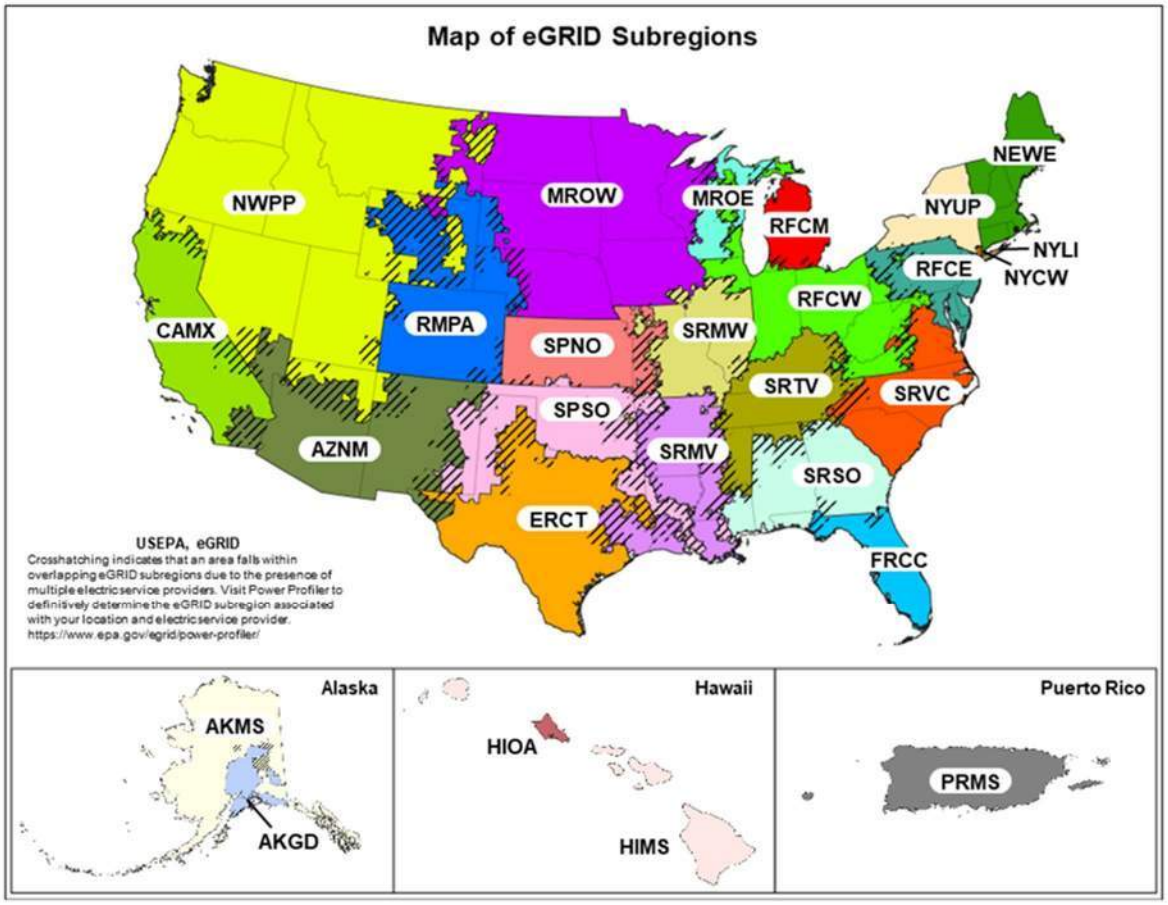
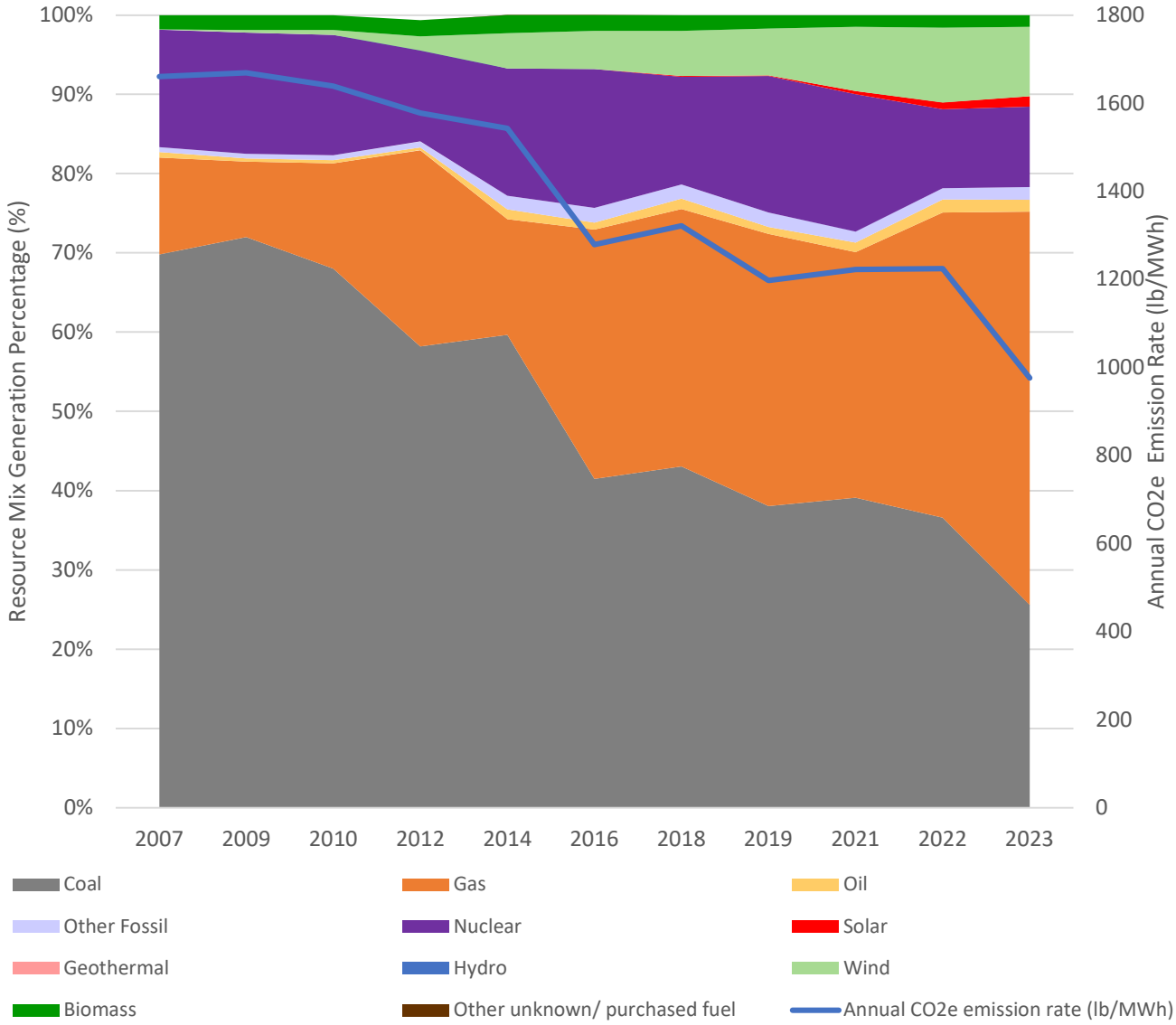


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 42 percent of carbon emissions are attributed to natural gas and 58 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 301 tCO2e (campus-level Scope 1) and 410 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 711 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for East Annex are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	East Annex				**Electric EUI:**		52	kBTU/SF/yr
GFA:	61,138	SF			**Gas EUI:**		93	kBTU/SF/yr
eGRID Subregion:	RFCM				**Current EUI**		145	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	926,158	kWh	3.412	3,160	0.0004427	410	$101,877	79%
Natural Gas	5,485	MCF	1.038	5,693	0.0549206	301	$27,326	21%
		Totals		**8,853**		**711**	**$129,204**	**100%**

According to the US EPA, the average site energy use intensity for a prison/incarceration facility is 69.9 kBTU/SF/yr. Currently, the building is used occasionally as office space, which has an average energy use intensity of 52.9 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 145 kBTU/SF, which is significantly higher than the national benchmark for both the historical and current use types. It's important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison and observations from the site visit indicate there is a significant opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient

3.8 End Use Distribution

Table 8 shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees and visitors. Table 8 and Figure 7 and Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	5,369	0	5,573,429	91	295
Space Cooling	281,490	0	0	960,444	16	125
Fans	404,392	0	0	1,379,787	23	179
Pumps	155,706	0	0	531,268	9	69
DHW	0	115	0	119,571	2	6
Conveyance	0	0	0	0	0	0
Lighting	12,423	0	0	42,388	1	5
Plug Loads	68,303	0	0	233,049	4	30
Process Loads	3,844	0	0	13,116	0	2
Refrigeration	0	0	0	0	0	0
Cooking	0	0	0	0	0	0
Information Technology	0	0	0	0	0	0
TOTAL	926,158	5,485	**0**	8,853,051	145	711
Historical Billing	926,158	5,485	0			
Percent of Actual	100%	100%	0%			
per sqft	15.1	0.1	0			

Figure 7: Existing Electricity End Use Distribution

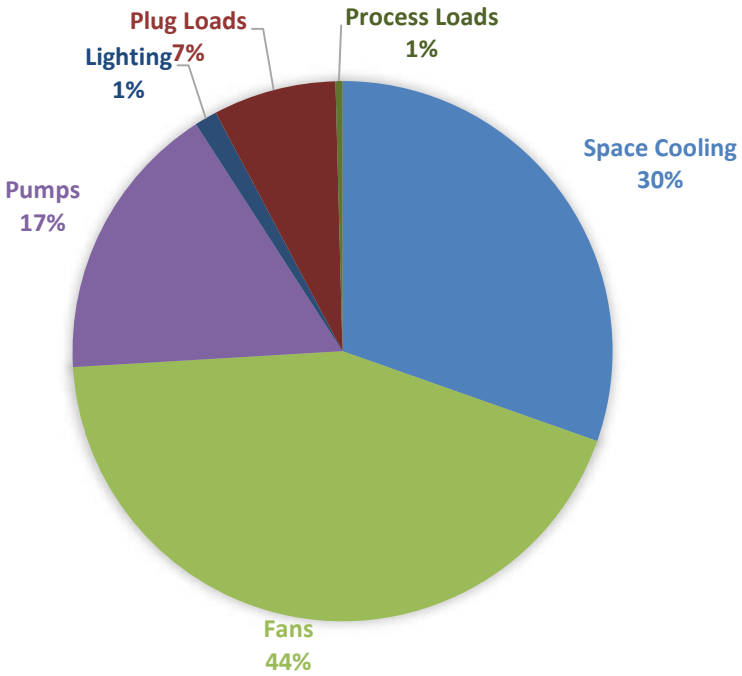
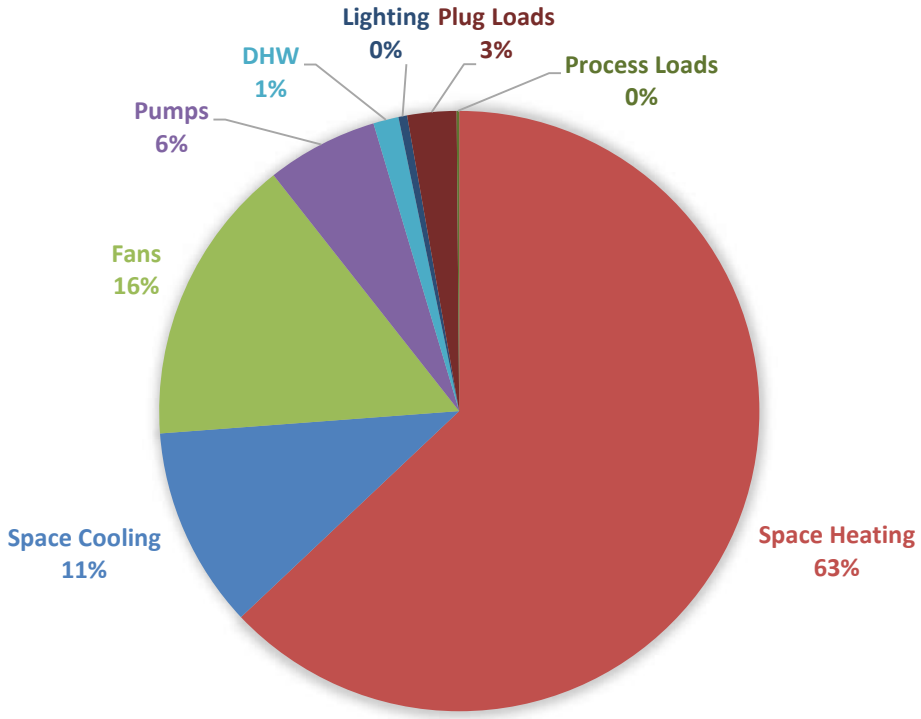


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 - Retro-Commissioning and HVAC Scheduling

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent. RCx presents a valuable opportunity to verify that existing reset sequences are operating as intended, ensure coordination between DDC and pneumatic systems, and identify opportunities to refine scheduling, setpoints, and equipment control. Implementing RCx to its fullest extent will improve system performance, extend equipment life, and reduce energy costs. This measure recommends completing HVAC scheduling and temperature and ventilation setbacks as part of a comprehensive retro-commissioning project because these adjustments on their own may reveal operational issues (such as the static pressure issues with AHU-2) that might go unnoticed in a vacant building and lead to unwanted outcomes (such as high humidity or freezing pipes).

Observations from the site visit and high-level review of the BMS system indicate that not all systems are operating optimally or communicating with the BMS. A few examples include:

- HVAC schedules operate 24/7 at occupied setpoints while the building is mostly vacant. HVAC schedules and setpoints should be assessed to accommodate current building occupancy. This is the most significant savings opportunity.
- AHU-1 and AHU-2 minimum outdoor air is set to 20% to meet ventilation requirements of a fully occupied building. This can be reduced to minimize unnecessary heating and cooling loads while the building remains vacant.
- Domestic hot water is stored at 140°F and originally designed for large simultaneous loads for kitchen use, showering, and laundry. The two 1,500 gallon hot water storage tanks are unnecessary for the current building use and the DHW system should be evaluated to

minimize storage while maintaining safe water temperatures for occasional bathroom use. Areas of piping around the storage tanks were also lacking insulation.

- AHU-2 supply and return fans were observed to be running at 100% and the duct static pressure was 0.62 in WC while the setpoint was 1.25 in WC. This indicates an issue with the AHU that may stem from a faulty pressure sensor, duct leakage, damper issues, or fan performance.
- The high electricity usage and high baseload gas usage in the summer months indicate there may be unnecessary simultaneous heating and cooling occurring.

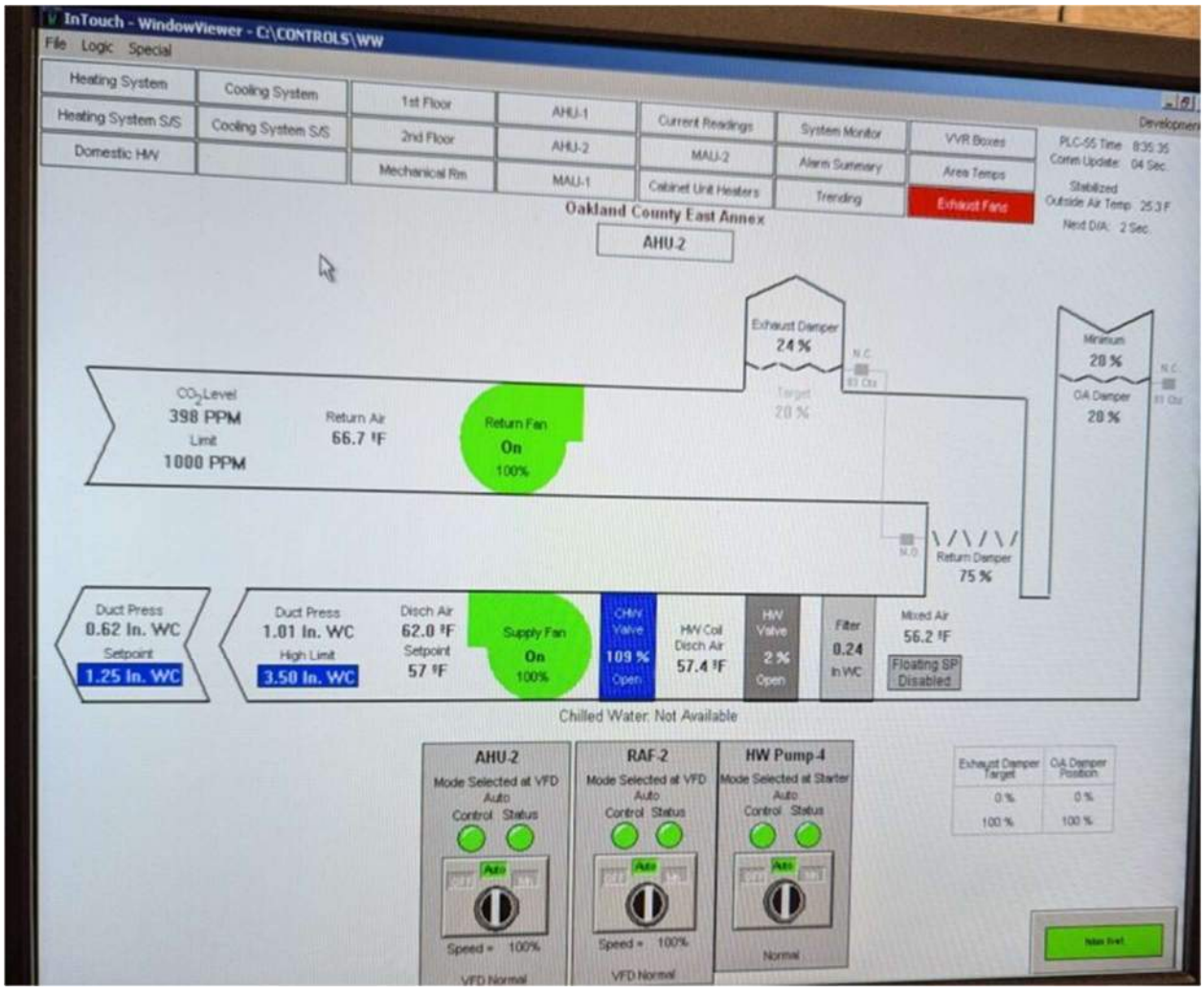


Figure 9: BMS screenshot showing AHU-2 operational issues

While each of these individual examples are minor concerns, these illustrate an opportunity to systematically evaluate all major systems to identify and resolve similar operational discrepancies to optimize system performance and reduce energy usage. The following list represents all RCx opportunities that should be evaluated to validate operation, modify and/or repair if discrepancies identified if systems not scheduled for timely replacement. This effort will proactively improve building system operation and optimize energy usage.

- Optimize HVAC scheduling
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water and chilled water supply reset
- Discharge air setpoint reset
- Outside air temperature lockouts
- Outside air damper control
- Duct static pressure reset
- Repair airside or waterside economizing
- Demand-controlled ventilation

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 25% reduction in estimated heating, cooling, and fan end use energy consumption (largely attributed to HVAC scheduling and setback).
- Project cost is estimated at $0.50 per square foot of building area.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: This measure proposes engaging a third-party contractor to determine if this building is eligible for the DTE RCx program and systematically evaluate and prioritize major HVAC and control systems and complete retro-commissioning to restore systems to their original design intent. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 9: ECM 1 Savings and ROM Cost

	Savings Summary							
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings (($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
RCx & Scheduling	1,371	173,253	2,014	152	$0	$25,889	$30,569	1
Overall % Reduction	25%	18.7%	22.8%	21.4%	$0	20.0%	-	-

4.2 ECM 2 - Variable Frequency Drives for Chilled Water Pumps

Variable Frequency Drives (VFDs) on pumps will provide a dynamic and energy-efficient solution by allowing precise control of pump speed, optimizing performance, and reducing

unnecessary energy consumption during periods of lower demand. Currently, there are two 15 HP chilled water pumps which are assumed to operate in lead/lag mode which operate at constant speed when the chilled water system is operational (typically above 75°F according to the BMS setpoints). The hot water system has VFDs on the 10 HP secondary distribution pumps which operate year-round for reheat. This ECM proposes installing VFDs on the chilled water pumps to modulate pump speed as needed to meet cooling requirements which will reduce pump energy.

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- VFDs will be most effective when paired with a BMS to automatically control speeds.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed. VFDs will likely increase the service life of the equipment if properly selected and installed.
- The savings for this measure assume an average 20% reduction in equipment speed.
- Assumes a cost of $300/HP for VFD and installation.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the chilled water pumps for compatibility with a VFD and assess the usage pattern and energy consumption. Once this data is collected, select the appropriate type of VFD. Choose VFD based on compatibility with current systems, programmability, and reliability. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 10: ECM 2 Savings and ROM Cost

Savings Summary								
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
VFDs on CHW Pumps	0	26,863	92	12	$0	$2,955	$9,000	3
Overall % Reduction	0%	2.9%	1.0%	1.7%	--	2.3%	-	-

5 Measures Requiring Additional Consideration

This section provides additional information about projects that have been evaluated but are not currently recommended for implementation due to poor economics, feasibility issues, conflicts with other projects already recommended, or requirements for additional study that may impact feasibility. Equipment electrification projects, which have longer paybacks, may be listed here but will be expanded upon in the final Electrification Plan for each building. All electrification projects that are required for campus electrification are not included in the energy audit reports. This report includes two measures that are included in the Not Recommend Category. The measure summaries are given below:

5.1 ECM 3 – Lighting Upgrade

This measure proposes upgrading all remaining fluorescent lighting to Light-emitting diode (LED) lightbulbs to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements.

The current lighting in the East Annex is approximately 50% LED and 50% fluorescent and the estimated wattage is approximately 0.35 W/ft². However, the building is mostly vacant and reported to only be used approximately 4 days per month therefore, the current estimated lighting energy usage is relatively low and savings based on the current estimated use is negligible. Therefore, this measure is not currently recommended but should be considered in the future if the building becomes regularly occupied again.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Lights are assumed to be on approximately 12 hours per day for 48 days of the year when the building is occupied. Lighting is assumed to be mostly off the remainder of the year as the building is primarily vacant.
- This measure assumes lighting savings of approximately 0.19 W/ft² or approximately 50% reduction in interior lighting power.
- LED upgrades cost $150/fixture and do not include integrated lighting controls.
- O&M savings assume an average cost of $0.48/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. This measure is not currently recommended for implementation due to extended payback, which is a result of low occupancy and operating hours of equipment.

ECM Savings and ROM Cost:

Table 11: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
LED Upgrade	0	5,774	20	2.6	$233	$635	$32,925	38
Overall % Reduction	0%	0.6%	0.2%	0.4%	--	0.5%	--	--

5.2 ECM 4 - Upgrade Pneumatic Controls to DDC

Pneumatic controls upgrades refers to the process of upgrading antiquated pneumatic control systems and components to direct digital controls (DDC) and integrating it with a centralized control system. Pneumatic controls use compressed air to operate valves and dampers and are prone to operational and maintenance issues. Upgrading these antiquated controls to DDC will enhance the overall efficiency, functionality, and manageability of HVAC system operation. This measure directly produces electricity savings by eliminating the need for a compressed air system, but also indirectly contributes additional energy savings by enabling better control and functionality such as scheduling and optimization. In the East Annex, the BMS utilizes a combination of Aveva and Niagara platforms with graphics available for all major HVAC systems. Currently, approximately 40% of control devices are direct digital control (DDC) while the remaining 60% are pneumatic. This measure proposes replacing all pneumatic controls with DDC and integrating them into the existing BMS platform. Converting to full DDC will improve controllability, enhance monitoring and optimization opportunities, and allow more effective implementation of advanced energy-saving strategies such as supply temperature reset and demand-based scheduling. This effort will ensure that systems operate efficiently, extend equipment life, and reduce overall energy costs.

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- Upgrading pneumatic controls to DDC will improve existing control functionality.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed.
- Energy savings assume removal of the compressed air system.
- A unit cost of $3/sf for 60% of the building area was assumed, given that DDC is already implemented in 40% of building systems.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Identify equipment to be connected to the central control system and engage a building controls integration company to plan and price the system integration. Coordinate with planned capital upgrades and renovations where possible to optimize benefits. This measure is recommended for further evaluation which can be completed during the retro-commissioning process .

ECM Savings and ROM Cost:

Table 12: ECM 5 Savings and ROM Cost

Savings Summary								
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
Upgrade Pneumatic Controls	0	3,844	13	2	$0	$423	$110,048	260
Overall % Reduction	0%	0.4%	0.1%	0.2%	--	0.3%	--	--

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Table 13: Monthly Utility Data (2023 to 2024)

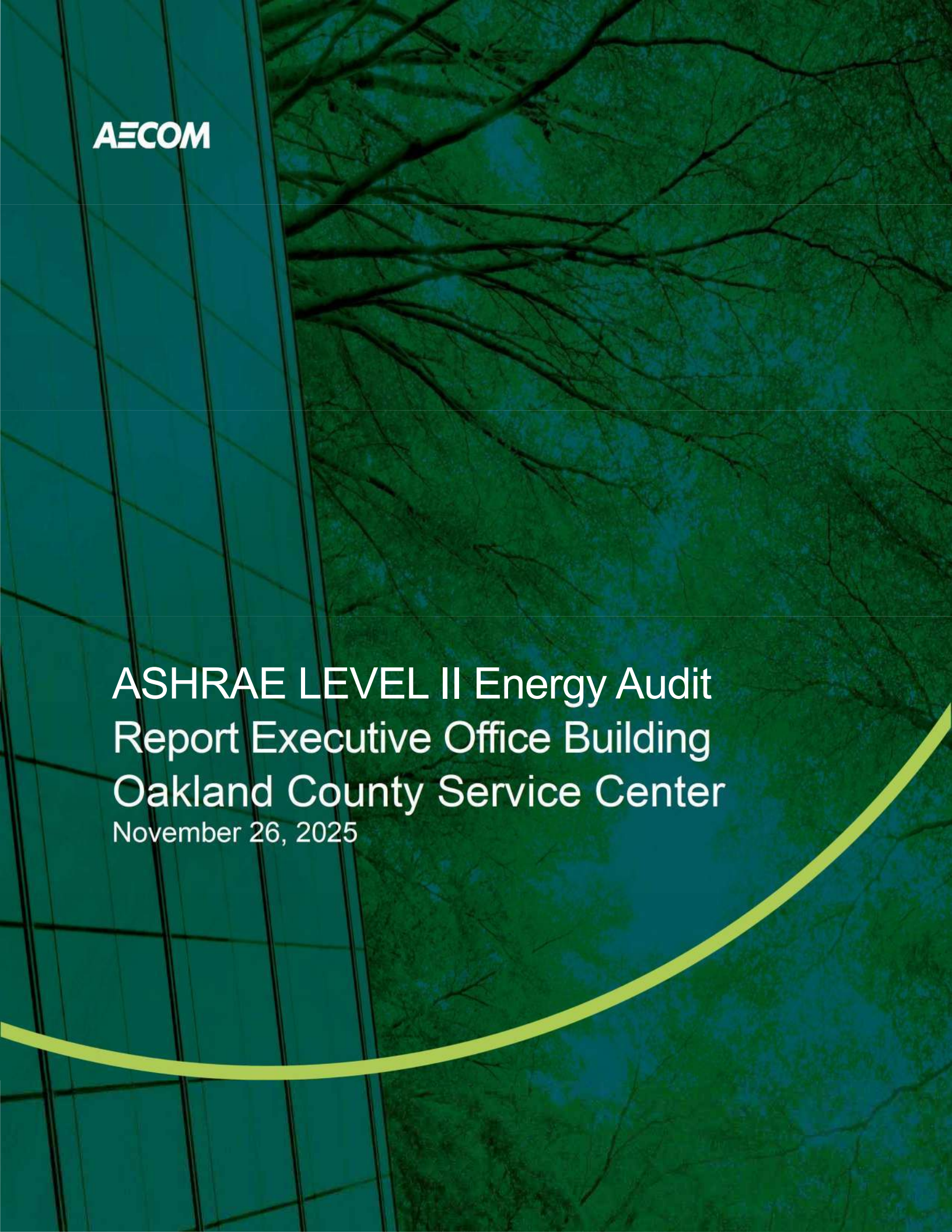
Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	645	$3,958	58,785	$6,309	79	105	1,051	0
Feb-23	807	$4,716	58,785	$5,537	87	109	955	0
Mar-23	732	$2,230	65,854	$5,907	89	142	918	0
Apr-23	449	$1,555	66,564	$5,857	92	151	525	28
May-23	397	$1,189	79,264	$6,251	107	175	283	76
Jun-23	260	$642	84,360	$6,319	117	183	86	139
Jul-23	359	$1,440	134,582	$10,893	181	250	11	227
Aug-23	434	$1,251	144,303	$11,464	194	287	48	141
Sep-23	426	$1,209	110,023	$10,128	153	249	113	85
Oct-23	532	$1,533	88,120	$7,170	118	189	415	31
Nov-23	690	$2,573	64,441	$4,949	90	150	779	0
Dec-23	673	$3,321	61,460	$4,363	83	105	834	0
Jan-24	957	$4,213	74,300	$1,715	100	132	1,194	0
Feb-24	679	$3,695	61,233	$6,263	91	114	874	1
Mar-24	589	$3,334	69,638	$5,618	94	150	771	2
Apr-24	544	$1,133	64,740	$5,679	121	197	437	21
May-24	323	$657	86,840	$7,285	117	191	148	98
Jun-24	205	$664	88,564	$8,138	123	193	51	207
Jul-24	242	$783	118,971	$10,597	160	221	18	251
Aug-24	226	$482	99,668	$9,166	134	198	37	215
Sep-24	211	$513	89,923	$7,211	125	203	84	112
Oct-24	396	$1,062	57,872	$5,497	78	124	356	31
Nov-24	456	$1,579	50,983	$5,499	71	119	607	4
Dec-24	657	$1,460	63,426	$5,334	85	108	1,037	0
2023 Sum	6,404	$25,617	1,016,541	$85,147			6,019	727
2024 Sum	5,485	$19,575	926,158	$78,002			5,614	942

7 Appendix B

Table 14: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity	Units
MAU-1	1	Air Handling Unit	Laundry	Trane	MCCBG08UAC	4355	CFM
MAU-2	1	Air Handling Unit	Converted laundry	Trane	TSCB012UOFOOOO		
AHU-1	1	Air Handling Unit	Whole building			25000	CFM
AHU-2	1	Air Handling Unit	Whole building			18000	CFM
ACC-1	1	Air cooled chiller	AHU-1 and AHU-2	Trane	RTAC1704UDONUAFNL1NY1DDNRAOEA1ONPOFXN	170.6	TON
B-1, B-2	2	Boiler (NG)	Building heat	Weil McLain	1588	2858 min, 4762 max	MBH
DWH-1 to 3	3	Water heater (NG)	Whole building, showers and laundry	Lochnivar	PFN 2000PM SN: B03H00151468	2000 in	MBH
	1	Air compressor	HVAC controls (40% DDC, 60% pneumatic)	Speedaire	5Z702A	3	HP
RAF-1	1	Return air fan		Greenheck	TCF	18600	CFM
RAF-2	1	Return air fan		Greenheck	TCF	12500	CFM
P-1, P-2	2	Hot water pumps	Boilers			5	HP
P-3	1	Heating Hot Water Pump	AHU-1			1.5	HP
P-4	1	Heating Hot Water Pump	AHU-2			1	HP
P-5,P-6	2	Secondary HW Pumps w/ VFD	HWHS-GH			10	HP
P-7, P-8	2	Domestic hot water pumps	DWH-1 to 3			0.25	HP
P-9	1	Pump	MAU-1			0.5	HP
P-10, P-11	2	Chilled water pumps	CH-1	Bell & Gossett		15	HP
EF-1 to EF-9	9	Exhaust fans w/ VFDs		Greenheck	SQ	3/4 (EF-3), 1/6 (EF-9), 1/3 (All else)	HP

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity	Units
	1	Clothes Dryer (NG)		UniMac - Alliance	UT075NRUF6C2W02	165 in	MBH
	4	Clothes Dryer (NG)		UniMac - Alliance	UT120NRUF6C2W03	270 in	MBH
	5	Washing Machine (Electric)		UniMac - Alliance	UW100VVQU10001		
CUH-1,2,6	3	Cabinet unit heater (HW)		Sterling		25	MBH
CUH-3,4,7	3	Cabinet unit heater (HW)		Sterling		50	MBH
UH-1,2,3	3	Unit heater (HW)		Modine	(2) HS-86, (1) HS-121	(2) 50, (1) 80	MBH



AECOM

ASHRAE LEVEL II Energy Audit Report Executive Office Building Oakland County Service Center

November 26, 2025

Quality information

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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Executive Office Building (EOB), 41 West in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its' facilities' existing energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

All identified energy reduction opportunities have been characterized in this report as ECMs regardless of scope and scale of capital investment. Additionally, AECOM recognizes that Oakland County wishes to pursue the future electrification of its facilities to the extent practical, as described in AECOM's Service Center-wide assessment report of future electrification options. The ECMs listed in this report address opportunities identified within existing conditions and existing energy infrastructure. The report's proposed ECMs may or may not be relevant to an energy infrastructure environment evolved from fossil fuel-driven energy infrastructure to fully electrically powered energy infrastructure.

The Executive Office Building is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Friday, April 4th, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates four ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The four recommended measures represent a projected 35% annual energy cost savings with an aggregate simple payback of 8.2 years.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Executive Office Building Proposed Energy Savings Summary

Energy Conservation Measures												
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	MMBTU	tCO2e	$/yr	$/yr	$	Years
1	Retro-Commissioning	HIGH	R	68,778	0	540	795.6	60.1	$0	$10,264	$31,607	3.1
2a	LED Upgrade	HIGH	R	260,122	110		887.5	115.2	$8,313	$28,613	$386,850	10.5
2b	Lighting Controls	HIGH	R	46,828	0		159.8	20.7	$0	$5,151	$64,475	12.5
3	Terminal Unit Occupancy Sensors	HIGH	R	76,293	0	884	1,178.1	82.3	$0	$12,807	$60,000	4.7
4	Install Snow Melt Pump Sensor	HIGH	R	12,610	0	0	43.0	5.6	$0	$1,387	$2,500	1.8
			Sum	**464,631**	**110**	**1,425**	**3,064**	**284**	**$8,313**	**$58,222**	**$545,432**	**8.2**
			Overall % Reduction	**37%**	**0%**	**26%**	**31%**	**33%**		**35%**		

Notes
Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Executive Office Building was built in 1967 with a major renovation in 2008. Full renovation drawings are available in the mechanical penthouse. On the date of the walk through, the building was predominately unoccupied. The building and its systems are in very good condition and the mechanical areas are well-maintained.

2.1 Building Systems

2.1.1 Building Envelope

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Panel Construction	Good to Moderate – based on visual inspection
Roof	Flat roof with black membrane	Assumed R-20 or less (age-dependent)
Glazing	Double pane windows	Good to Moderate – based on visual inspection

*Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The Executive Office Building has a central chiller plant and gas fired boilers serving two air handling units (AHUs). The major HVAC equipment was upgraded during the 2008 renovation.

Chilled water is produced by a single 375-ton water cooled chiller with cooling tower. Chilled water is distributed to the AHUs by two constant speed 30 horsepower (HP) pumps. Three natural gas fired hot water condensing boilers (input 2,000 MBH and output 1,720 MBH) and rated efficiency of 86% each provide hot water to the air handling units, baseboard heating, and reheat coils. The 7.5 HP secondary hot water distribution pumps have VFDs and the hot water is divided into three constant speed tertiary pumping zones with pumps ranging from 1.5 HP to 3 HP each.

The two AHUs are located in the mechanical penthouse. AHU-1 is 75,000 cubic feet per minute (CFM) and serves all floors except the conference center which is served by AHU-2. Both AHUs are equipped with VFDs on supply and return fans which varies the fan speed based on the variable air volume (VAV) terminal unit (TU) demand and duct static pressure. The TUs are equipped with hot water reheat.

2.1.2.2 Plumbing

There is a Lochinvar 285 MBH input gas-fired domestic water heater (DHW) and recirculating pump. The DHW heater provides 120°F hot water for bathrooms throughout the building.

2.1.2.3 Building Controls

The Executive Office Building uses a Niagara building management system (BMS) to control and monitor all HVAC equipment throughout the building. Staff reported they are pleased with the current operation of the building. AHU-1 and AHU-2 have regular weekly occupancy schedules, with AHU-1 occupied from 5:00 AM to 9:00 PM Tuesday to Friday and one hour earlier start on Mondays. AHU-2 has a regular weekly occupancy schedule from 5:00 AM to 5:00 PM Monday to Friday with slight variations in stop time on Tuesday and Wednesday. The BMS indicates an optimal start program is also enabled, which may extend the occupancy schedule if the system determines it needs more time to recover, but the trend data observed indicates the system is operating on its weekly schedule as intended. Both AHUs appear to have airside economizing modes to allow free cooling when outdoor air conditions are appropriate and AHU-1 has a CO2 sensor indicating the AHU is capable of demand-controlled ventilation.

The heating hot water and chilled water systems have outdoor air temperature lockouts (or enable setpoints) enabled with 57°F for heating hot water and 99°F for chilled water. The chilled water setpoint appears to be set for the winter months and is likely adjusted to around 60-65°F during the cooling season when the chiller is enabled. The heating hot water system also has two hot water reset schedules for the south and north tertiary zones, currently set to adjust the hot water supply temperature from 180°F to 90°F as the outdoor air temperature ranges from 15°F to 50°F. The third tertiary zone which goes to the AHUs and terminal units appears to remain constant at the boiler temperature which appears to be set to 180°F.

The BMS shows 3 outdoor air sensors, a main sensor, east and west sensors. The west and main sensors appear to be reading accurately (31.8F and 33.1F at the time of the assessment) but the east sensor reads over 20 degrees higher (56F) which impacts HVAC system operation such as the heating hot water reset schedule.

Lighting control schedules are also shown on graphic screens on the Niagara system but appear to not be in use as the interior lighting controls are reportedly overridden and exterior lights operate on photocells.

2.1.3 Lighting Systems

The lighting system is all fluorescent, installed throughout the facility based on spatial and functional needs. Fixtures are recessed, ceiling-mounted, or suspended. Fluorescent lamps are rated at 32W. This building includes a basement, first, second, third, fourth, fifth, and penthouse floor. The lighting fixture quantities are based on the provided drawings.

The lighting fixture quantities, based on the drawings, are as follows:

Table 3: Lighting Summary

First Floor		
Lighting	Total Fixtures	Lamps per Fixture
Fluorescent	436	2 lamp
Fluorescent	7	8 lamp
Downlights	112	-
Second to Fifth Floors		
Lighting	Total Fixtures	Lamps per Fixture
Fluorescent	397	2 lamp
Penthouse		
Lighting	Total Fixtures	Lamps per Fixture
Fluorescent	44	2 lamp
Downlights	12	-
Basement		
Lighting	Total Fixtures	Lamps per Fixture
Fluorescent	380	2 lamp

The approximate total wattage is 176,380 watts and the approximate area per drawing is 105,356 ft^2 which results in a calculated lighting density of 1.67 W/ft^2. It's unlikely the actual lighting load operates at the full total load at any given time, given some areas with lighting, such as the penthouse are minimally used.

Oakland County staff shared that the office operates approximately 6 AM to 5 PM. This schedule informed the assumption that the lights operate approximately 9.5 hours per day for 252 business days per year, resulting in an estimated electricity usage of 416,215 kWh.

2.1.4 Electrical Infrastructure

The facility is powered by a 1000 kVA transformer located in the substation room. The main service is rated at 480/277V, 1600A, 3-phase. A spot measurement shows a demand of 549 kW. Backup power is available via a 350-kW generator.

3 Utility Billing Analysis

3.1 Utility Type and Usage

The Executive Office Building receives electric service, natural gas service, and is not connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh. AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

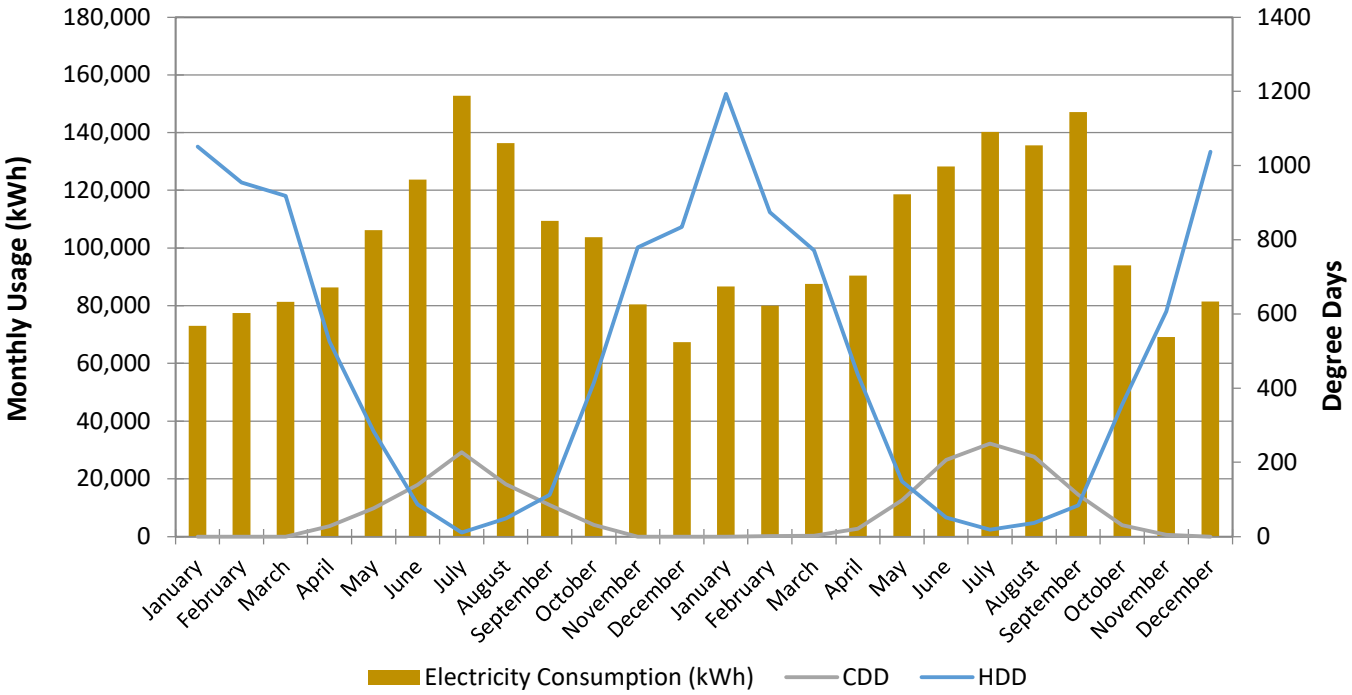
Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	1,259,002 kWh	4,296	$107,362	$0.11/kWh	0.0004427	557
Natural Gas	5,530 MCF	5,740	$19,953	$4.98/MCF	0.0549206	304
Total	**--**	**10,035**	**$127,315**	**--**	**--**	**861**

**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a correlation to weather data, indicating that there is a summer cooling load, however a significant portion of electricity usage consists of baseload usage. This baseline usage does not vary much from month to month and includes loads such as lighting, fans, and pump loads. The annual usage for the baseline 12-month period from January to December 2024 is 1,259,002 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



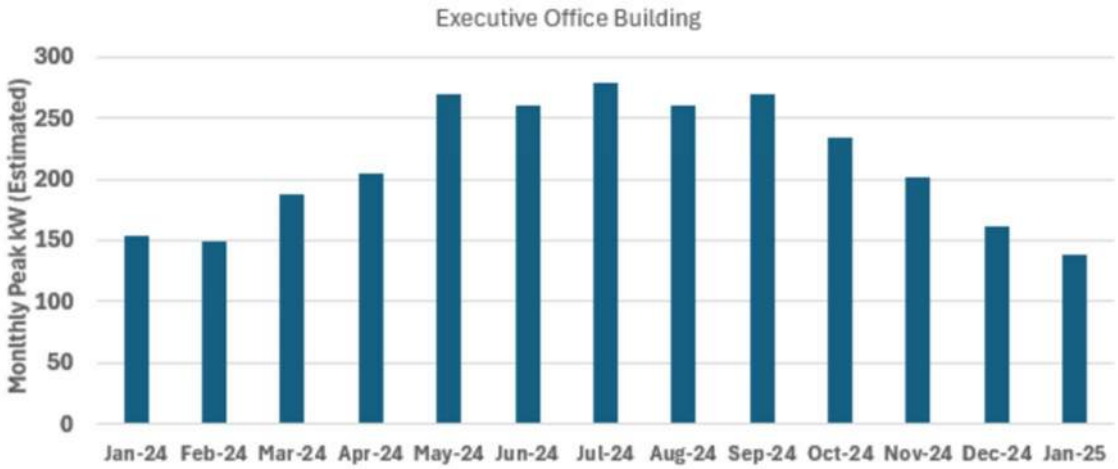
3.3 Building Electrical Capacity Analysis

AECOM has developed a methodology to estimate the peak demand of the building which uses the metered consumption of the building, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 5: Electric Capacity Results

Maximum Building Capacity at Service Transformer	1000 kW
Maximum Capacity at Switchgear (A*V*Ph)	1328 kW
Estimated Peak Demand	280 kW (estimated)
Remaining Capacity	**720 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

The base does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge:	**$0.057/kWh**
DTE Electric Demand Charge:	**$6.15/kW/Month**
Average Dollar per kWh Used in Calculations:	**$0.11/kWh**

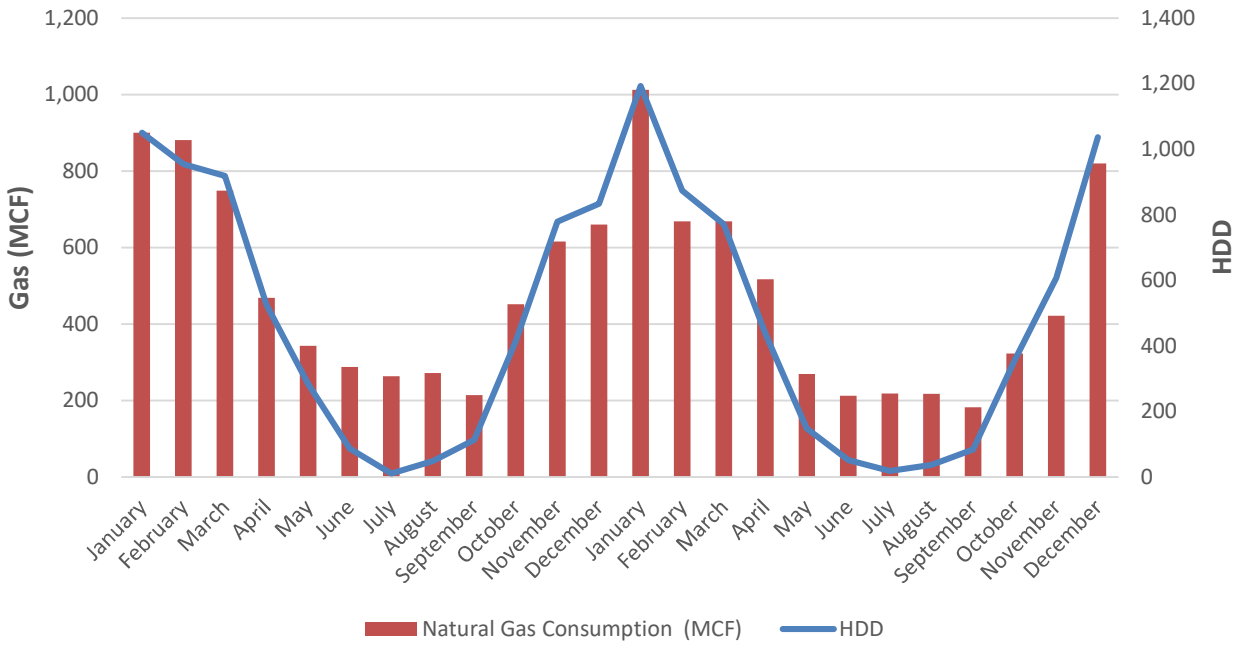
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows a direct correlation to weather data, as natural gas is primarily used for space heating. However, there is baseload summer usage due to domestic hot water usage for bathrooms and terminal unit reheat coils. The annual usage for the baseline 12-month period from January to December 2024 is 5,530 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the

year. Gas is billed with a similar structure to electricity, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): $3.48/dTh (decatherm, or 1.038 MCF)

Constellation NG Usage Charge (Day Gas): $5.29/dTh (decatherm, or 1.038 MCF)

Average Dollar per MCF Used in Calculations: $4.98/MCF

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for (16) separate buildings. The steam plant received natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$138,490
Natural Gas	$27,608
Total	$166,098
ECI	$1.58/SF/yr

3.6 Carbon Emissions

Federal agencies reporting their annual energy consumption emissions use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine their energy consumption carbon impact. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within the RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

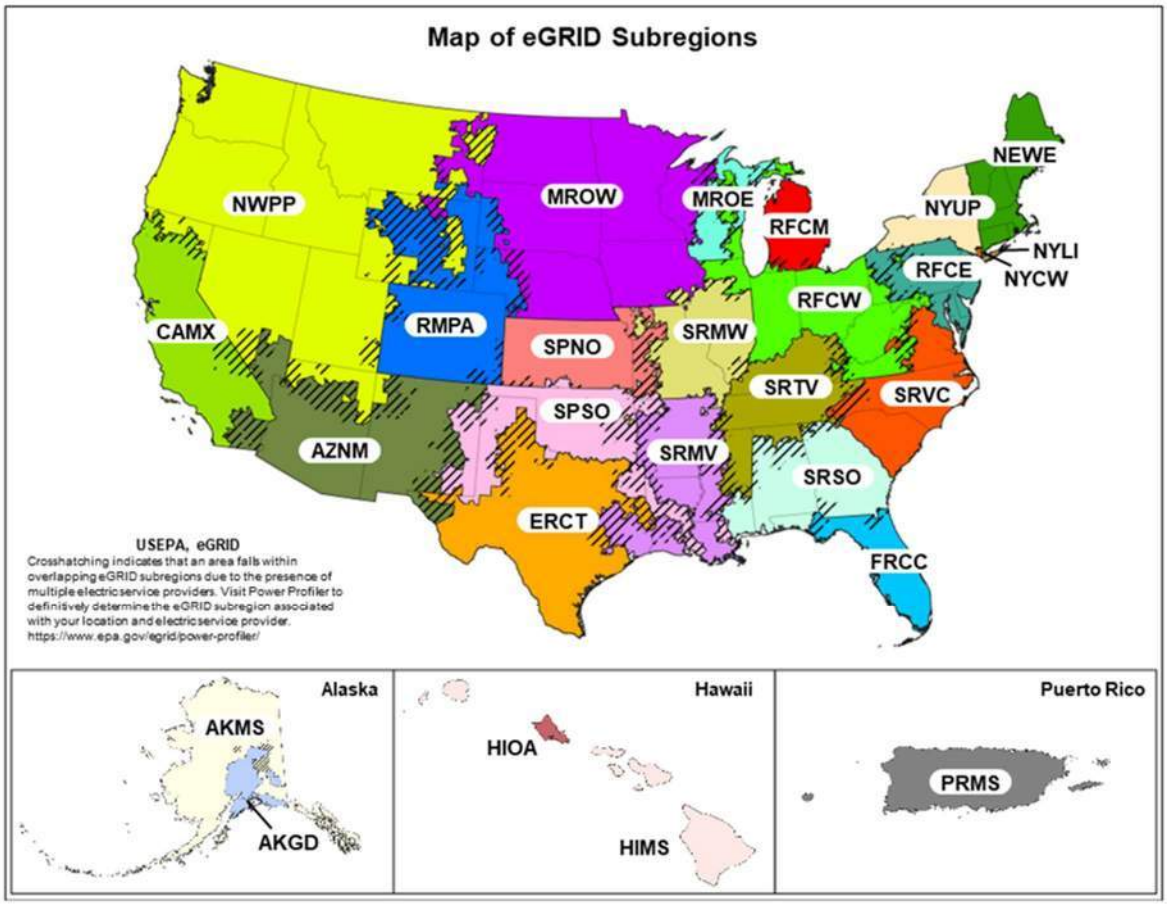
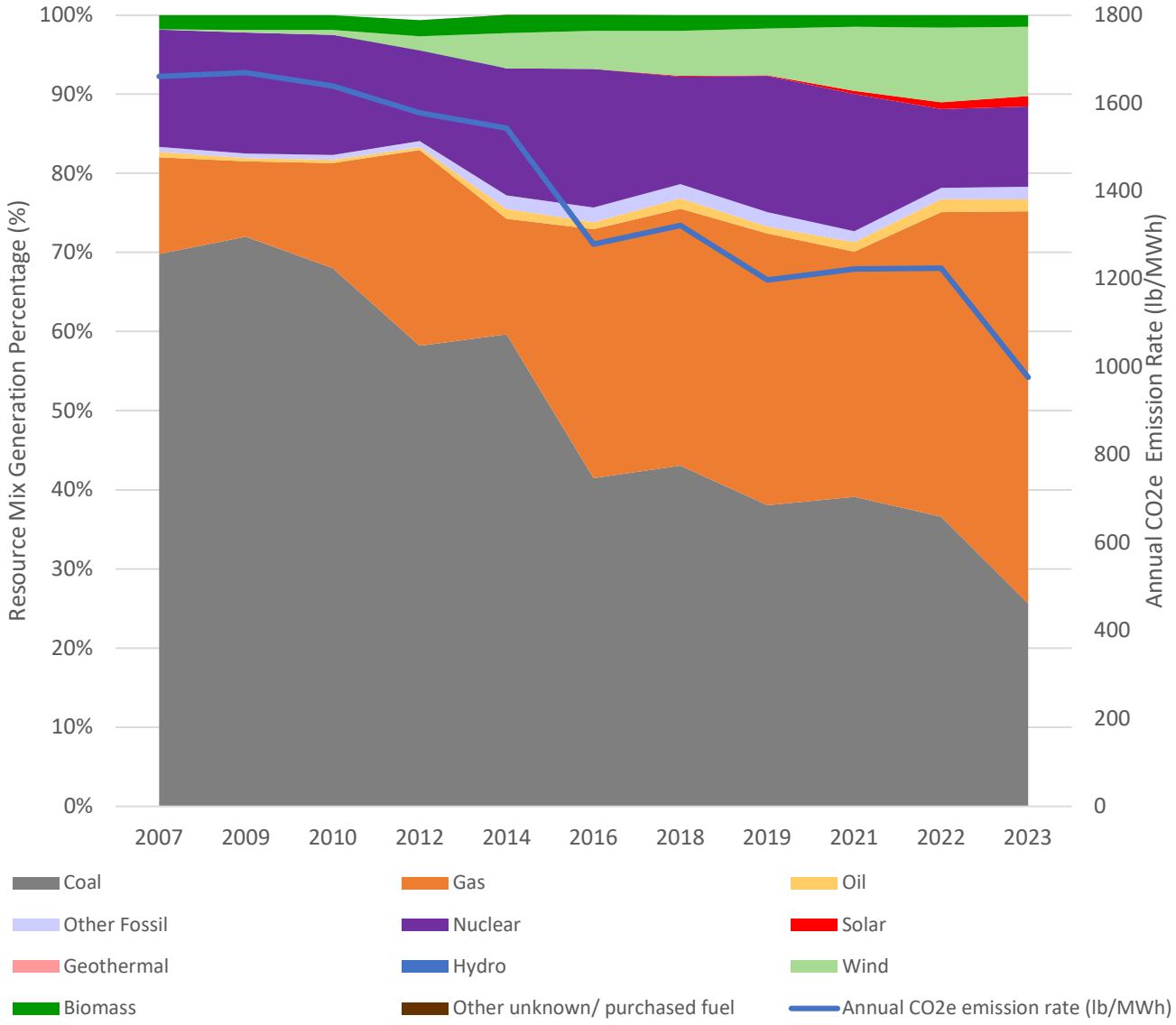


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 35 percent of carbon emissions are attributed to natural gas and 65 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 304 tCO2e (campus-level Scope 1) and 557 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 861 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for the Executive Office Building are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Executive Office Building				**Electric EUI:**		41	kBTU/SF/yr
GFA:	105,358	SF			**Gas EUI:**		54	kBTU/SF/yr
eGRID Subregion:	RFCM				**Current EUI**		95	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	1,259,002	kWh	3.412	4,296	0.0004427	557	$138,490	83%
Natural Gas	5,530	MCF	1.038	5,740	0.0549206	304	$27,608	17%
		Totals		**10,035**		**861**	**$166,098**	**100%**

According to the US EPA, the average site energy use intensity for an office building is 52.9 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 95 kBTU/SF, which is significantly higher than the national benchmark. It's important to note the national benchmark does not factor in the variance of weather conditions given that Oakland County is located in one of the colder regions of the country with higher heating requirements. However, the EUI indicates there is still an opportunity to optimize existing systems to reduce energy consumption and improve the efficiency of the facility.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient

3.8 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based on an annual hot water usage estimation by factoring in the water heater efficiency and number of employees and visitors. Table 8 and Figure 6 and Figure 7 below show the full estimated distribution of each end use and their contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Breakdown (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (klbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	5,404	0	5,609,269	53	297
Space Cooling	228,763	0	0	780,541	7	101
Fans	309,614	0	0	1,056,401	10	137
Pumps	149,398	0	0	509,746	5	66
DHW	0	91	0	94,365	1	5
Conveyance	29,297	0	0	99,963	1	13
Lighting	416,215	0	0	1,420,127	13	184
Plug Loads	120,714	0	0	411,877	4	53
Process Loads	0	0	0	0	0	0
Refrigeration	0	0	0	0	0	0
Cooking	0	0	0	0	0	0
Information Technology	0	0	0	0	0	0
TOTAL	**1,254,002**	**5,495**	**0**	**9,982,289**	**95**	**857**
Historical Billing	1,259,002	5,530	0			
Percent of Actual	100%	99%	0%			
per sqft	11.9	0.1	0			

Figure 7: Existing Electricity End Use Distribution

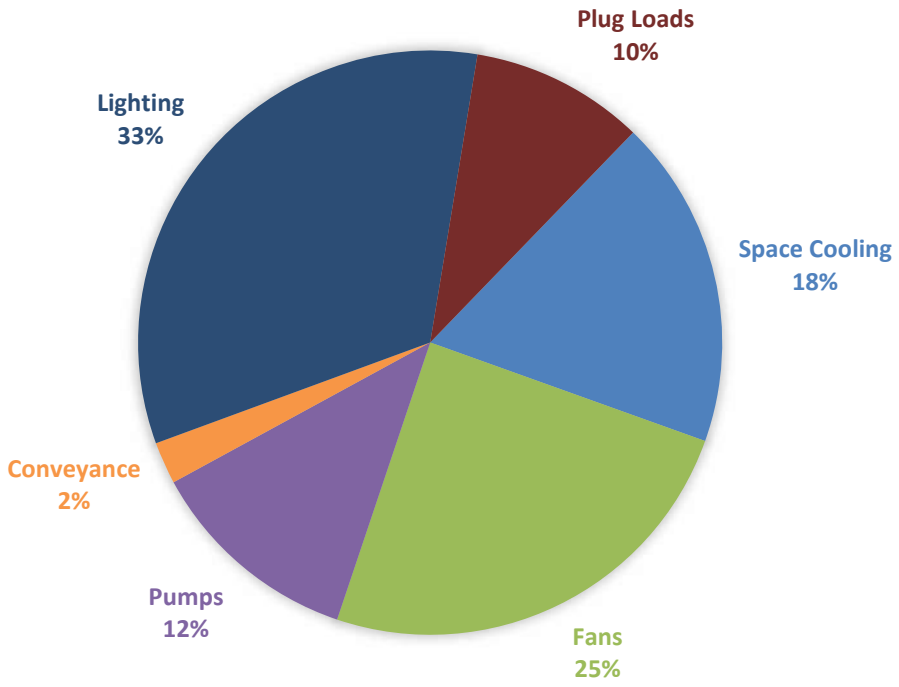
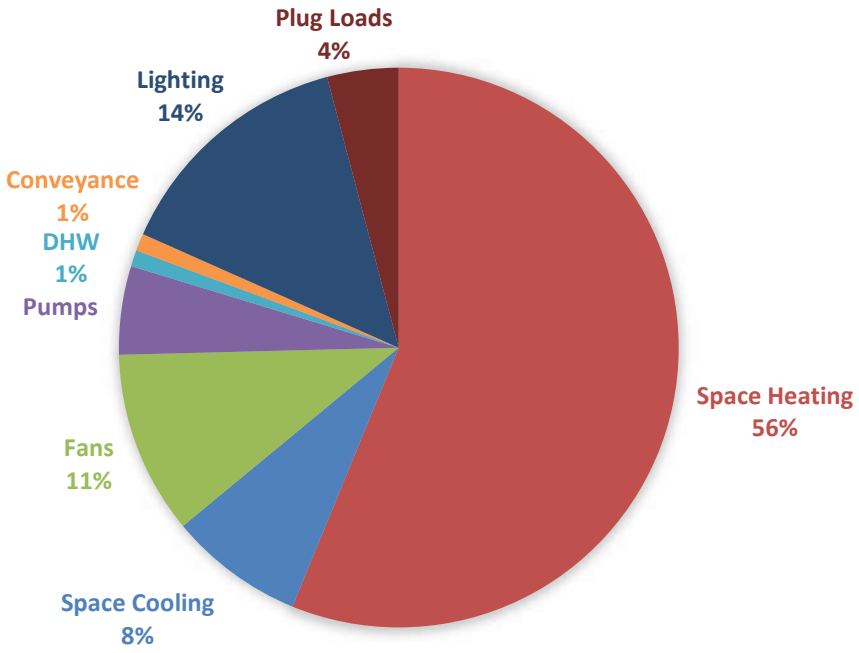


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The projects discussed in this section are economically viable and reduce carbon emissions but are not full inclusive of the requirements to meet Oakland County's comprehensive decarbonization goals. The measures identified in this report can be used as an enabling factor for potential capital improvement measures and decarbonization projects. This list does not mandate the installation of each measure, but it reveals their potential impact for achieving incremental economic and GHG reduction benefits. The main goal of these measures is to provide options for facility management and set the baseline for proceeding with the implementation of selected projects. On the other hand, some of these measures may interact with capital improvement projects. In this case, the project selection and planning for implementation must be meticulously considered the future projects to avoid double dipping, emphasizing the need for caution and attention to detail in decision-making.

The cost estimates are rough orders of magnitude (ROM) numbers that show an estimated price for each measure. Once the project enters the design phase, more precise cost estimates may be created. The cost estimates used information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 - Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent. The Executive Office Building currently utilizes a building automation system enabled by Niagara controls software which allows for advanced control of HVAC systems and scheduling. However, observations from the site visit and high-level review of the BMS system indicate that there may be optimization opportunities. A few examples include:

- The BMS shows three outdoor air sensors, a main sensor, east and west sensors. The west and main sensors appear to be reading accurately (31.8°F and 33.1°F at the time of the assessment) but the east sensor reads over 20 degrees higher (56°F) which impacts HVAC system operation such as the heating hot water reset schedule.
- The boilers appear to operate at 180°F year-round and while there are hot water reset schedules for the South and North distribution loops, the loop to the AHUs and TUs does not appear to have a reset schedule. The boiler temperatures may be able to be adjusted lower during the summer months since the terminal reheat load is likely minimal.
- The AHU-1 HVAC schedule appears to run until 9PM Monday to Friday but the reported building occupancy is typically only until 5PM. This may be able to be trimmed.
- A lighting schedule feature is available in the BMS but does not appears to be overridden or not in use.

While each of these individual examples are minor concerns, these illustrate an opportunity to systematically evaluate all major systems to identify and resolve similar operational discrepancies to optimize system performance and reduce energy usage. The following list represents RCx opportunities that should be evaluated to optimize HVAC system operation and

repair of identified discrepancies. This effort will proactively improve building system operation and optimize energy usage.

- Optimize HVAC scheduling in non 24/7 occupied spaces
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water and chilled water supply reset
- Discharge air setpoint reset
- Outside air temperature lockouts
- Outside air damper control
- Duct static pressure reset
- Repair airside or waterside economizing
- Demand-controlled ventilation

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 10% reduction in estimated heating, cooling, fan, and pump end use energy consumption.
- Additional study of equipment capacity requirements can be performed as part of this measure.
- $0.30/sqft was used as estimate of cost of RCx evaluation and deficit correction.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: This measure proposes engaging a third-party contractor to determine if this building is eligible for the DTE RCx program and systematically evaluate and prioritize major HVAC and control systems and complete retro-commissioning to restore systems to their original design intent. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 9: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
RCx	540	68,778	796	60	$0	$10,264	$31,607	3.1
Overall % Reduction	**10%**	**5%**	**8%**	**7%**		**6%**	**--**	**--**

4.2 ECM 2 – LED Lighting and Controls

This measure proposes upgrading all fluorescent lighting to LED lightbulbs to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements.

Incorporating lighting controls allows for better management and customization of lighting systems, leading to reduced energy consumption, and increased overall efficiency by limiting the time lighting is on to only when necessary. For indoor lighting, lighting controls consist of occupancy, daylighting, timers, scheduling, and dimming features to optimize light levels based on external lighting availability and usage of a space. For outdoor lighting, the lighting controls consist of motion sensors, photocells, and timers to turn the lighting ON/OFF. The current lighting in the Executive Office Building is primarily fluorescent T8 fixtures. Based on the office operational schedule, it was also assumed that the lights operate approximately 9.5 hours per day for 252 business days per year. See Section 2.1.3 for the lighting counts used to estimate energy consumption.

Despite the relatively high payback period, it is still beneficial to convert the building to all LED lighting. The longer payback is driven by the large upfront cost of replacing a fully fluorescent lighting inventory rather than poor measure performance. LED fixtures will reduce long-term maintenance and lead to energy savings over the life of the building.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture.
- Lights operate 9.5 hours per day for 252 business days per year, based on office occupancy.
- This measure assumes a 1.05 W/SF or 60% reduction in lighting power through and 30% reduction in hours of operation for adding controls.
- LED upgrades cost $150/fixture and motion and/or daylighting controls, costing $250 per sensor, would be placed on 10% of the fixtures. This measure does not recommend integrated controls in each fixture due to high cost.
- O&M savings assume an average cost of $2.01/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each. An adjustment factor of 75% was applied to the O&M savings as the amount of lighting within the building likely reduces the frequency of replacements.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For

lighting controls, evaluate the lighting system and determine the most cost-effective sensor locations for each zone. Install sensors in place of existing wall switches, or in ceiling panels with wiring connected to the lighting control circuit.

ECM Savings and ROM Cost:

Table 10: ECM 2 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost ($)	Simple Payback (Yrs)
LED Upgrade	0	260,122	889	115	$8,313	$18,376	$196,480	10.5
Lighting Controls	0	46,828	160	21	$0	$5,151	$64,475	12.5
Total	**0**	**306,950**	**1,047**	**136**	**$8,313**	**$33,765**	**$451,325**	**10.7**
Overall % Reduction	**0%**	**24%**	**10.4%**	**15.8**	**--**	**26.5%**	**--**	**--**

4.3 ECM 3 – Terminal Unit Occupancy Sensors

Installing occupancy sensors on HVAC systems can lower energy consumption by reducing the heating or cooling load when the building is occupied but actual occupancy is low. This is accomplished by detecting zone occupancy to determine appropriate heating and cooling setpoints. The Executive Office Building has 57 “terminal units” (TU) with heating coils that maintain occupied setpoints when the schedule is occupied, regardless of whether the space the TU serves is occupied. Installing TU occupancy sensors reduces unit heating, cooling, and ventilation demand, optimizing energy use.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Occupancy sensors would allow the terminal units to reduce the CFM they provide by 20%
- 40 TUs out of the total 57 would have sensors installed at $1,500 each.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Work with the controls team to understand steps and cost of installing hardware in building. Consult with design engineer to develop optimum control sequence for using sensors to control terminal unit flow rates and temperature setpoints.

ECM Savings and ROM Cost

Table 11: ECM 3 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost ($)	Simple Payback (Yrs)
Terminal Unit Sensors	884	76,293	1,178	82	$0	$12,807	$60,000	4.7
Overall % Reduction	**16%**	**6%**	**12%**	**10%**	**--**	**8%**	**--**	**--**

4.4 ECM 4 – Install Snow Melt Pump Sensor

Turning off equipment when not needed reduces its operation hours and energy consumption. This can be accomplished by using a timer to turn the equipment on or off based on occupancy or installing a sensor that can signal when the equipment should operate based on environmental conditions like temperature. Currently, the Executive Office Building has a 3HP electric snow melt pump that was running on the assessment day although there was no snow, and the temperature was more than 32°F. Installing a temperature sensor is a simple way to reduce the snow melt pump's operational hours by ensuring the pump only operates when the temperature is less than 32°F and thus snow melting may be needed.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- The pump, assumed to be 99.5% efficient with a load factor of 80%, currently operates 24/7. The proposed condition includes running only when the temperature is less than 32°F.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Purchase and install a [timer/temperature sensor that can be installed as a stand-alone relay, or built into the existing BAS to allow customizable control.

ECM Savings and ROM Cost:

Table 12: ECM 4 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost ($)	Simple Payback (Yrs)
Snow Melt Pump Sensor	0	12,610	43.0	5.6	$0	$1,387	$2,500	1.8
Overall % Reduction	**0%**	**1%**	**0.4%**	**0.6%**	**--**	**1.1%**	**--**	**--**

5 Considered But Not Currently Recommended

No additional measures were considered.

6 Appendix A

Table 13: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	900	$5,527	73,040	$7,839	98	130	1,050.9	0
Feb-23	881	$5,149	77,504	$7,301	115	144	954.6	0
Mar-23	749	$2,280	81,296	$7,292	109	175	918.4	0
Apr-23	468	$1,624	86,286	$7,592	120	196	525.3	28.1
May-23	343	$1,025	106,230	$8,378	143	234	283.4	76.3
Jun-23	287	$709	123,698	$9,265	172	269	86.3	139.1
Jul-23	264	$1,056	152,787	$12,366	205	284	11.3	226.9
Aug-23	272	$785	136,372	$10,834	183	271	48.3	140.6
Sep-23	214	$607	109,448	$10,075	152	247	112.5	84.9
Oct-23	451	$1,301	103,790	$8,445	140	223	414.5	31.1
Nov-23	616	$2,296	80,457	$6,179	112	188	779.2	0
Dec-23	660	$3,257	67,313	$4,778	90	115	834.1	0
Jan-24	1,013	$4,461	86,622	$1,999	116	154	1,193.6	0
Feb-24	668	$3,639	79,984	$8,181	119	149	873.9	1
Mar-24	668	$3,783	87,499	$7,059	118	188	771.2	2.1
Apr-24	517	$1,078	90,430	$7,932	165	269	437.1	20.9
May-24	269	$546	118,648	$10,411	159	261	148.4	98
Jun-24	212	$687	128,304	$11,789	178	279	51.4	206.7
Jul-24	218	$706	140,194	$12,488	188	261	18.4	250.9
Aug-24	218	$463	135,531	$12,464	182	270	36.6	215.4
Sep-24	182	$443	147,161	$11,800	204	333	84.0	112.3
Oct-24	323	$865	94,014	$8,930	126	202	356.0	30.7
Nov-24	421	$1,459	69,118	$7,456	96	161	606.9	4.2
Dec-24	820	$1,823	81,497	$6,853	110	139	1,036.8	0
2023 Sum	6,106	$25,616	1,198,221	$100,344			6,019	727
2024 Sum	5,530	$19,953	1,259,002	$107,362			5,614	942

7 Appendix B

Table 14: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Efficiency	Capacity 2	Capacity 3	Approx Year Installed
AHU-1	1	Air handling unit	Everywhere except basement	Built up unit		74500 CFM		1326 MBH	3250 MBH	
AHU-2	1	Air handling unit	Basement	Trane	MCCB025UA0BOUA	10600 CFM		284 MBH	588 MBH	
CH-1	1	Centrifugal chiller (water cooled)		Trane Centravac	CVHF410	375 TON	4.5 COP	392.9 HP		
CT-1	1	Cooling Tower, VSD	CH-1	Trane	Series Quiet 801491A1TQ305F (8094-91-A1-TQ8305F1CG-06)	116000 CFM		20 HP		2006
N/A	3	Boiler (NG)	Whole building (AHUs, baseboard, reheat coils)	Thermal Solutions	EVA2000SBN-1	1720 MBH	86%			
DWH	1	Domestic water heater (NG)		Lochnivar	SNA286-125	285 MBH	96%			2014
CHWP-1,-2	2	Chilled water pumps		Bell and Gossett	1510 BF 10.347	30 HP	84.5%	900 GPM		
CWP-1,-2	2	Condenser water pump		Bell and Gossett	1510 BF 10.250	30 HP	82.4%	1125 GPM		
SHWP-1,2	2	Secondary HW pump, VFD		Baldor	EJMM3611T	7.5 HP	91.7%			
TWHP-1, 2	2	Tertiary HW Pump	North baseboard zone	Baldor	EJMM3611T	3 HP	89.5%			2006
TWHP-3, 4	2	Tertiary HW Pump	South baseboard zone	Baldor	EJMM3611T	3 HP	89.5%			

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Efficiency	Capacity 2	Capacity 3	Approx Year Installed
PHWP-1,2,3	3	Primary hot water pumps	Boilers 1,2,3			1 HP				
TWHP-5	1	AHU-1 HW booster pump	AHU-1			1.5 HP				
TWHP-6	1	AHU-2 HW booster pump	AHU-2			0.75 HP				
N/A	1	Snow melt (electric) pump	Front sidewalk	Bell and Gossett	size 80 BF 7.625	3 HP	99.5%	39 GPM		

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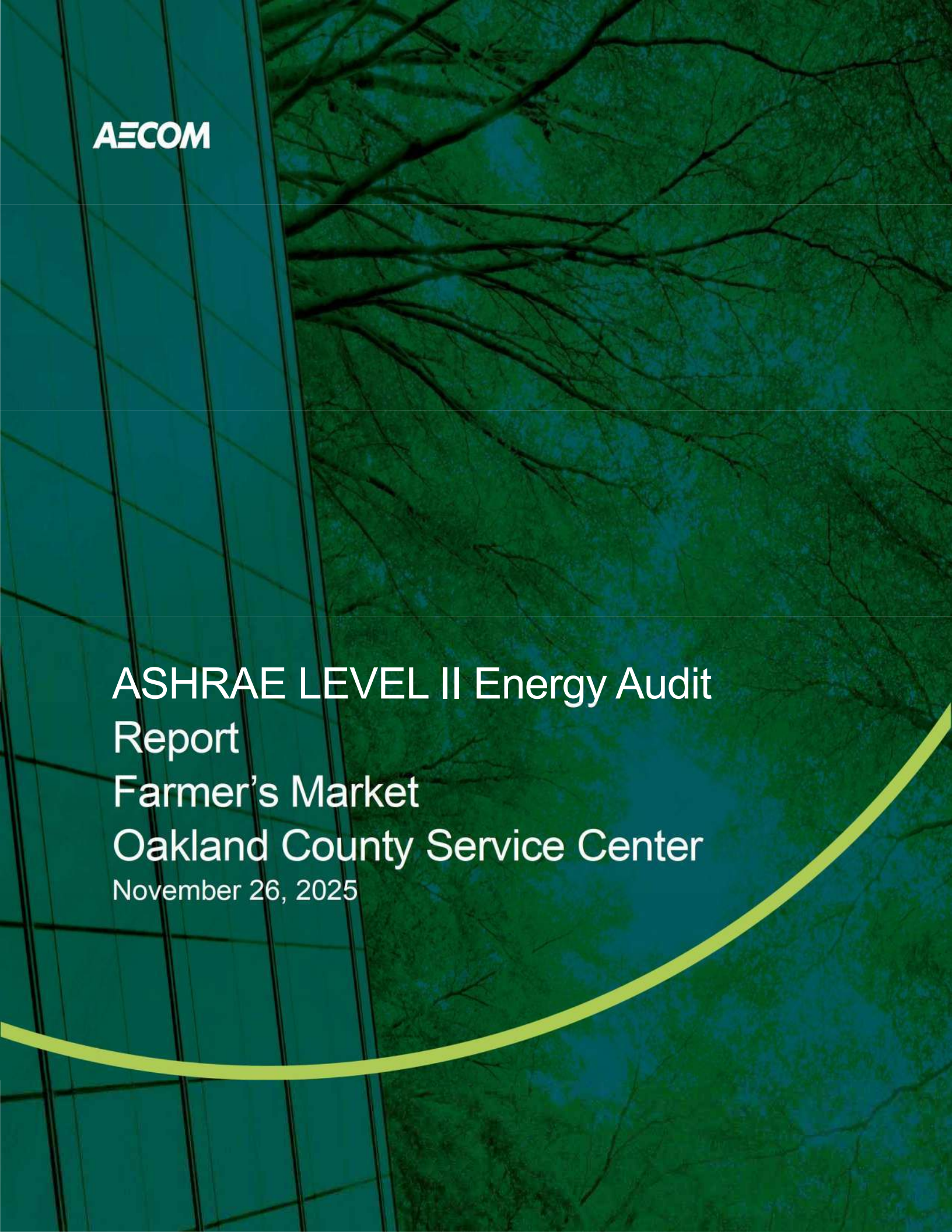

AECOM

ASHRAE LEVEL II Energy Audit Report
Farmer's Market
Oakland County Service Center

November 26, 2025

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

Prepared for:
OAKLAND COUNTY, MI Government

Prepared by:
AECOM

Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Farmer's Market in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County Farmer's Market is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Wednesday April 10, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates five ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The three listed measures represent a projected 35% annual energy cost savings with an aggregate simple payback of 5.3 years. All three measures are prioritized as "Recommended" for implementation.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be "electrification-ready" to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE's prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Farmer's Market Proposed Energy Savings Summary

ECM #	Measure Description	Priority	Measure Status	Year -1 Electricity Savings	Demand Reduction*	Year -1 Gas Savings	Total Energy Saved	Year - 1 GHG Savings	O&M and Water Savings	Year - 1 Cost Savings	Project Cost (Est)	Simple Payback Period
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	MMBTU	tCO2e	$/yr	$/yr	$	Years
1a	Replace fluorescent bulbs and metal halide wall packs with LED equivalents	HIGH	R	4,533	4	0	15.5	2.0	$232	$730	$6,600	9.0
1b	Install occupancy sensors on interior lighting fixtures	HIGH	R	482	0	0	1.6	0.2	$0	$53	$2,681	50.6
1c	Install photocell controls on exterior lights	HIGH	R	2,227	0	0	7.6	1.0	$0	$245	$780	3.2
2	Replace electric water heater with instantaneous under sink water heaters	HIGH	R	1,070	0	0	3.7	0.5	$0	$118	$600	5.1
3	Implement temperature setbacks during unoccupied hours	HIGH	R	0	0	245	254.2	13.5	$0	$1,223	$1,500	1.2
Sum of Recommended Measures				**9,790**	**4**	**245**	**288**	**18**	**$232**	**$2,532**	**$12,161**	**4.8**
Overall % Reduction				**27%**	**-**	**48%**	**44%**	**41%**	**--**	**39%**	--	--
Measures Considered but not Recommended												
4	Building retro-commissioning	N/A	R	1816.1	0.0	52	60.2	3.7	$0	$459	$5,220	11.4
5	Replace NG Heaters with ASHP	N/A	RS	-42,613	0	507	381.0	9.0	$0	-$2,155	$98,000	-45.5

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Farmer's Market building is a public space open during limited weekly hours that is used for retail purposes. The space is mostly unconditioned with lights off. The exact year of construction is not known. The conditioned square footage is approximately 7,000 ft^2.

2.1 Building Systems

2.1.1 Building Envelope

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Masonry base with windows covering ~75% of the exterior	Poor
Roof	The roof was not accessible during the site visit	n/a
Glazing	Single pane	Poor

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The facility is heated by two Sterling natural gas fired duct furnaces with a maximum input of 350,000 BTUh and an 80% efficiency. The space is not cooled and only natural ventilation is provided.

2.1.2.2 Plumbing

One 19-gallon 1,500W electric domestic hot water heater serves the entire building.

2.1.2.3 Building Controls

The building utilizes local controls for its duct heaters.

2.1.3 Lighting Systems

During the site visit, lighting fixtures were found to be suspended. Interior fixture wattages varied and were a mix of roughly 50% 34W and 50% 17 W T-8 LEDs. Exterior lights were covered and not operating during the site visit, and their wattage is not known.

Based on the drawings, the lighting fixture counts are as follows:

Table 3: Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
Interior	55	2 lamp
Exterior	16	1 lamps

The total approximate quantity of light fixtures in the building is 55. The approximate total wattage is 1,402 watts. The approximate area per Google Earth measurement is 9,700 ft^2. The calculated lighting density is 0.14 W/ft^2.

2.1.4 Electrical Infrastructure

The building is served by a 400A 120/240V single phase electrical service which is fed from a 150kVA pad mounted transformer. The various loads within the building are supplied power from various sub-panels, but no submetering is present.

3 Utility Billing Analysis

3.1 Utility Type and Usage

The Farmer's Market receives electric service, natural gas service, and is not connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

Table 4 summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

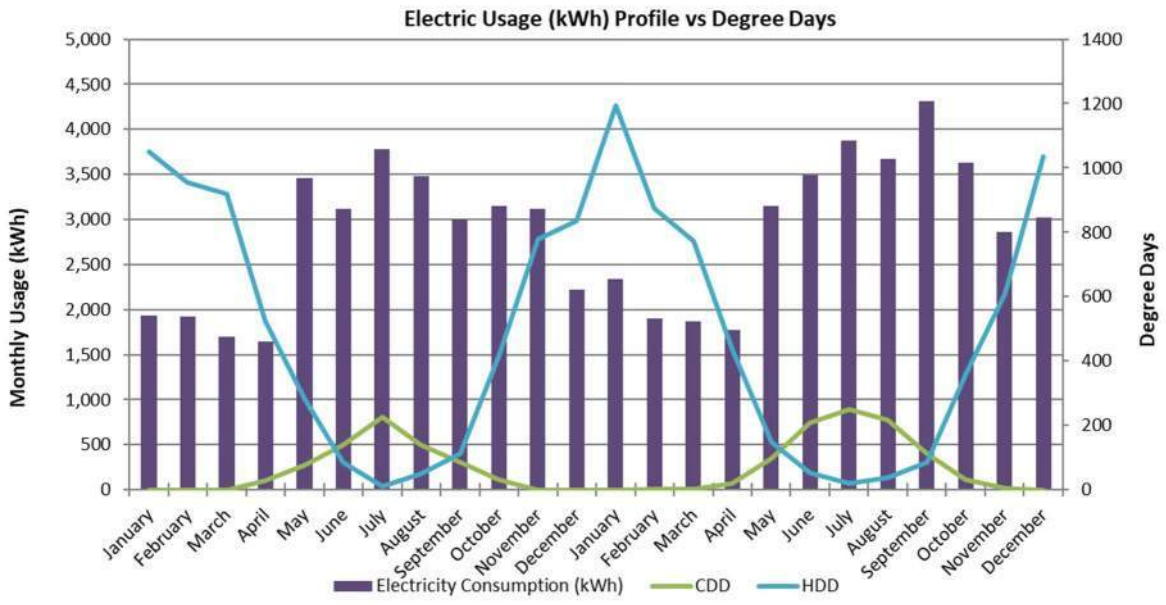
Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	35,880 kWh	122	$3,947	$0.11/kWh	0.0004427	16
Natural Gas	507 MCF	526	$2,532	$4.98/MCF	0.0549206	28
Total	**--**	**649**	**$6,479**	**--**	**--**	**44**

**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a distinct correlation to weather data, indicating a significant portion of electricity usage goes towards cooling requirements while the remaining consists of baseload usage. This usage does not vary much from month to month and includes loads such as lighting, fans, and pump loads. The annual usage for the baseline 12-month period from January to December 2024 is 35,880 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

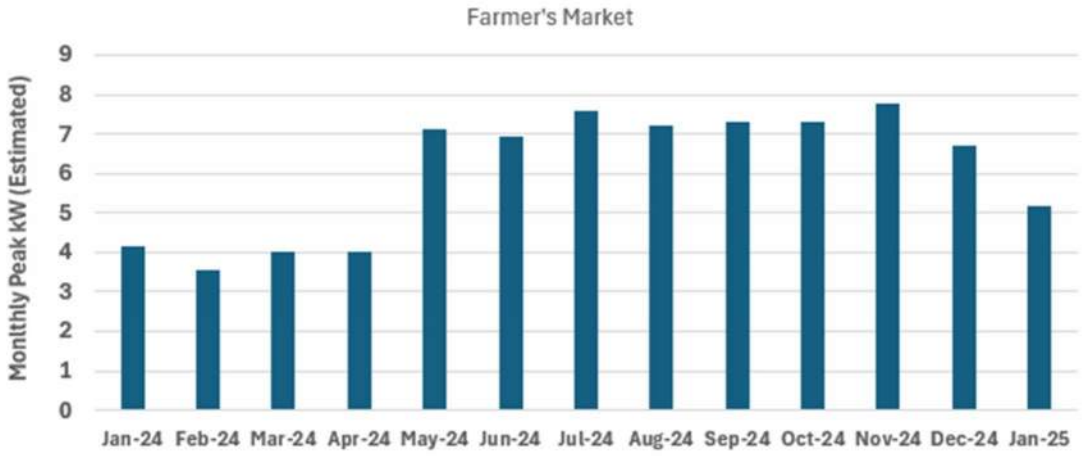
The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 5: Electric Capacity Results

Maximum Building Capacity at Service Transformer	150 kW
Maximum Capacity at Switchgear (A*V*Ph)	144 kW
Estimated Peak Demand	7.7 kW (estimated)
Remaining Capacity	**137 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge: **$6.15/kW/Month**

Average Dollar per kWh Used in Calculations: **$0.11/kWh**

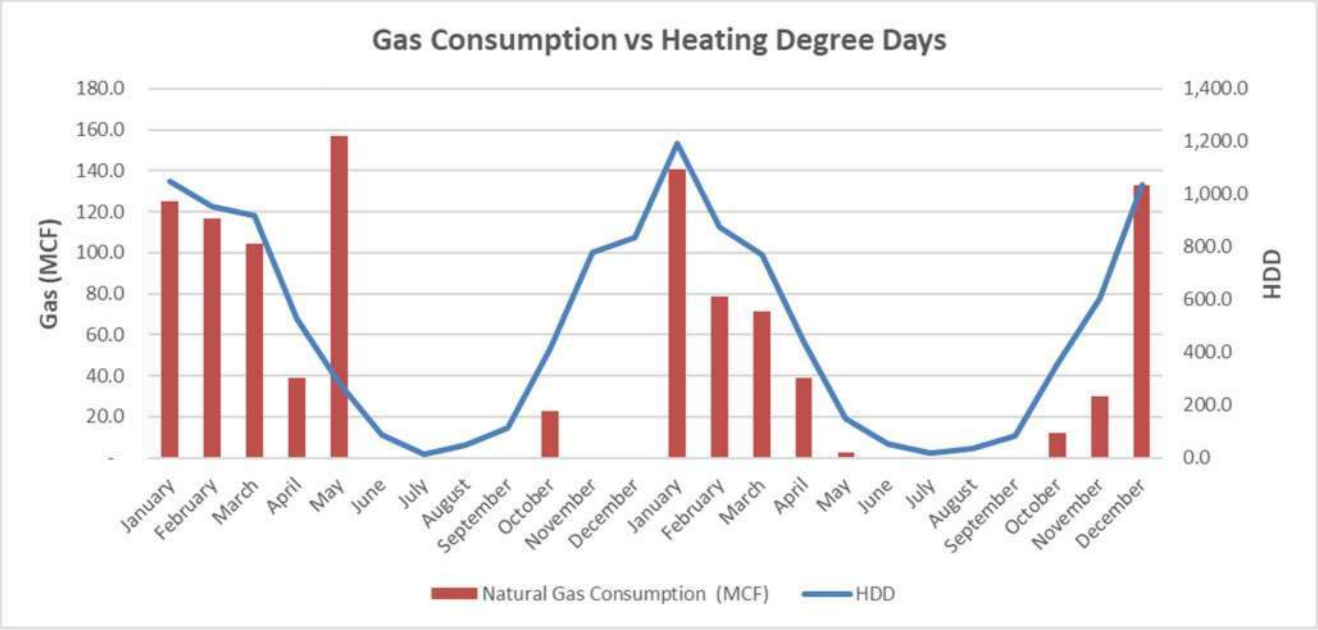
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

As 2024 data was not available at the time of this audit, Figure 3 shows the monthly natural gas usage profile for 2022 and 2023 with local monthly weather data indicated by HDD. Natural gas usage shows a direct correlation to weather data, as natural gas is exclusively used for space heating. 2024 data would likely follow a similar trend. The annual usage for the baseline 12-month period from January to December 2024 is 507 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master

account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): $3.48/dTh (decatherm, or 1.038 MCF)

Constellation NG Usage Charge (Day Gas): $5.29/dTh (decatherm, or 1.038 MCF)

Average Dollar per MCF Used in Calculations: $4.98/MCF

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$3,947
Natural Gas	$2,532
Total	$6,479
ECI $/yr/sf	$0.87

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

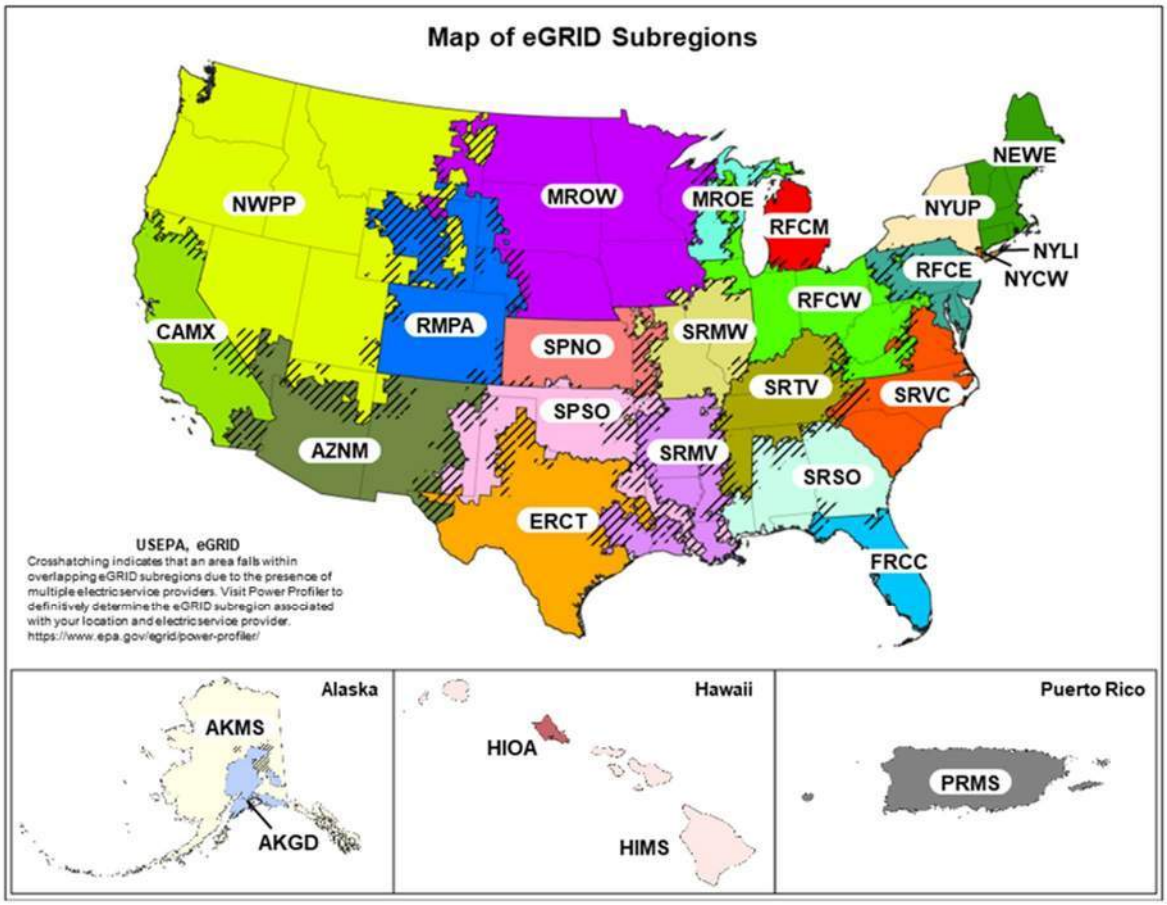
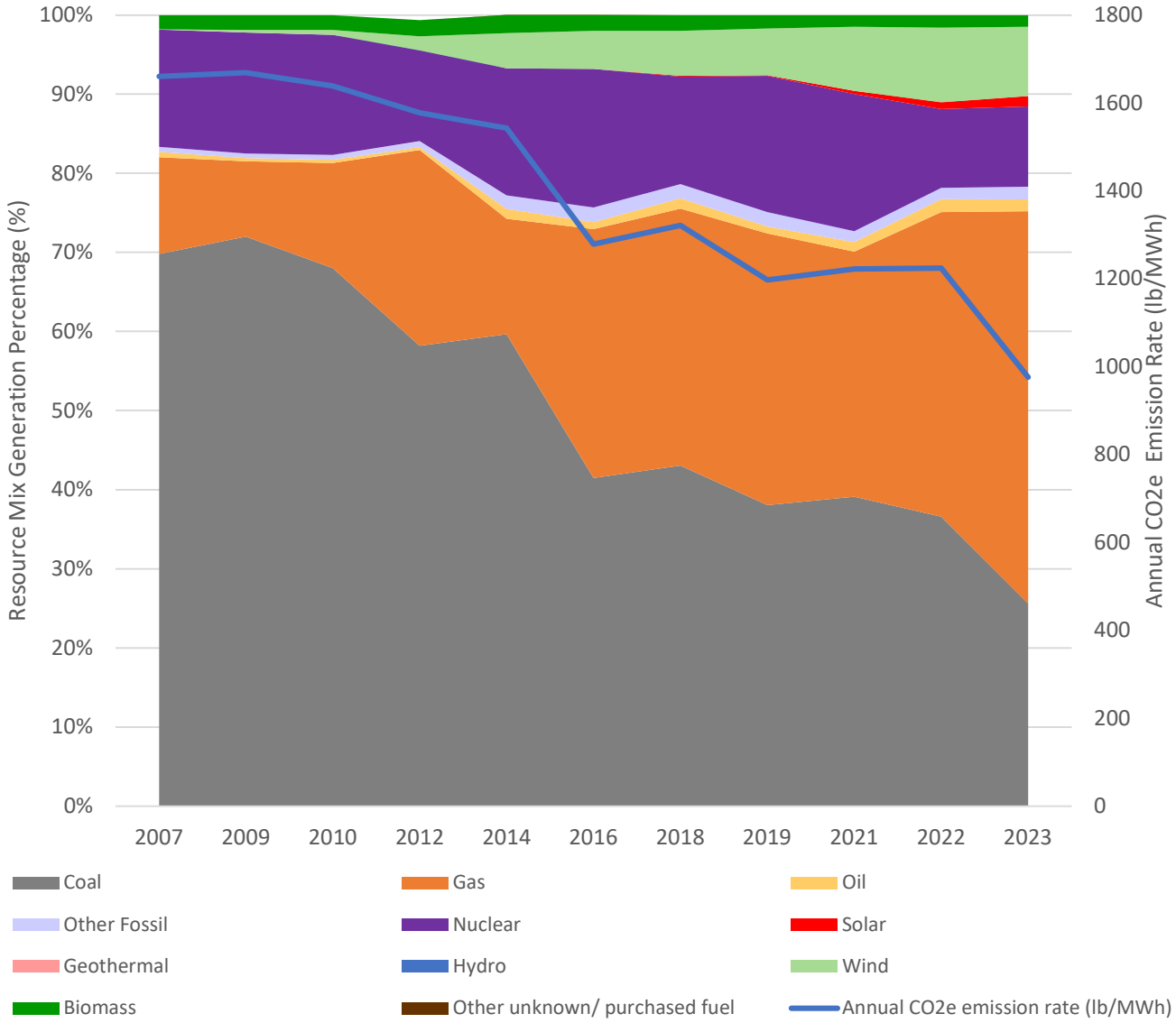


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 64 percent of carbon emissions are attributed to natural gas and 36 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 28 tCO2e (campus-level Scope 1) and 16 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 44 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for the Farmer's Market are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Farmer's Market				**Electric EUI:**		16	kBTU/SF/yr
GFA:	7,457	SF			**Gas EUI:**		71	kBTU/SF/yr
eGRID Subregion:	RFCM				**Current EUI**		87	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	35,880	kWh	3.412	122	0.0004427	16	$3,946	61%
Natural Gas	507	MCF	1.038	526	0.0549206	28	$2,525	39%
Totals				649		44	$6,471	100%

According to the US EPA, the average site energy use intensity for a retail store is 51.4 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 87 kBTU/SF, which is higher than the national benchmark. Therefore, there is opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Parking	Parking		N/A	N/A	None Available
Public Services	Courthouse*		211.4	101.2	CBECS - Courthouse
	Drinking Water Treatment & Distribution (*Average EUI presented in Energy per Flow in gallons per day*)		5.90	2.27	AWWA - Water Treatment Plant
	Fire Station		124.9	63.5	CBECS - Fire Station/Police Station
	Library		143.6	71.6	CBECS - Library
	Mailing Center/Post Office		96.9	47.9	CBECS - Service
	Police Station		124.9	63.5	CBECS - Fire Station/Police Station
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Social/Meeting Hall		109.6	56.1	CBECS - Social/Meeting
	Transportation Terminal/Station		112.0	56.2	CBECS - Public Assembly
	Wastewater Treatment Plant* (*Average EUI presented in Energy per Flow in gallons per day*)		7.51	2.89	AWWA - Wastewater Plant
	Other - Public Services		89.3	40.1	CBECS - Other
Religious Worship	Worship Facility*		58.4	30.5	CBECS - Religious Worship
Retail	Convenience Store*	Convenience Store with Gas Station	883.5	350.9	Industry Survey
		Convenience Store without Gas Station			
	Mall	Enclosed Mall	170.7	65.7	CBECS - Enclosed Mall
		Lifestyle Center	228.8	103.5	CBECS - Strip Shopping Mall
		Strip Mall			
		Other - Mall	225.3	101.6	CBECS - Enclosed Mall and Strip Shopping Mall
	Retail Store*		120.0	51.4	CBECS - Retail Store
	Supermarket/Grocery Store*		444.0	196.0	CBECS - Grocery Store/Food Market
	Vehicle Dealership*		138.2	71.9	Industry Survey

3.8 End Use Distribution

Table 8 shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees and visitors. Table 8 and Figure 7 and Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	520	0	545,180	**73.1**	**28.6**
Space Cooling	0	0	0	0	**0.0**	**0.0**
Fans	18,161	0	0	61,965	**8.3**	**8.0**
Pumps	0	0	0	0	**0.0**	**0.0**
DHW	2,190	0	0	7,472	**1.0**	**1.0**
Conveyance	0	0	0	0	**0.0**	**0.0**
Lighting	12,071	0	0	41,185	**5.5**	**5.3**
Plug Loads	1,038	0	0	3,543	**0.5**	**0.5**
Process Loads	0	0	0	0	**0.0**	**0.0**
Refrigeration	2,000	0	0	6,824	**0.9**	**0.9**
Cooking	0	0	0	0	0.0	**0.0**
Information Technology	0	0	0	0	0.0	**0.0**
TOTAL	**35,460**	**520**	**0**	**660,168**	**89**	**44**
Historical Billing	35,880	526	0			
Percent of Actual	99%	99%	0%			
per sqft	4.81	0.07	0			

Figure 7: Existing Electricity End Use Distribution

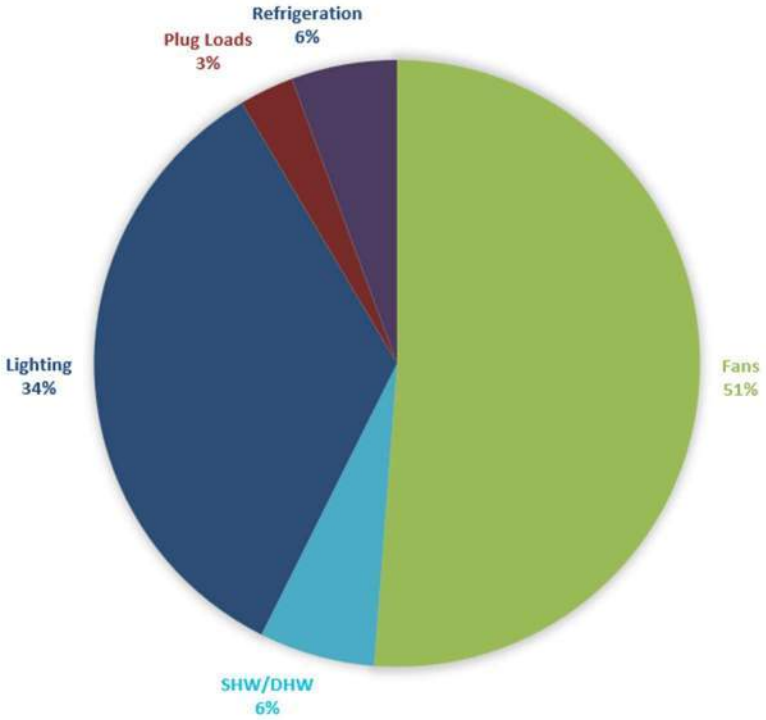
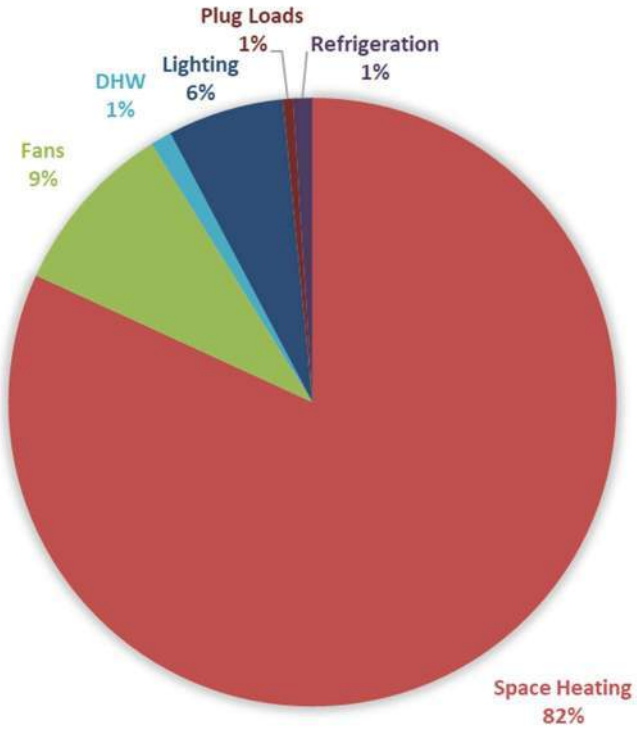


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – LED Lighting and Controls

This measure proposes upgrading all remaining fluorescent lighting to Light-emitting diode (LED) lightbulbs with sensors to reduce energy consumption and electrical demand. LEDs are highly energy efficient as most of the electrical energy supplied to the fixture is converted into light – 80% or more depending upon the LED lamp. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements.

Incorporating lighting controls allows for better management and customization of lighting systems, leading to reduced energy consumption, and increased overall efficiency by limiting the time lighting is on to only when necessary. For indoor lighting, lighting controls consist of occupancy, daylighting, timers, scheduling, and dimming features to optimize light levels based on external lighting availability and usage of a space. For outdoor lighting, the lighting controls consist of motion sensors, photocells, and timers to turn the lighting ON/OFF. The interior lighting in Admin Annex I consists of 32W fluorescent T8 and T12 fixtures. The current lighting in the Farmer's Market is approximately 50% LED and 50% fluorescent. Based on the office operational schedule, it was also assumed that the lights operate approximately 9 hours per day for 252 business days per year. However, a factor of 0.6 was applied to account for the lower operation of the rest of the market, which is only open approximately 850 hours per year. See Section 2.1.3 for the lighting counts used to estimate energy consumption.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.

Figure 9: Example Fixture with Integrated Occupancy Controls



Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture.
- Interior lights operate 5 hours per day for 252 business days per year, an estimate made to balance office occupancy with market operation hours as described by Oakland County. Exterior lights were estimated to operate 11 hours per day year-round.
- O&M savings assume an average cost of $1.68/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- This measure assumes a 30% reduction in interior lighting energy (kWh) and a 50% reduction for the exterior lights through implementation of controls.
- LED upgrades cost $150/fixture; motion sensors cost $250 per sensor; sensors placed on 25% of the fixtures.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, subsequent steps consist of conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. Following this assessment, a controls contractor can be engaged to install the lighting controls and assist building engineers in configuring the schedule to optimize lighting usage.

ECM Savings and ROM Cost:

Table 9: ECM 1 Savings and ROM Cost

	Savings Summary							
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M and Water Savings($)	Annual Utility Cost Savings ($)	Est Project Cost ($)	Simple Payback (Yrs)
LED Upgrade	0	4,533	15.5	2.0	$232	$730	$6,600	9.0
Lighting Controls	0	482	1.6	0.2	$0	$53	$2,681	50.6
Calibrate Photocell Controls	0	2,227	7.6	1.0	$0	$245	$780	3.2
Total	**0**	**7,242**	**25**	**3**	**$232**	**$1,028**	**$10,061**	**12.6**
Overall % Reduction	**0%**	**20%**	**3%**	**4%**	**--**	**12%**	**--**	**--**

4.2 ECM 2 – Domestic Hot Water Upgrade to Under-Sink Heaters

Domestic hot water systems provide heated water for uses such as handwashing, cleaning, showering, cooking, and laundry. This can represent a significant portion of a building's overall energy usage. Maintaining proper water temperature and control is not only critical for energy efficiency but also for health and safety – temperatures must be 140F to prevent bacteria growth such as Legionella, yet low enough to prevent scalding and prevent excessive energy use.

This measure proposes replacing the existing 1,500 W American Water Heater Company electric domestic hot water heater with installing instantaneous electric under-sink water heaters for each bathroom or break room sink. Unlike traditional hot water heaters with storage, under-sink electric heaters provide hot water on-demand and eliminate the need to continuously maintain a storage tank of hot water. As the sink tap turns on, cold water flows through an electric resistance heating element and is quickly heated before flowing through the faucet. This method of water heating for bathroom and break room use during regular business hours reduces energy consumption by eliminating standby heat losses associated with hot water storage tanks and heat loss associated with piping between water heaters and their end use.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Domestic hot water use assumed 1.5 gallons hot water/person per occupied day, 80% water heater efficiency, and 10,000 BTU/day standby losses.
- Instantaneous water heater calculations assume 1,800W to meet the same demand.
- The ASHP water heater calculation assumes a COP of 2.8.
- Unit costs of $200/MBH and $300/sink were used to estimate costs for Option A and B respectively.
- There are approximately 2 sinks in the building.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Perform a site survey to confirm the number of heaters needed and requirements, then install new instantaneous electric water heaters under each bathroom and break room sink. Next, disable and drain existing DHW heater and remove or cap off existing DHW piping to accommodate the new heaters. The existing system may be retained as backup if desired. Provide electrical work as needed according to product size and voltage.

ECM Savings and ROM Cost:

Table 10: ECM 2 Savings and ROM Cost

	Savings Summary							
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M and Water Savings($)	Annual Utility Cost Savings ($)	Est Project Cost ($)	Simple Payback (Yrs)
Under Sink Heaters	0	1,070	3.7	0.5	$0	$118	$600	5.1
Overall % Reduction	**0%**	**3%**	**1%**	**1.1%**	**--**	**2%**	**--**	**--**

4.3 ECM 3 – Implement Temperature Setbacks for HVAC Systems

Implementing standardized setpoints and occupancy schedules for the HVAC system can reduce energy consumption to enhance energy efficiency in areas with regular weekly occupancy. By establishing consistent temperature setpoints and aligning HVAC schedules with actual occupancy patterns, the system avoids unnecessary heating or cooling during unoccupied hours such as evenings, weekends, and holidays. This can be done by enabling seasonal occupied and unoccupied setpoints and schedules on programmable thermostats or enabling these controls in a centralized BAS where only authorized individuals can adjust as needed. This allows the HVAC system to “coast” toward unoccupied setpoints when the spaces are unoccupied and minimizes the need for the HVAC system to run. The Farmer’s Market is heated by two 280 MBH Sterling Radiator QVD-3505 duct furnaces. Given that the building does not currently have a BAS, the units are assumed to run 24/7. However, the building only operates during typical business hours except for when the market is open, offering an opportunity to reduce the total HVAC operation time with setbacks to reduce energy consumption.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- The existing furnaces run 24/7 to maintain occupied setpoints due to the current local controls.
- This measure assumes heating season energy savings due to reduced HVAC operation hours. Cooling season savings are omitted due to Michigan's climate.
- The occupied setpoint was assumed to be 72°F setback temperature was assumed to be 50°F for freeze protection.
- $1,500 was used to estimate programming costs required to implement the setbacks.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Conduct a survey of existing control functionalities to determine any necessary upgrades and then establish seasonal setpoints (generally targeting 68-74°F when occupied and 55-60°F/80-85°F when unoccupied) and HVAC schedules that align with building occupancy patterns. Following these steps, the centralized BMS HVAC schedule should be configured accordingly. Verify and monitor to ensure the system is operating as intended and adjust as needed. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 11: ECM 3 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	O&M and Water Savings($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
HVAC Setback	245	0	254.2	13.5	$0	$1,223	$1,500	1.2
Overall % Reduction	**48%**	**0%**	**39%**	**31%**	**--**	**19%**	**--**	**--**

5 Measure Requiring Additional Consideration

5.1 ECM 4 – BAS Controls Integration and Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent. This combined measure involves installing a building automation system (BAS) and completing RCx once the BAS is operational. Together, these steps enable centralized control, improve system coordination, and ensure building operations are optimized for efficiency and reliability.

BAS Integration

BAS integration refers to connecting and coordinating various building systems and components through a centralized control platform. The goal is to enhance the overall efficiency, functionality, and manageability of building operations. While BAS installation does not directly yield energy savings, it enables the optimization of other measures. The Farmer's Market currently utilizes local controls for its duct heaters and does not have a building automation system to allow for advanced control of HVAC systems and scheduling. BAS integration would allow centralized monitoring and optimization of the HVAC systems, which currently operate independently with minimal automation.

Commissioning

With a BAS installed, the Farmer's Market will have centralized visibility and control of major HVAC and pump systems for the first time. Commissioning is a critical follow-on activity to ensure the BAS is properly configured, sequences of operation are optimized, and long-standing inefficiencies are resolved. Commissioning includes systematically evaluating and fine-tuning HVAC, controls, and other energy-consuming systems to restore them to design intent and reduce energy waste.

The following list represents commissioning opportunities that should be evaluated to validate operation, repair if discrepancies identified or implement if not active and feasible for major HVAC systems. This effort will proactively improve building system operation and optimize energy usage. For example, ECM 5, typically identified in a retro-commissioning effort, describes the savings potential of a particular scheduling opportunity for the duct furnaces.

- Optimize HVAC scheduling in non 24/7 occupied spaces
- Optimize HVAC occupied and unoccupied setpoints
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water and chilled water supply reset
- Discharge air setpoint reset
- Outside air temperature lockouts

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing a BAS will have no change to existing controls capabilities and will increase customization of equipment.
- Commissioning will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 10% reduction in estimated heating and cooling end use energy consumption.
- Project cost is estimated at $3 per square foot of building area (7,457 SF).
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Identify equipment to be connected to the central control system and engage a building controls integration company to plan and cost the system integration. Coordinate with planned capital upgrades and renovations where possible to optimize benefits. This measure is not recommended for implementation due to the overall low energy consumption of the facility.

ECM Savings and ROM Cost

Table 12: ECM 4 Savings and ROM Cost

Savings Summary								
ECM	**Natural Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M and Water Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
RCx + Install BAS	52	1,816	60.2	3.7	$0	$459	$5,220	23.3
Overall % Reduction	10%	5%	9%	10%	--	7%	--	--

5.2 ECM 5 – Replace Duct Furnaces with ASHP

This measure proposes replacing the two existing duct furnace units — 280 MBH Sterling Radiator QVD-3505 units — with new high-efficiency air source heat pumps (ASHPs). The existing units are at or near end-of-life, operate only in recirculation mode. Replacing these units with ASHPs provides simultaneous improvements in efficiency, decarbonization-readiness, and occupant comfort.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- New ASHPs are sized to meet existing thermal loads.
- Efficiency assumptions are based on an average coefficient of performance (COP) of 2.8 for heating.
- Additional study of equipment capacity requirements could be performed as part of this measure.
- ASHP cost is estimated at $3,500 per ton of installed capacity, which is applied to the total AHU replacement tonnage. A factor of 60% was applied to account for opportunities to downsize the units.
- A Microsoft Excel™ spreadsheet was used to determine energy savings based upon 2024 utility costs.

Next Steps: AECOM recommends conducting a detailed design study to confirm load requirements and ASHP sizing, assess electrical infrastructure capacity, and coordinate with BAS integration (ECM 1) for optimal scheduling and sequencing. A phasing plan should also be developed to minimize downtime in record storage areas during installation.

ECM Savings and ROM Cost:

Table 13: ECM 5 Savings and ROM Cost

Savings Summary							
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**Est Project Cost ($)**	**Simple Payback (Yrs)***
Replace Furnaces with ASHP	507	-42,613	381	9	-$2,155	$98,000	N/A
Overall % Reduction	**100%**	**-119%**	**59%**	**21%**	**-33%**	**--**	**--**

**N/A indicates a negative payback period which results from negative cost savings due to the higher cost of electricity relative to the cost of natural gas, common for electrification measures.

6 Appendix A

Table 14: Monthly Utility Data (2022 to 2023)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	125.2	$680	1,934	$208	3	3	1,051	0
Feb-23	116.9	$1,181	1,919	$181	3	4	955	0
Mar-23	104.3	$557	1,700	$152	2	4	918	0
Apr-23	39.0	$477	1,648	$145	2	4	525	28
May-23	157.0	$147	3,456	$273	5	8	283	76
Jun-23	0.3	$0	3,122	$234	4	7	86	139
Jul-23	0	$0	3,782	$306	5	7	11	227
Aug-23	0	$0	3,481	$277	5	7	48	141
Sep-23	0	$20	3,004	$277	4	7	113	85
Oct-23	22.8	$224	3,146	$256	4	7	415	31
Nov-23	0	$317	3,122	$240	4	7	779	0
Dec-23	0	$162	2,220	$158	3	4	834	0
Jan-24	140.8	$769	2,334	$54	3	4	1,194	0
Feb-24	78.5	$683	1,901	$194	3	4	874	1
Mar-24	71.3	$318	1,865	$150	3	4	771	2
Apr-24	39.0	$135	1,774	$201	4	7	437	21
May-24	2.5	$470	3,145	$282	4	7	148	98
Jun-24	0	$1	3,494	$321	5	8	51	207
Jul-24	0	$0	3,874	$345	5	7	18	251
Aug-24	0	$0	3,669	$337	5	7	37	215
Sep-24	0	$0	4,309	$346	6	10	84	112
Oct-24	12.0	$66	3,625	$344	5	8	356	31
Nov-24	30.1	$144*	2,866	$309	4	7	607	4
Dec-24	132.9	$635*	3,024	$254	4	5	1,037	0
2023 Sum	566	3,765	32,534	2,707			6,019	727
2024 Sum	507	3,220	35,880	3,137			5,614	942

*Estimated with building-level unit cost, $6.35/MCF.

7 Appendix B

Table 15: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Efficiency	Capacity 2	Approx Year Installed
N/A	2	Duct furnace (NG)	Whole building	Sterling radiator	QVD-3505	280 MBH	80%		
N/A	1	Domestic water heater	Whole building	American water heater company	E6120u015SV	1,500 W		19 gal	

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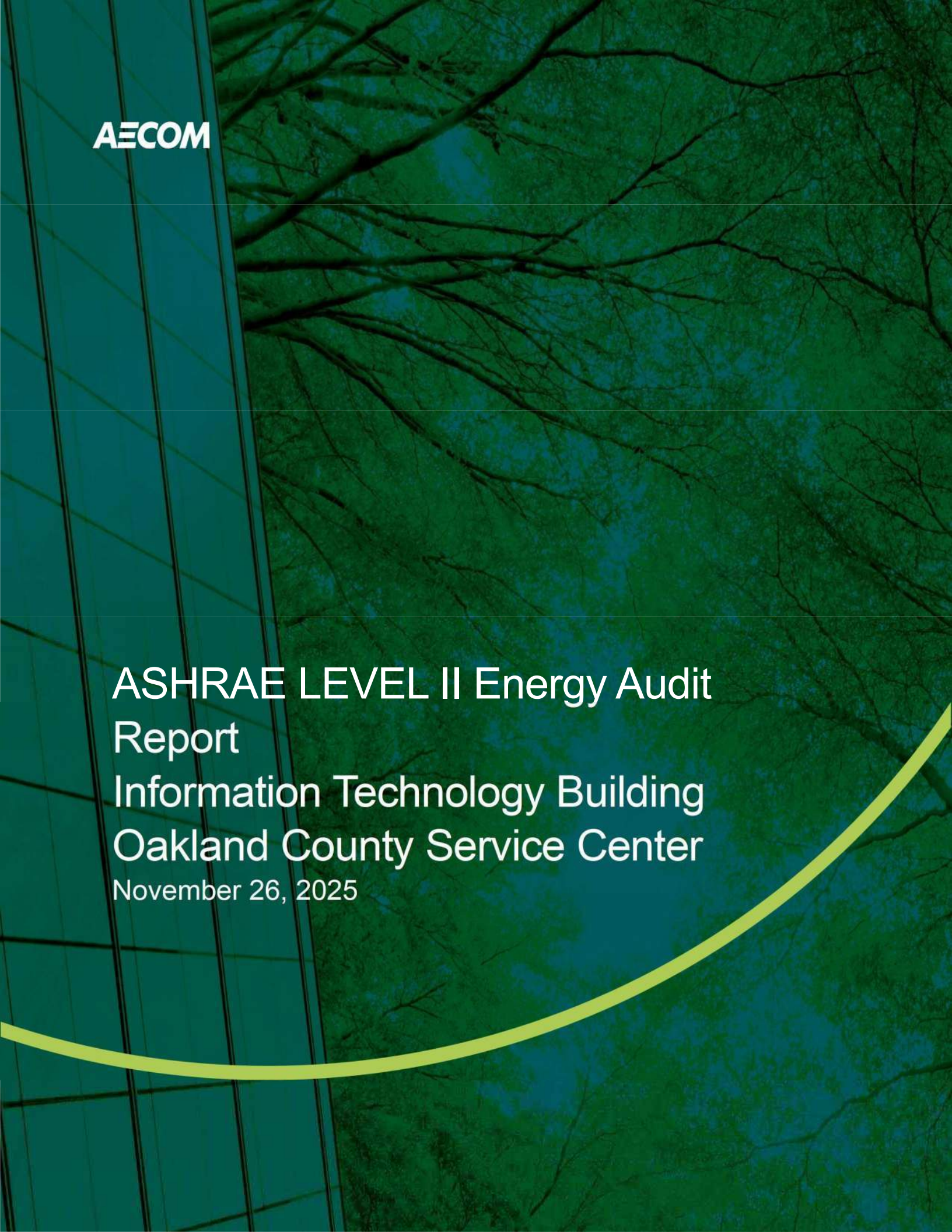

AECOM

ASHRAE LEVEL II Energy Audit Report
Information Technology Building
Oakland County Service Center

November 26, 2025

Quality information

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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Information Technology (IT) Building in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County IT Building is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates 7 Energy Conservation Measures (ECMs) for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. 6 of the 7 measures are recommended for implementation, with the remaining 1 measure recommended for further study. The 6 recommended measures represent a projected 24% annual energy cost savings with an aggregate simple payback of 5.1 years.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan Deliverable. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Energy Conservation Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction (kW)***	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Green House Gas Savings**	**O&M and Water**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	KW	MCF/yr	Mlbs/y	MMBTU	MTCO2e	$	$/yr	$	Years
1	Building Retrocommissioning	HIGH	R	94,440	11	0	547.38	322	107	$	$15,862	$40,770	2.6
2	Upgrade all T12 and T8s to LEDs	HIGH	R	281,965	46	0	0	962	125	$11,062	$31,016	$169,980	4.0
3	Install motion and daylight harvesting sensors in MERs and low-density office spaces	HIGH	R	30,008	0	0	0	102	13	$0	$3,301	$32,625	9.9
4	Install VFDs on heating hot water distribution system and optimize pumping sequence of operations	HIGH	R	41,796	0	0	0	143	19	$0	$4,598	$32,670	7.1
5	Isolate data center cooling from the comfort cooling by utilizing the Vertiv system for complete cooling.	HIGH	R	135,425	0	0	0	462	60	$0	$14,897	$66,550	4.5
6	Install VFDs on Exhaust Fans	LOW	R	6,299	0	0	55.26	21	9	$0	$1,246	$13,310	10.7
			Sum	**589,932**	**57**	**0**	**603**	**2,013**	**333**	**$11,062**	**$70,919**	**$355,905**	**5.0**
			Overall % Reduction	25%	11%	0%	16%	0%	23%		24%		

Measures Considered but not Recommended													
ECM #	Energy Conservation Measure Description	Priority	Measure Status	Year -1 Electricity Savings	Demand Reduction (kW)*	Year -1 Gas Savings	District Steam Savings	Total Energy Saved	Green House Gas Savings	O&M and Water	Year - 1 Cost Savings	Project Cost (Est)	Simple Payback Period
7	Install cooling tower cooled high-temperature water-cooled servers and decommission Vertiv Chillers.	MED	RS	235,321	55	0	0	803	104	$0	$25,885	$359,059	13.9

2 Existing Conditions and Observations

The Oakland County Information Technology Building, located at 1200 N Telegraph Road, Building #49W, Pontiac, MI 48341. It serves a jurisdictional population of approximately 1.2 million residents, providing direct law enforcement services to over 343,000 individuals through contracts with 15 communities.

The building consists of single and two-floor blocks. The main occupancies of the building are a data center and office spaces. This 24/7 operating facility has undergone renovations since its construction. The data center and controls group operate 24/7, and the regular offices operate during regular business hours.

2.1 Building Systems

2.1.1 Building Envelope

The building consists of two blocks: one is a single floor, while the other has two floors. The first floor primarily contains the data center, office spaces, and mechanical rooms, and features minimal windows. The second floor includes strip windows that stretch across the entire floor, resulting in a window-to-wall ratio of approximately 40%. The overall window/wall ratio is projected to be 25%. These tinted windows have rubber-sealed frames, and their construction dates back to the mid-1990s. Although they seem to be in good condition, they are single-pane windows. While they are reaching the end of their useful life, it's recommended to retrofit them with high-efficiency double-pane windows.

The walls are concrete masonry unit (CMU) structures with brick veneer on the exterior. There is no insulation on the interior side behind the drywall. The concrete roof deck is covered with black tar roof membrane the insulation levels are unknown at this stage.

Table 2. Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	CMU, red brick veneer	Good
Roof	Insulation above concrete deck, black tar	Good
Glazing	25% window/wall ratio, double pane, aluminum frame, tinted	Good

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The facility is heated by steam received from the central plant. The steam enters the building at 120 pounds per square inch (PSI) and drops to 24 PSI through a pressure reduction valve. The steam is converted to hot water and distributed throughout the air handling unit (AHU) heating coils, unit heaters, and perimeter heating. The steam-to-heating hot water (HHW) heat exchanger has a capacity of 3,870

MBH. The hot water distribution system is configured as a primary distribution system. Two constant-speed primary 10 horsepower (HP) with 91.7% efficient HHW pumps circulate hot water.

The chiller plant consists of three 130-ton air-cooled chillers, one of which is newer, and two 25 HP chilled water pumps. The chillers, constructed in 2015, and their full load coefficient of performance (COP) rating is 2.3, approximately 1.53 kW/Ton. The chiller efficiencies are within an acceptable range. However, an optimization is required for better performance.

The chillers use HFC-134a (R-134a) refrigerant, which is being phased down nationwide as of 2025, including in Michigan, under the American Innovation and Manufacturing (AIM) Act, which aligns with the Kigali Amendment to reduce high-global warming potential (GWP) refrigerants. Michigan follows federal guidelines and is a member of the U.S. Climate Alliance, which supports stricter hydrofluorocarbon (HFC) regulations. However, Michigan has not enacted additional state-specific bans beyond federal rules.

The data center has a Vertiv Liebert cooling system, which is primarily used for humidity monitoring and control. 2 dry coolers serving the data racks and computer room have a capacity of 600 MBH. The unit uses a dry cooling system with refrigeration R410A. The chilled water system primarily cools the data center, and isolating the center cooling from the comfort cooling is being considered.

The facility comprises 5 AHUs. The heating and cooling capacity and the rooms served are as follows:

Table 3. Facility Heating and Cooling Capacity Summary

AHU	Heating Capacity (MBH)	Cooling Capacity (Ton)	Rooms Served
AHU-1	1,620	168	N building, 1st and 2nd floor, Basement
AHU-2	484	42	Auditorium
AHU-3	648	-	Computer room
AHU-4	-	65	Computer room
AHU-5	25	1.5	Microfilm room

The AHU-1 is a large unit with a 100 HP supply and 50 HP return fans. All fans are controlled by variable frequency drives (VFDs) based on the duct static pressure. AHU-2 is equipped with a steam humidifier. The AHU-2 air distribution system splits into seven zones at the unit, and pneumatic dampers control these zones. AHU-3 has a steam humidifier to control the humidity levels in the computer room.

Two 3-ton mini-splits are cooling the telephone room.

12 exhaust fans have a total motor input requirement of 67 HP. Exhaust fans are controlled through the BAS (7), and local controls (5). 14 pumps have a combined motor input requirement of 170 HP. The total cooling capacity of the systems serving the building is 390 Tons, and the total heating capacity is 325 Tons.

2.1.3 Lighting Systems

49W lighting system consists of a mixture of 32W T8 fluorescent lamps and 12.5W LED lamps. Fixture type is many recessed, with some suspended, can or wall sconce, and track or down lighting located throughout the building as needed. Lighting is controlled via manual switches throughout the building. The following is an approximation based on the As-Built drawings for 49E Information Technology.

Table 4. Lighting Summary

Lighting	Total Fixtures
Fluorescent Lights	772
Metal Halide Lights	10
LED Lights	261

There are approximately 1,044 total light fixtures. The approximate total wattage is 24,722 watts for fluorescent lights, 1,500 watts for metal halide lights, 3,263 watts for LED lights, and 29,485 in total. The approximate area per the drawings is 81,540/ft². The calculated lighting density is 0.36 W/ft².

2.1.4 Plumbing

The domestic hot water is generated by steam supplied from the central plant. The steam enters a 170-gallon tank equipped with a steam-to-water coil. The water is stored at 125°F and then divided into two main zones after passing through the domestic hot water circulation pump. Storing the water at 125°F may cause the growth of Legionella bacteria, which is a health concern for users. It is advisable to increase the storage temperature to 140°F in the tank and mix the water with city and return water to lower the temperature to 110°F within the circulation loop. The steam is controlled by an electric actuator based on the water temperature in the tank.

The domestic water pipes near the water meter appear to have a galvanic corrosion problem. This electrochemical corrosion occurs when steel and copper pipes are in contact, which seems to be the case in this piping configuration. To prevent galvanic corrosion, dielectric unions, fittings, insulating gaskets, or bushings should be used in the piping setup. The facility installed copper wiring between the metals in contact to mitigate galvanic corrosion. However, equalizing the electrical potential between the dissimilar piping does not always reduce galvanic corrosion, and clearly, that's the case here.

2.1.5 Building Controls

The building is connected to the Niagara BMS, and the majority of equipment is controlled via electric actuators. Pneumatic controls remain on some legacy equipment, indicating a mix of control mechanisms throughout the facility.

2.1.6 Electrical Infrastructure

The main service to 49E is fed from Feeder A and Feeder B into three 1000AA/1333FA kVA, 13200Δ-480/277Y V, Westinghouse Dry-Type transformers located in room 158 - Electrical Switchgear. The Westinghouse Switchboard is rated at 480/277Y, 3-phase, 4-wire, 2000A supply current, and is dated 11/90. The switchboard has a Westinghouse totalizing watthour meter, number 81585066.

Breaker 52-1 protects the "Computer Room" and is monitored via an SEL-735 Power Quality and Revenue Meter, number 3211130033. Breaker 52.2 is monitored via an SEL-735 Power

Quality and Revenue Meter, number 3211130031. Breaker 52-3 is monitored via an SEL-735 Power Quality and Revenue Meter, number 3211130032.

Backup power is supplied from a 600kW-750kVA, 3-phase, 10-wire, Wye-connected, Caterpillar model SR-4 diesel generator located in room 157 – Emergency Generator. The generator's fuel tank has a capacity of 2500-gallons and is estimated to have a run time of 60 hours at full load.

3 Utility Billing Analysis

3.1 Utility Type and Usage

The Information Technology Building receives electric service and is connected to the steam network. Utility billing is managed through separate arrangements for all fuels. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

Steam usage is metered and billed to the building based on the cost to generate the utility. Steam is the primary heating source for the building.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Steam:** Oakland County Internal Tracking

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 5: Total Energy Usage and GHG Emissions (2024)

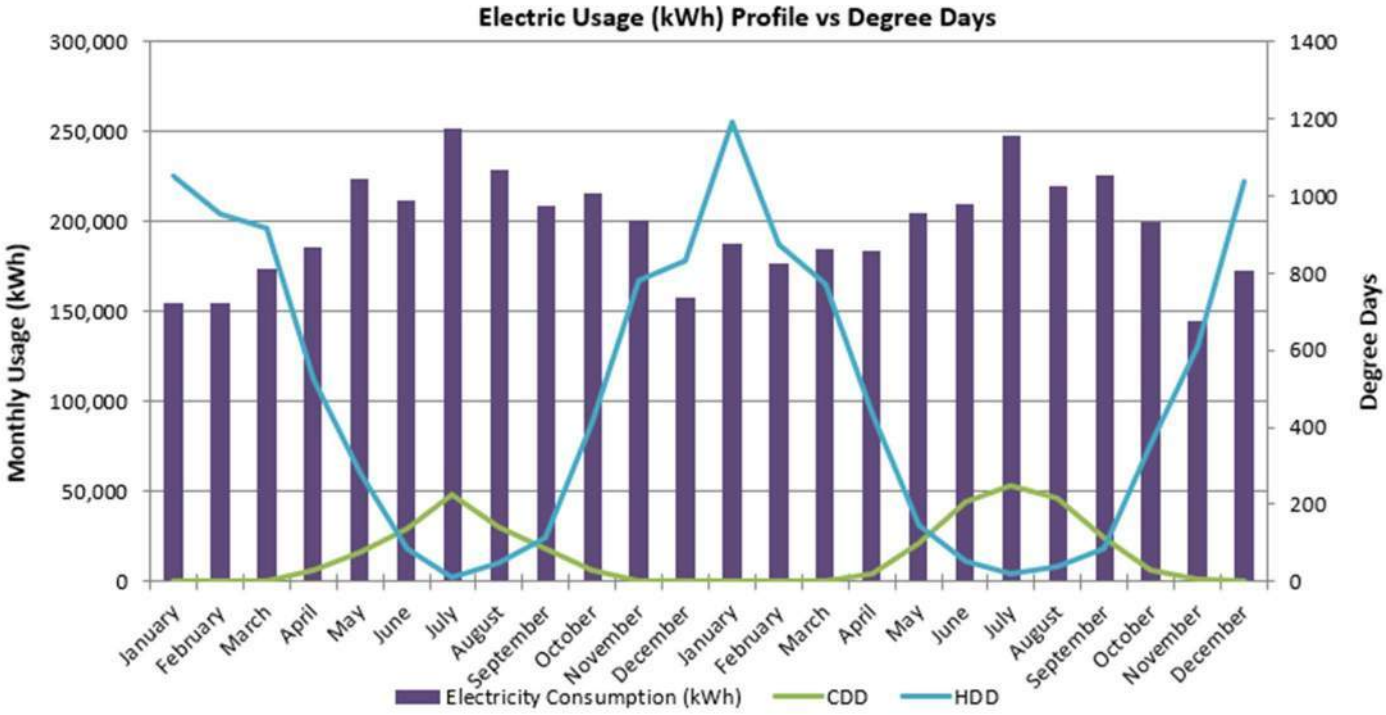
Utility	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	8,056	$259,710.00	$0.11	*0.0004427*	1,045
Steam	4,570	$38,278.23	$10.00/Mlb	*0.119*	456
Total	**12,626**	**$297,988**	--	--	**1,501**

**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage does show a strong correlation to weather data, indicating that cooling energy impacts overall electricity usage, however there is a high baseload that is likely from constant IT loads within the building. The annual usage for the baseline 12-month period from January to December 2024 is 2,361,000 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

AECOM has developed a methodology to estimate the peak demand of the building which uses the metered consumption of the building, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated to be 465 kW.

Based on metered data from the LIMBACH BMS, the building's peak demand totals approximately 70.8 kW, significantly lower than the previously estimated 465 kW. This demand is distributed across three monitored panels (SEL735-1, -2, and -3). This electrical capacity is lower than the average kWh/hr of the monthly metered energy and may represent the technical load (IT equipment) of the facility.

Table 6. Electric Capacity Results

Maximum Building Capacity at Service Transformer	1000 kW
Maximum Capacity at Switchgear (A*V*Ph)	1333 kW
Estimated Peak Demand	465 kW
Remaining Capacity	**535 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge: **$6.15/kW/Month**

Average Dollar per kWh Used in Calculations: $0.11/kWh

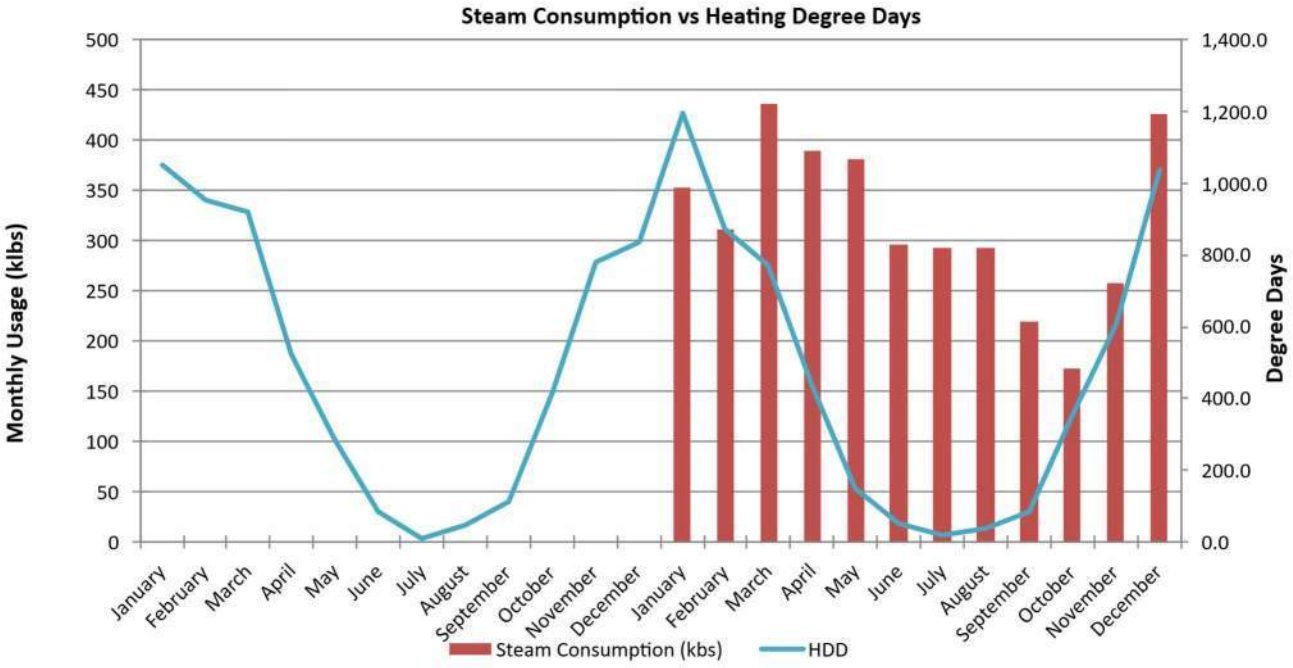
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Steam Usage Profile

Figure 3 shows the monthly steam usage profile for 2024 and local monthly weather data indicated by HDD. Steam consumption exhibits a strong seasonal pattern that aligns with heating degree days, with higher usage during winter months and minimal usage in summer, consistent with steam being used primarily for space heating. The annual usage for the baseline 12-month period from January to December 2024 is 3,828 klbs. Detailed monthly steam usage and costs are in Appendix A.

Figure 3: Steam Usage Profile (January 2024 to December 2024)



3.4.1 Steam Rate Structure

Unlike electricity and natural gas, which are billed directly by external utilities, steam is an internal utility produced on campus. The cost allocation for steam is derived from the total

natural gas cost at the central steam plant, as well as costs to operate the plant. Each steam-served building is billed proportionally based on its metered steam usage relative to the campus total. As a result, there are no separate delivery, demand, or third-party charges; the unit cost of steam reflects the cost of natural gas, plant operating cost and efficiency, and distribution system performance.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. For the purpose of the document, the cost of steam has been inflated to include some of the costs of operating the steam plant, includes labor, maintenance, equipment depreciation and other O&M factors. The assumed cost if provided below:

Average Dollar per klb Used in Calculations: $10.00/thousand lbs

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 7 below.

Table 7: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$259,710
Natural Gas	$0
Steam	$38,278.23
Total	$297,988.23
ECI $/yr/sf	**$3.65**

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4. Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

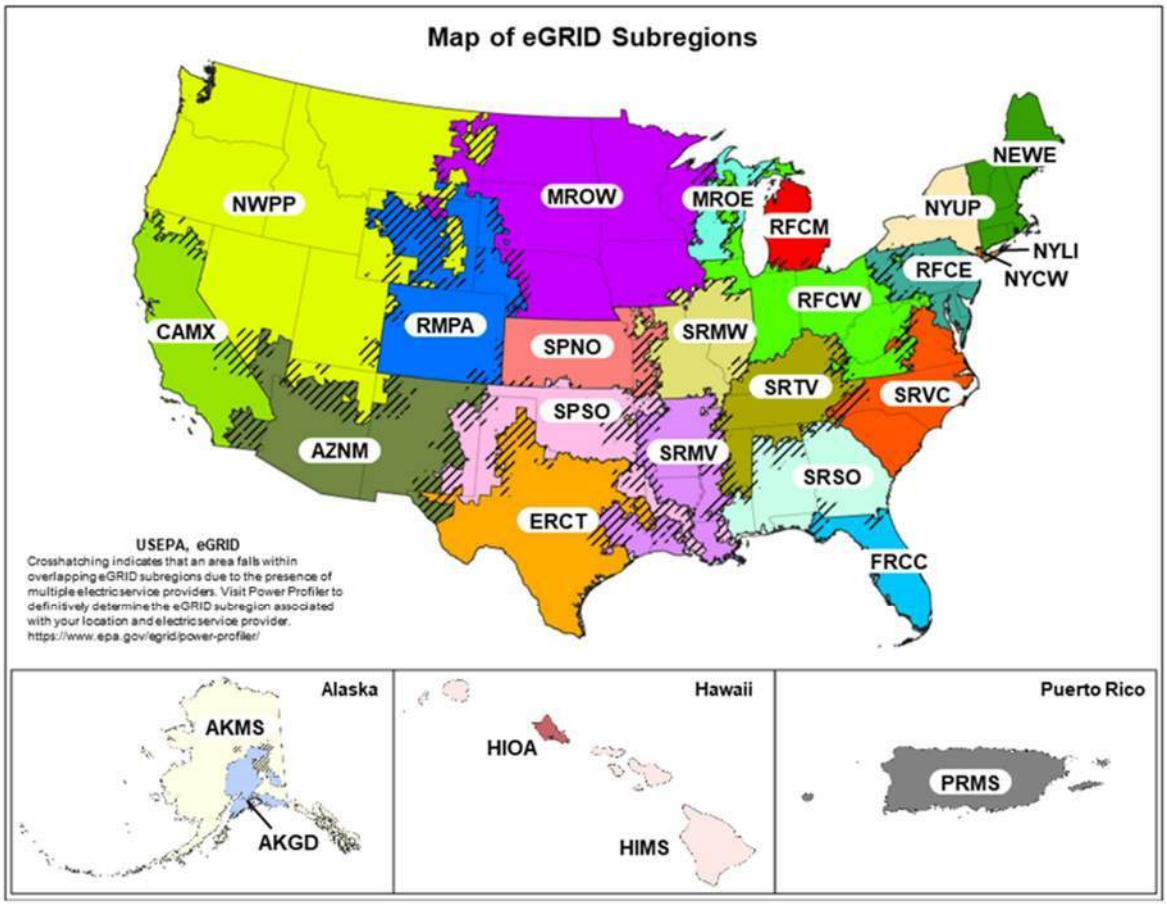
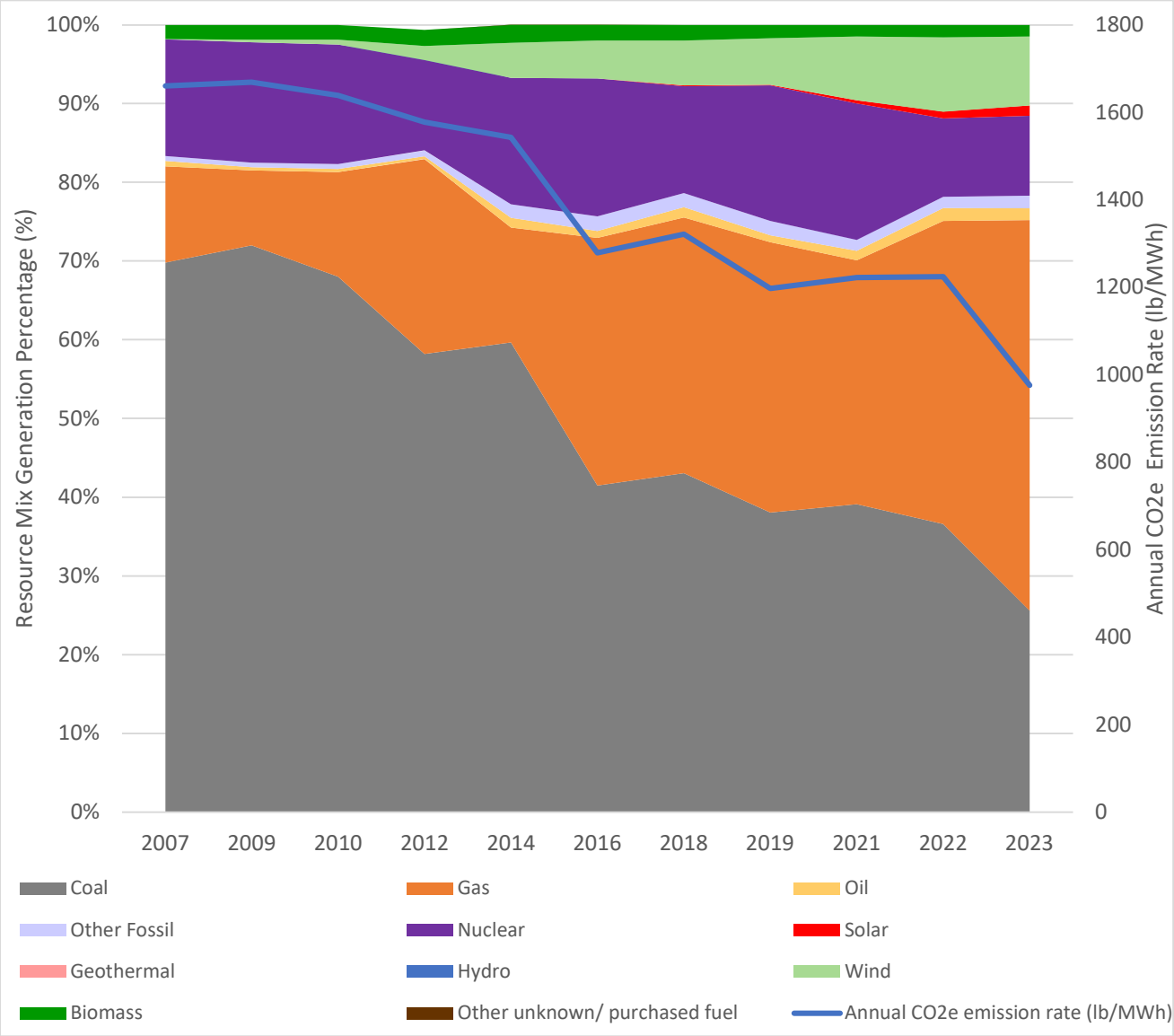


Figure 5 displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 28 percent of carbon emissions are attributed to steam and 73 percent are associated with electricity, with trace amounts associated with natural gas. Steam, natural gas combustion and imported electricity resulted in 1,045 tCO2e (campus-level Scope 1) and 456 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 1,501 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for the IT Building are converted to kBTUs units, summed, and divided by the total square footage.

Table 8: Annual Utility Summary (2024)

Building:	Information Technology				**Electric EUI:**		99	kBTU/SF/yr
GFA:	81,540	SF			**Gas/steam EUI:**		56	kBTU/SF/yr
eGRID Subregion:	RFCM				**Current EUI**		155	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	2,361,000	kWh	3.412	8,056	*0.0004427*	1,045	$259,710	87%
Natural Gas	0	MCF	1.038	0	*0.05294*	0	$0	0%
Steam	3,828	klbs	1194	4,570	*0.119*	456	$38,278.23	13%
Totals				**12,626**		**1,501**	**$297,988.23**	**100%**

According to the US EPA, the average site energy use intensity for a Data Center facility is given using the Power Use Effectiveness (PUE) metric which is defined as (Total Enegy/IT Energy). The average PUE given is 1.82, while the facility calculates a PUE of 2.83, mainly due to the low IT load in comparison to the capacity of the building to support data center equipment. It's important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison indicates there is a significant opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency, specifically with the cooling energy of the building.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
	Wholesale Club/Supercenter*		120.0	51.4	CBECS - Retail Store
Technology/Science	Data Center* (Average PUE presented in place of EUI: PUE = Total Energy / IT Energy)		1.82	1.82	EPA - Data Center
	Laboratory		318.2	115.3	CBECS - Laboratory
	Other – Technology/Science		89.3	40.1	CBECS - Other
Services	Data Center* (Average PUE presented in place of EUI: PUE = Total Energy / IT Energy)		1.82	1.82	EPA - Data Center
	Personal Services (Health/Beauty, Dry Cleaning, etc.)		96.9	47.9	CBECS - Service
	Repair Services (Vehicle, Shoe, Locksmith, etc.)				
	Other - Services				
Utility	Drinking Water Treatment & Distribution (Average EUI presented in Energy per Flow in gallons per day)		5.90	2.27	AWWA - Water Treatment Plant
	Energy/Power Station		89.3	40.1	CBECS - Other
	Wastewater Treatment Plant* (Average EUI presented in Energy per Flow in gallons per day)		7.51	2.89	AWWA - Wastewater Plant
	Other - Utility		89.3	40.1	CBECS - Other
Warehouse/Storage	Self-Storage Facility		47.8	20.2	CBECS – Non-refrigerated Warehouse
	Warehouse/Distribution Center	Distribution Center*	52.9	22.7	CBECS – Non-refrigerated Warehouse & Distribution Center
		Non-Refrigerated Warehouse*			
		Refrigerated Warehouse*	235.6	84.1	CBECS – Refrigerated Warehouses
Other	Other		89.3	40.1	CBECS - Other

3.8 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and estimated daily occupancy. Table 9 and Figure 6 and Figure 7 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 9: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	0	3,613	4,313,551	**52.9**	**429.9**
Space Cooling	511,675	0	0	1,745,836	**21.4**	**226.5**
Fans	414,793	0	0	1,415,275	**17.4**	**183.6**
Pumps	190,737	0	0	650,794	**8.0**	**84.4**
SHW/DHW	0	0	215	256,870	**3.2**	**25.6**
Conveyance	2,441	0	0	8,330	**0.1**	**1.1**
Lighting	693,536	0	0	2,366,345	**29.0**	**307.0**
Plug Loads	34,298	0	0	117,023	**1.4**	**15.2**
Process Loads	0	0	0	0	**0.0**	**0.0**
Refrigeration	0	0	0	0	**0.0**	**0.0**
Cooking	384	0	0	1,310	0.0	**0.2**
Information Technology*	481,800	0	0	1,643,902	20.2	**213.3**
TOTAL	2,329,665	0	3,828	12,519,236	154	1,487
Historical Billing	**2,361,000**	**0**	**3,827.8**			
Percent of Actual	99%	0%	100%			
per sqft	**28.96**	**0.00**	**0.05**			

*Includes only IT server equipment

Figure 7: Existing Electricity End Use Distribution

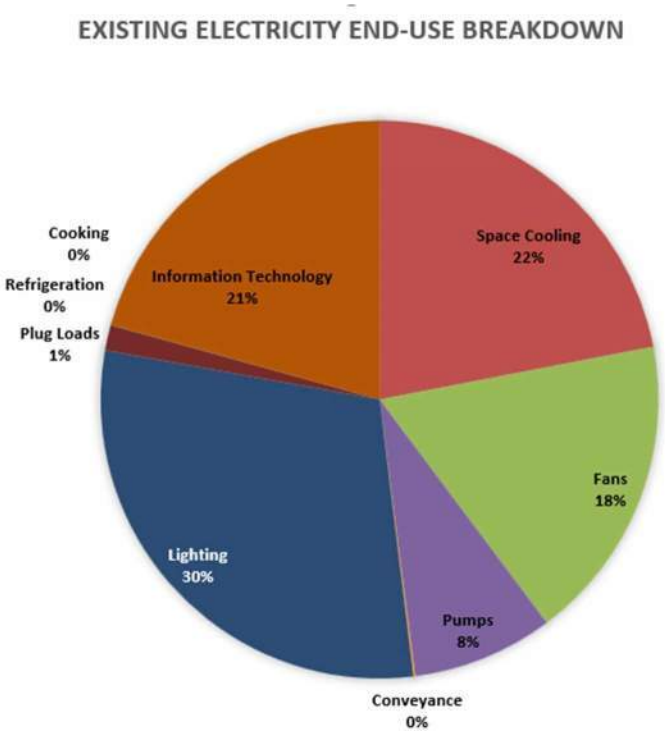
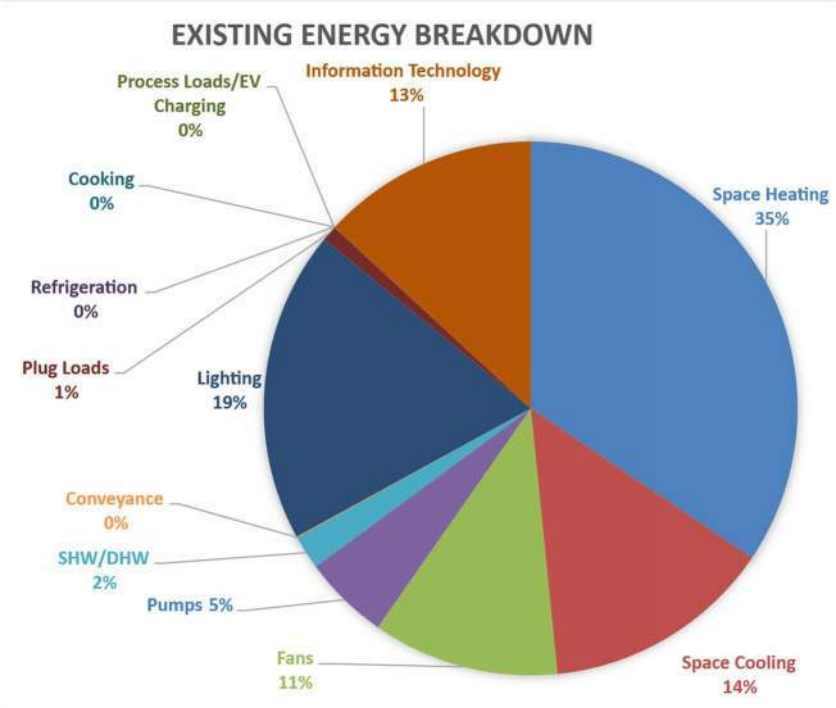


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – Building Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent. The IT building has a robust building automation system that can be leveraged to improve efficiency, however, capital investment into HVAC and replacement of existing pneumatic controls can further improve the impact of building optimization on the overall energy. In the short term, RCx is an extremely valuable measure that should be implemented to its fullest extent to ensure systems are operating effectively and efficiently. This can be completed for existing systems connected to the BAS or delayed until the remaining systems are upgraded and connected to the BAS system.

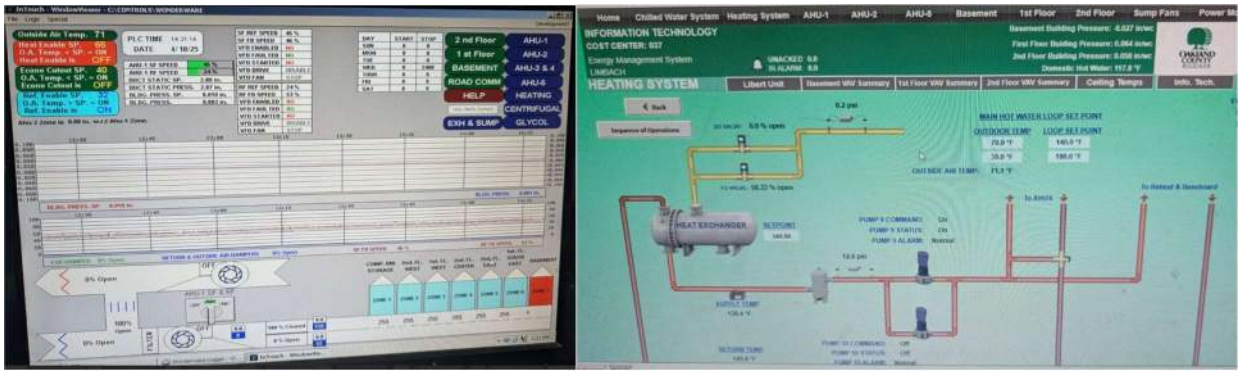


Image 1: Sample Control Graphics

The following list represents RCx opportunities that should be evaluated to validate operation, modify and/or repair if discrepancies identified if systems not scheduled for timely replacement. This effort will proactively improve building system operation and optimize energy usage.

- Equipment Scheduling
- Temperature and Pressure Resets
- System Calibration
- Setpoint adjustments
- Test and balance air distribution systems and reduce duct static pressure setpoints
- Reconfigure the condensate return system, avoid the steam trap submerge
- Install DHW preheat system with condensate return
- Test and repair leaky steam traps
- Reduce Heating Enable Setpoint

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 4% reduction in overall building electricity and 15% in the heating energy. RCx savings can range from 3%-25% of total building energy use.
- Implementation costs assume both investigation to uncover opportunities, and costs to correct deficiencies.
- Additional study of equipment capacity requirements could be performed as part of this measure.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: This measure proposes engaging a third-party contractor to determine if this building is eligible for the DTE RCx program and systematically evaluate and prioritize major HVAC and control systems and complete retro-commissioning to restore systems to their original design intent. This measure is recommended for implementation.

This measure also suggests that Oakland County increase their in-house capabilities to identify, correct, and maintain existing equipment to extend service life, maintain optimum cost of operation, and to reduce implementation costs for routine building improvements. This may require the addition of new staff members and/or additional training of existing staff members to analyze and troubleshoot building equipment issues.

ECM Savings and ROM Cost:

Table 10. ECM 1 Savings and ROM Cost

	Savings Summary							
ECM	**Electric Savings (kWh)**	**Steam Savings (klbs)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
Building Retrocommissioning	94,440	547.38	322	107	$0	$15,862	$40,770	2.6
Overall % Reduction	**4.00%**	**14.30%**	**2.55%**	**7.13%**		**5.32%**		

4.2 ECM 2 – Install LED Lighting on Interior Fixtures

This measure proposes upgrading all remaining fluorescent lighting to Light-emitting diode (LED) lightbulbs with integrated motion and/or daylight sensors to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.

Figure 9: Example Fixture with Integrated Occupancy Controls



The current lighting in the IT Building is described in Section 2.1.3.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture.
- This measure assumes lighting savings of approximately 0.2 W/ft².
- Implementation costs for this measure are based on a fixture count completed on-site. It is estimated the 772 linear fluorescent fixtures are used to illuminate the building space. The cost per fixture to replace is $215 and assumes integrated occupancy controls for each fixture.

- Lights operate an average of 12 hours per day for 365 days per year based on office operational hours and BMS lighting schedule.
- O&M savings assume an average cost of $3.81/lamp/year, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 11. ECM 2 Savings and ROM Cost

	Savings Summary							
ECM	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Upgrade all T12 and T8s to LEDs	281,965	0	962	125	$11,062	$31,016	$169,980	4.0
Overall % Reduction	**12%**	**0.00%**	**8%**	**9%**		**10%**		

4.3 ECM 3 – Install Motion Sensors and Daylighting to Existing LED Fixtures

During the site audit, it was observed that lighting was left on in many unoccupied offices. This measure suggests adding lighting control through motion sensors in spaces that are not regularly occupied. Motion or occupancy sensors detect activity in spaces and automatically turn lighting on when needed. If no activity is detected, the sensors shut off the lighting to save energy. These controls can be easily integrated into the current lighting control circuits or fixtures. This measure applies to existing LED fixtures that were not converted as part of ECM 2, which is approximately 261 fixtures.

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- Implementation is assumed to be one sensor per 1000 square feet of building area.
- There will be no impact on the lighting equipment useful life.
- The savings for this measure assume a 60% reduction in lighting energy on existing LED fixtures
- Implementation costs assume $500/zone for sensor installation. A zone is estimated at an average of 4 fixtures.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the lighting system and determine the most cost-effective sensor locations for each zone. Install sensors in place of existing wall switches, or in ceiling panels with wiring connected to the lighting control circuit.

ECM Savings and ROM Cost:

Table 12. ECM 3 Savings and ROM Cost

ECM	Savings Summary							
	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Install motion and daylight harvesting sensors in MERs and low-density office spaces	30,008	0	102	13	$0	$3,301	$32,625	9.9
Overall % Reduction	**1%**	**0.00%**	**1%**	**1%**		**1%**		

4.4 ECM 4 – Install VFDs on Heating Hot Water Pumps

Variable Frequency Drives (VFDs) on pumps will provide a dynamic and energy-efficient solution by allowing precise control of pump speed, optimizing performance, and reducing unnecessary energy consumption during periods of lower demand. The existing 10hp hot water pumps do not have VFDs and run at constant speed. This ECM proposes evaluating the heating hot water system pumps for feasibility to add a VFDs to reduce pump energy. This may be coupled with a routine upgrade of pumps as they near end of useful life to include premium efficiency motors and VFDs.



Image 2: Heating Hot Water Pumps

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- VFDs will be most effective when paired with a BAS to automatically control speeds.

- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed. VFDs will likely increase the service life of the equipment if properly selected and installed.
- The savings for this measure assume an average 30% reduction in equipment speed.
- If coupled with routine upgrades to include premium efficiency motors additional energy savings may be achieved.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the heating hot water system pumps for compatibility with a VFD and assess the usage pattern and energy consumption. Once this data is collected, select the appropriate type of VFD. Choose VFD based on compatibility with current systems, programmability, and reliability.

ECM Savings and ROM Cost:

Table 13. ECM 4 Savings and ROM Cost

	Savings Summary							
ECM	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Install VFDs on heating hot water distribution system and optimize pumping sequence of operations	41,796	0	143	19	$0	$4,598	$32,670	7.1
Overall % Reduction	**1.77%**	**0.00%**	**1.18%**	**1.28%**		**1.57%**		

4.5 ECM 5 – Isolate an Optimize Data Center Cooling

The server rooms of the IT building are expansive, and use of the space for IT operations is limited to a fraction of the open floor area. The cooling system serving the space is split between dedicated Vertiv systems, designed for IT cooling, and the building air handling and cooling system, which is sized for the entire building load. This measure suggests two improvements: First, isolate the data center cooling from the remainder of the building and allow the specialized units to modulate to meeting the data center load specifically. This will allow the base-building system to operate based on actual comfort cooling load, and not the process load of the IT equipment, which will increase the efficiency and reduce the run hours of the system. Second, this measure includes creating partitions within the existing data center space around the the area that is used, and allowing the Vertiv system to supply air to the active areas, limiting airflow to the areas of the server room that are not being utilized. This will reduce the total CFM required to condition the area and allow the IT cooling equipment to serve the active, heat generating equipment directly. Energy savings for this measure include a reduction in overall cooling energy consumption for the entire building, mainly driven by lower utilization of the base-building systems.



Image 3: IT Room Utilization

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- This measure may require some curtains or temporary space partitions to be installed around active server areas. Minor ductwork my be required to isolate the cooling to the new active areas.
- The savings for this measure assume reductions in pump speeds, reduced chiller loads from set point adjustments, and reduced hours of operation for the system overall through system optimization.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Additional investigation into the optimum configuration of the equipment is required to properly design this measure. It is recommended that a long term IT plan be determined to understand growth of the server load before physical changes are implemented to the space and the systems.

ECM Savings and ROM Cost:

Table 14. ECM 5 Savings and ROM Cost

	Savings Summary							
ECM	**Electric Savings (kWh)**	**Steam Savings (klbs)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
Isolate data center cooling from the comfort cooling by utilizing the Vertiv system for complete cooling.	135,425	0	462	60	$0	$14,897	$66,550	4.5
Overall % Reduction	**5.74%**	**0.00%**	**3.84%**	**4.16%**		**5.08%**		

4.6 ECM 6 – Install VFDs and Demand Control on Exhaust Fans

Multiple exhaust fans are present on the roof of the facility that are set to run continuously at constant speed. The demand for exhausting air in the occupied spaces is variable, and depends on usage of equipment that requires make-up air to ventilate spaces. For each exhaust system, demand based controls pair with Variable Frequency Drives (VFDs) can reduce the total air being exhausted from the building, which directly reduces the total air that requires heating and cooling in the building. Energy savings are calculated from an assumed usage schedule of equipment. VFD control provides a dynamic and energy-efficient solution by allowing precise control of fan speed, optimizing performance, and reducing unnecessary energy consumption during periods of lower demand.



Image 4: Sample of Roof Exhaust Fans

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety, and should improve occupant thermal comfort.
- VFDs will be most effective when paired with a BAS to automatically control speeds.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed. VFDs will likely increase the service life of the equipment if properly selected and installed.
- The savings for this measure assume an average 10% reduction in equipment speed.
- Implementation costs assume $300/hp to install VFDs, plus additional sensor and programming costs.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the building exhaust systems and specify the specific control methodologies required to implement variable speed controls.

ECM Savings and ROM Cost:

Table 15. ECM 6 Savings and ROM Cost

	Savings Summary							
ECM	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Install VFDs on Exhaust Fans	6,299	55.26	21	9	$0	$1,246	$13,310	10.7
Overall % Reduction	**0.27%**	**1.66%**	**0.18%**	**0.65%**		**0.43%**		

5 Measure Requiring Additional Consideration

This section provides additional information about projects that have been evaluated but are not currently recommended for implementation due to poor economics, feasibility issues, conflicts with other projects already recommended, or requirements for additional study that may impact feasibility. Equipment electrification projects, which have longer paybacks, may be listed here but will be expanded upon in the final Electrification Plan for each building. All electrification projects that are required for campus electrification are not included in the energy audit reports. This report includes one measure that is included in the Not Recommend Category. The measure summaries are given below:

Table 16: Proposed Energy Savings Summary

	Savings Summary							
ECM	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Install Water Cooled IT Servers	235,321	0	803	104	$0	$25,885	$359,059	13.9

Project Descriptions:

- ECM 7 – Install Water Cooled IT Servers: The measure suggests replacing the traditional air-cooled servers with liquid cooled units that can operate at a much high temperature. This allows data center cooling to be provided by air to water cooling tower and no mechanical refrigeration is required. This can reduce cooling energy use by as much as 80% but requires significant changes to the building infrastructure. This ECM requires the replacement of servers, and the cost of the server upgrade is excluded. ECM 5 and ECM 6 are mutually exclusive. This measure is not recommended currently due to the low overall demand of IT systems.

6 Appendix A

Table 17: Monthly Utility Data (2023 to 2024)

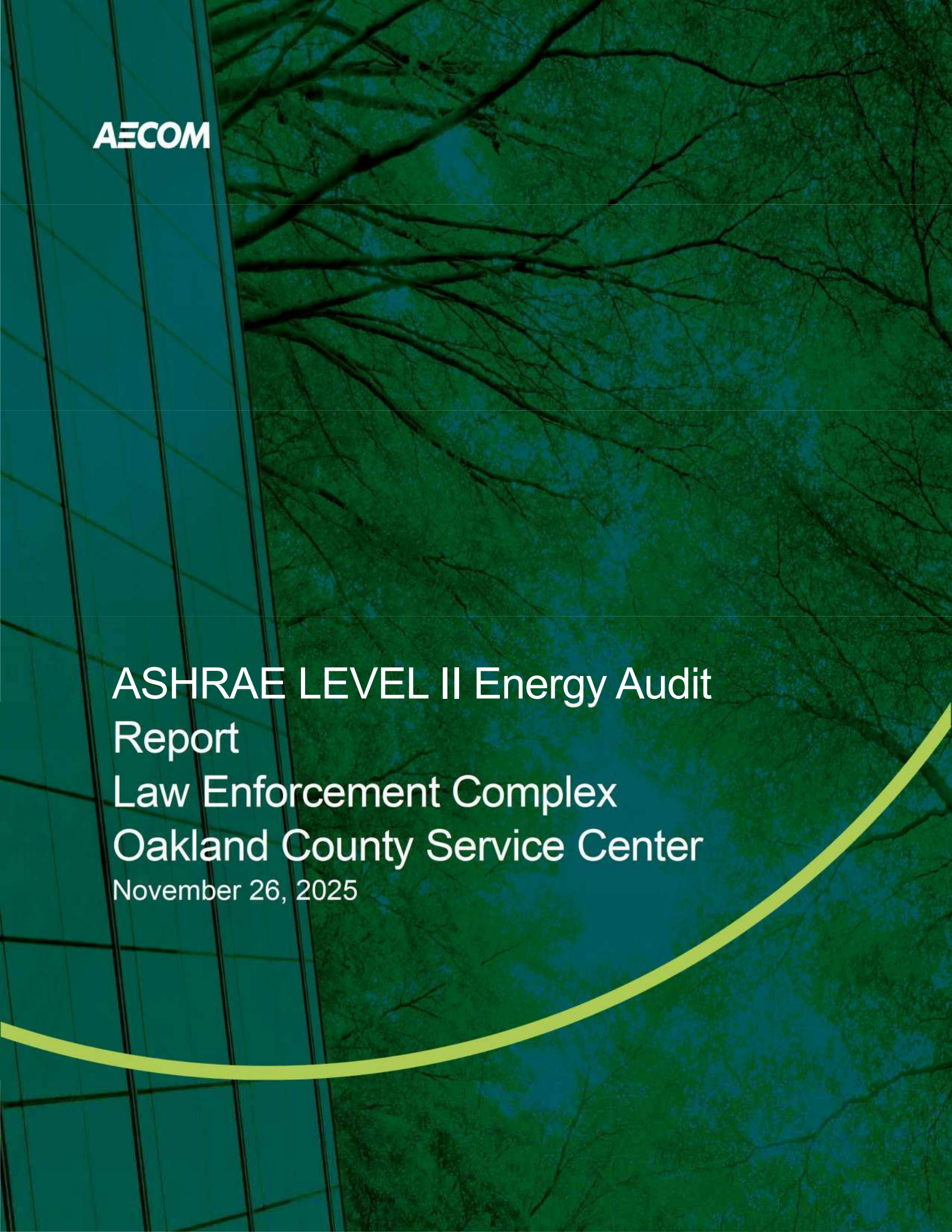
Month	Steam Consumption (kBtu)	Electricity Consumption (kWh)	Natural Gas Consumption (MCF)	Total Cost
Jan-23	-	155,000		
Feb-23	-	155,000		
Mar-23	-	174,000		
Apr-23	-	186,000		
May-23	-	224,000		
Jun-23	-	212,000		
Jul-23	-	252,000		
Aug-23	-	229,000		
Sep-23	-	209,000		
Oct-23	-	216,000		
Nov-23	-	201,000		
Dec-23	-	158,000		
Jan-24	420,795	188,000		$24,204.25
Feb-24	371,482	177,000		$22,581.24
Mar-24	520,539	185,000		$24,709.62
Apr-24	464,897	184,000		$24,133.61
May-24	454,487	205,000		$26,356.42
Jun-24	353,843	210,000		$26,063.51
Jul-24	349,670	248,000		$30,208.56
Aug-24	348,647	220,000		$27,119.99
Sep-24	262,361	226,000		$27,057.33
Oct-24	206,545	200,000		$23,729.86
Nov-24	308,556	145,000		$18,534.22
Dec-24	508,599	173,000		$23,289.62
2023 Sum	-	2,371,000		
2024 Sum	-	2,361,000		**$297,988**
2024 Sum (kBtu)	4,570,421	8,056,068		

7 Appendix B

Table 18. Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Units
AHU-1	1	Air handling unit, dual duct (HW,CHW)	N BLDG, 1ST FL, 2ND FL, BASEMENT			1620	MBH
AHU-2	1	Air handling unit, VAV (HW, CHW)	Auditorium	BUFFALO FORGE	700 BB	484	MBH
AHU-3	1	Air handling unit, VAV (HW, CHW)	Computer room	BUFFALO FORGE	112 BB	648	MBH
AHU-4	1	Air handling unit, VAV (HW, CHW)	Computer room	BUFFALO FOIRGE	310 BB		
AHU-5	1	Air handling unit, VAV (HW, CHW)	Microfilm room	BUFFALO FORGE	310 BB	25	MBH
ACCH-1,2,3	3	Air cooled chillers w/ waterside Fisen Corp. economizers		Fisen corporation	YLAA0156HE46XFBSDTXA	130	TON
	2	Minisplit	Telephone room			3	Ton
HX-1	1	Steam to HW heat exchanger		Bell and Gossett		3870	MBH
P-1,2	2	Chilled water pumps		Bell and Gossett	Series 1510-4E	25	HP
P-3,4	2	Condenser water pumps		Bell and Gossett	Series 1510-5E	30	HP
P-7,8	2	Glycol pumps		Goulds	3996MT-2X3-13	20	HP
P-9,10	2	Heating pumps		Bell and Gossett	Series 1510-2E	10	HP
SF-1	1	Supply Fan	1st level mech room	Greenheck		3	HP
SF-2	1	Supply Fan		Greenheck		3	HP
RF-1	1	Return Fan	AHU-1	Buffalo	1320BLSWSI	50	HP
RF_2	1	Return Fan	AHU-2	Buffalo	600BLSWSI	5	HP
CF-1	1	Exhaust fan	1st level burster	Greenheck	BSQ-16	2	HP

AECOM



AECOM

ASHRAE LEVEL II Energy Audit Report
Law Enforcement Complex
Oakland County Service Center

November 26, 2025

Quality information

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Revision	Revision date	Details	Authorized	Name	Position

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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Law Enforcement Complex in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County Law Enforcement Complex (LEC) is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates 14 ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. Ten of the 14 measures are recommended for implementation, with the remaining 4 measures recommended for further study or not recommended at this time. The 10 recommended measures represent a projected 24% annual energy cost savings with an aggregate simple payback of 7.8 years.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan Deliverable. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	KW	MCF/yr	k lbs/y	MMBTU	tCO2e	$/yr	$/yr	$	Years
ECM 1	Building Retro-Commissioning	HIGH	R	353,476	0	0	1,473	2,965	332	$0	$53,613	$133,989	2.5
ECM 2	VFDs on HHW Pumps	HIGH	R	92,024	0	0	0	314	41	$0	$10,123	$44,165	4.4
ECM 3	VFDs on CHW and CW pumps and optimize chiller plant	HIGH	R	114,499	0	0	0	391	51	$0	$12,595	$45,375	3.6
ECM 4	Pneumatic Controls Upgrade	MED	R	233,291	0	0	1,155	2,176	241	$13,520	$37,216	$539,660	10.6
ECM 5	Retrofit water-cooled walk-ins using city water with air-cooled systems	MED	R	5,505	0	0	0	19	2	$56,133	$606	$210,600	3.7
ECM 6	Retrofit AC in the GYM control booth with a split AC unit.	LOW	R	1,835	0	0	0	6	1	$18,711	$202	$77,440	4.1
ECM 7	Lighting Occupancy Sensors in Office Areas	MED	R	44,162	0	0	0	151	20	$0	$4,858	$20,098	4.1
ECM 8	Replace fluorescent fixtures with LEDs	LOW	R	260,073	51	0	0	887	115	$5,494	$28,608	$192,000	5.6
ECM 9	Retrofit HPS wall packs on roof with LEDs	HIGH	R	21,024	0	0	0	72	9	$343	$2,313	$9,600	3.6
ECM 10	Upgrade Exhaust Fans with VFDs	MED	R	29,845	0	0	191	330	36	$0	$5,193	$25,000	4.8
			Sum	**1,116,314**	**82**	**0**	**2,820**	**7,310**	**847**	**$94,202**	**$155,327**	**$1,163,938**	**4.7**
			Overall % Reduction	**33%**	**5%**	**0%**	**9%**	**18%**	**18.8%**	**--**	**24%**	**--**	**--**

Measures Requiring Additional Consideration													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	KW	MCF/yr	k lbs/y	MMBTU	tCO2e	$/yr	$/yr	$	Years
ECM 11	Install energy recovery wheels between the common area exhaust fans and all AHUs.	N/A	NR	133,438	0	0	1,420	2,151	228	0	$28,882	$1,234,200	42.7
ECM 12	Convert dual duct air distribution systems to single duct.	N/A	RS	330,903	0	0	4,806	6,867	718	0	$84,456	$2,397,918	28.4
ECM 13	Install sewage waste heat recovery with storage tanks to produce heating and domestic hot water.	N/A	NR	-188,353	0	0	2,018	1,767	157	0	-$535	$7,018	-13.1
ECM 14	Add insulation to the roof.	N/A	RS	151,202	0	0	1,571	2,392	254	0	$32,345	$1,071,912	33.1

2 Existing Conditions and Observations

The Main Oakland County Jail, located at 1201 North Telegraph Road, was constructed in 1973. The second floor of the facility serves as a maximum-security unit, housing approximately 440 inmates. The first floor contains the intake area, which is used for processing new arrests and includes holding tanks and observation cells with a combined capacity of 109 inmates. In March 1989, the Annex, a direct supervision facility, was added to the Main Jail, increasing capacity by 487 inmates. There is a garage that is approximately 20,000 ft² in the basement.

A 24/7 health clinic operates within the jail and includes seven single-occupancy cells for medical observation or isolation. There's a commercial kitchen that prepares food for the inmates. The kitchen can prepare food for up to 1,000 detainees. The kitchen includes standard gas and electric food preparation equipment, a walk-in freezer, and a refrigerator. There is a gym and a chapel beside the office and the inmate units in the facility. There are mini server rooms, mechanical rooms, a garage, and storage spaces in the facility.

2.1 Building Systems

2.1.1 Building Envelope

The walls provide maximum security, durability, and resistance to tampering or escape attempts, while also accommodating surveillance and safety protocols for both inmates and staff. The wall construction consists of reinforced concrete and masonry block. The exterior walls are presumed to be double-layered with insulation and security features embedded between the layers. The flat roof is constructed of concrete with insulation placed above the deck. The exterior side of the roof is covered with a black tar membrane. The overall condition of the roof is observed to be in good condition.

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Poured concrete and CMU	Good
Roof	Insulation above concrete deck, black tar	Good
Glazing	2%	Good

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The facility is heated by steam received from the natural gas central plant. The steam enters the building at 120 pounds per square inch (PSI) and drops to 24 PSI through a pressure reduction valve. The steam is converted to hot water and distributed throughout the air handling unit (AHU) heating coils, unit heaters, and perimeter heating. The hot water distribution system is configured as a primary/secondary distribution system. Two constant-speed primary 15 horsepower (HP) 93% efficient heating hot water pumps distribute hot water. Four main

distribution loops circulate water by smaller pumps serving zones such as back up east, machine room, records basement unit, second floor main jail, baseboards in B, C, first floor main jail, baseboards in east end, I block, trustee baseboards, and the air conditioning (AC) units AC-3, AC-8, and heating and ventilation (HV) unit HV-5.

The facility comprises 12 rooftop units (RTUs), 10 air conditioning (AC) units, and 15 AHUs distributed between the Main and Annex buildings. The AHUs in the Annex and the RTUs located on the Main building's rooftop are in comparatively better condition. Equipment on the second floor is generally in fair shape but requires upgrades to the control systems and substantial enhancements to the air distribution network. In contrast, the AHUs in the Main building's basement are currently "non-operational" and in urgent need of replacement. The units in the basement and second-floor mechanical and electrical room (MER) in the Main building feature a dual duct air distribution system, which is inherently an inefficient system. These upgrades should be planned with future projects in mind to ensure long-term alignment and integration. Converting from dual to single duct with variable air volume (VAV) systems will significantly lower heating and cooling loads, as well as decrease electrical load, which can create space for electrification in the main electrical switchgear with all other projects.

The global heating and cooling setpoints at all zones are respectively 72°F and 74°F. AHU-7, which serves the lobby area, features hot and chilled water coils. The AHU serving the chapel and some unit heaters are equipped with steam coils. All AHUs are equipped with constant-speed supply and return fans. The return air plenum is the MER, where it mixes with outside air, controlled by pneumatic dampers. The exhaust fan serving the lobby and the men's room operates manually. The gym control booth is cooled by a water-cooled AC unit using city water, wasting significant water. All AHUs are constant volume systems serving multiple zones with CAVs. AHU-14, which serves the commissary, is equipped with hot and chilled water pumps for its coils. This constant volume unit is controlled by Belimo actuators. The relatively new domestic water pressurization pumps run at a constant speed, with a capacity of 0.5 HP. The loading dock is heated by steam unit heaters. Trane AHU-1, installed in 2005, is relatively new and features a VAV air distribution system. York AHU-4 is original to the building, equipped with constant air volume (CAV) and six air distribution zones on the unit with hot water reheat. Valves and dampers are controlled by pneumatic actuators. The heating and cooling coils are in fair condition.

There are two mini-splits on the second floor, MER cooling the server rooms. A 2-ton split AC unit cools the server room, and the indoor air temperature setpoint is 62°F. The AC-6 unit serving the gun range operates on 100% outdoor air with an exhaust fan discharging air from the range. The AC 101 in the garage serves the spaces in the basement. The HV-9 unit serving the uniform room is not linked to the building management system (BMS) and is controlled manually.

A new AHU serving the clinic area was being installed during the site visit, and it should be operational soon.

The kitchen exhaust fan is controlled manually by the kitchen personnel. The bathroom and general exhaust fans operate 24/7.

The chiller plant consists of two 290-ton magnetic bearing water-cooled chillers, two 25 HP chilled water pumps, two 25 HP condenser water pumps, and a cooling tower with two fans. The chillers, constructed in 2009, feature with soft start with a very low inrush current, and their full

load coefficient of performance (COP) rating is 6.1, approximately 0.58 kW/Ton. The chiller efficiencies are within an acceptable range. However, optimization is required for better performance.

The chillers use R-134a (HFC-134a) refrigerant, which is being phased down nationwide as of 2025, including in Michigan, under the American Innovation and Manufacturing (AIM) Act, which aligns with the Kigali Amendment to reduce high-global warming potential (GWP) refrigerants. Michigan follows federal guidelines and is a member of the U.S. Climate Alliance, which supports stricter hydrofluorocarbon (HFC) regulations. However, Michigan has not enacted additional state-specific bans beyond federal rules.

The cooling tower (CT) pumps (CWP) are constant speed inefficient (87.5% NEMA nom eff) equipment. The Marley cooling tower, installed in 2020, and its estimated capacity is 830 nominal tons and is in good operating condition. The 20 HP CT fans are controlled by variable frequency drives (VFDs), rated as 93% NEMA efficiency. The chiller plant is scheduled to turn on for cooling after April 15 or when the outdoor air temperatures exceed 70°F on average, until the average drops below 60°F.

2.1.3 Lighting Systems

All outdoor parking fixtures are light-emitting diode (LED) with photocell control. Within the building, the law enforcement complex lighting system consists mostly of 32W fluorescent and 12.5W LED lamps. As 32W T8 or T12 fluorescent lamps burn out, they are replaced with equivalent 12.5W LED lamps. Lighting fixture types range from suspended, recessed, downlighting, track lighting, and wall or ceiling-mounted fixtures, depending on the room layout and required lighting locations. The majority of rooms are controlled by manual wall switches.

Table 3: Lighting Summary

Lighting	South Section	
	Total Fixtures	Lamps per Fixture
Fluorescent Lights	24	1 lamp
Fluorescent Lights	75	2 lamp
Fluorescent Lights	29	3 lamp
LED Light	149	1 lamp
LED Light	50	2 lamp
MH Light	1	1 lamp
HPS Lights	8	1 lamp

Light fixture counts were taken from the South Section of the building, which is approximately 10% of the entire building square footage. The total approximate quantity of light fixtures in the South Section is 336, including 128 fluorescent fixtures, 199 LED fixtures, two metal halide (MH) fixtures, and eight high pressure sodium (HPS) fixtures. Extrapolating out across the entire complex, the approximate fixture count is roughly 3,500 fixtures, with approximately 1,280 of those as fluorescent. The approximate total wattage of interior lighting is 112,000 watts. The approximate area per drawing is 267,978 ft^2. The lighting density is calculated as 0.43 W/ft^2.

2.1.4 Plumbing

The domestic hot water is produced by the steam received from the central steam plant by instantaneous heat exchangers. There is no storage, and the hot water is circulated 24/7. The domestic hot water temperature setpoint is 110°F, determined by the Sheriff standard. The steam trap serving the heat exchanger appears to be leaky.

2.1.5 Building Controls

The jail is controlled by a BMS system integrated with a mix of pneumatic and direct digital control (DDC) components. Most RTUs, ACs, AHUs, HV units, terminal units, and heating/cooling equipment are connected to the BMS. However, not all equipment is currently integrated - for example, HV-09, which serves the uniform room, is manually controlled and not linked to the BMS.

2.1.6 Electrical Infrastructure

The law enforcement complex's main service is supplied by Feeders E and F to a 13200Δ-208Y/120V double-ended switchgear located in the basement electrical room. The switchgear is rated at 750kVA, 2500A, 3-phase. Peak demand was 303.2 kW and 284.74 kW for Feeder F and Feeder E, respectively. Backup power for the original law enforcement complex electrical infrastructure is fed from a Caterpillar, Model D353, diesel generator located in the basement near the electrical room. The diesel generator has a 3-phase, 10-wire standby rating of 419kVA, 335kW, 120/208V, 1119A, a fuel capacity of 600 gallons, and an estimated run time of approximately 26 hours under full load conditions.

Power to the south addition is also supplied by Feeders F and E to a 13200Δ-480Y/277V transformer with a capacity of 1500AA/2000FA kVA, 2500A, 3-phase. The meter number and peak demand were not available at this location. A spot measurement of 185 kW was collected at 1:45 PM on April 17th, 2025. Backup power to the law enforcement complex south-addition electrical infrastructure is fed from a 545kW-681kVA Caterpillar model SR-4 diesel generator located outside, along the southwest wall of the complex. The generator fuel tank has a capacity of 2,000 gallons and is estimated to have a fully loaded run time of roughly 52 hours.

2.1.7 Additional Information

The commercial kitchen, all water-cooled, has one walk-in freezer and two walk-in coolers. The freezer is approximately 400 ft², and the coolers are 320 ft². The facility also has six elevators.

The gate locks are now obsolete, and the internal crew handles their maintenance, which causes additional labor costs. According to the facility managers, it would cost up to $10 million to upgrade these systems.

Caterpillar-made 545 kW-rated and 335 kW gas generators serve the facility during blackouts. The generators are being tested monthly.

There are six Muffin Monster industrial grinders in the facility, between 5 HP and 10 HP. It is designed to grind up solids in wastewater and sludge to prevent clogging and damage to downstream equipment like pumps, valves, and pipelines.

3 Utility Billing Analysis

3.1 Utility Type and Usage

The LEC receives electric service, natural gas service, and is connected to the steam network. Utility billing is managed through separate arrangements for all fuels. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

Steam usage is metered and billed to the building based on the cost to generate the utility. Steam is the primary heating source for the building.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)
- **Steam:** Oakland County Internal Tracking

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	3,408,905 kWh	11,631	$374,980	$0.11	*0.0004427*	1,509
Natural Gas	2.8 MCF	2.9	$ 14	$4.98	*0.05492058*	2
Steam	25,200 klb	30,088	$251,996	$10.00/k lb	*0.119*	2,999
Total	**--**	**41,722**	**$626,989**	**--**	**--**	**4,509**

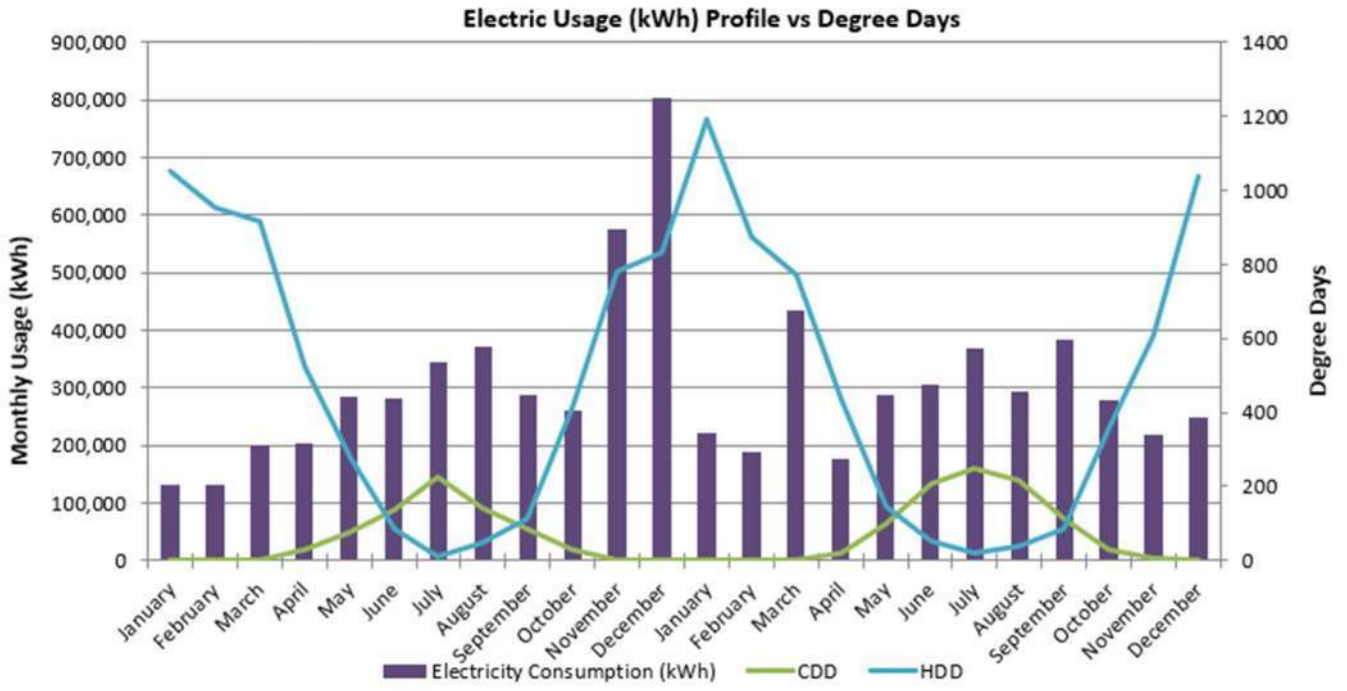
**Natural Gas (1 MCF = 1,038,000 BTU); Steam (1 klb = 1194 BTU); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage does show a strong correlation to weather data, indicating a significant proportion of electricity usage consists of space conditioning usage. Winter 2023 also shows a peak in November and December, which appears to be anomalous, but should be investigated

as a potential inefficiency. The annual usage for the baseline 12-month period from January to December 2024 is 3,408,905 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



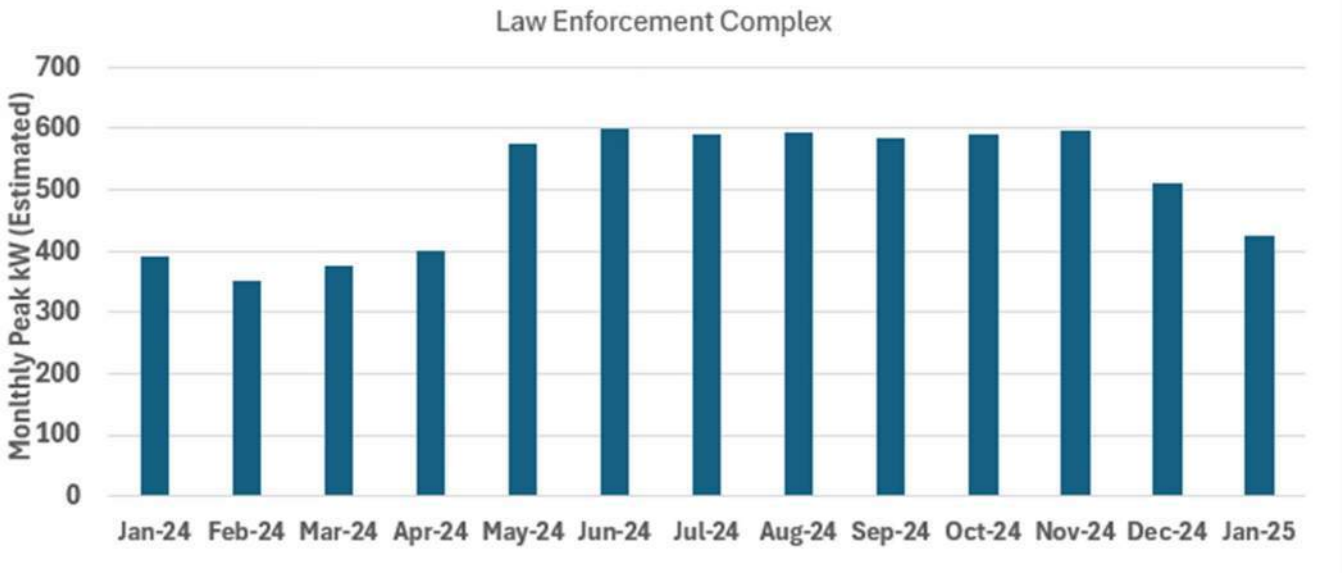
3.3 Building Electrical Capacity Analysis

AECOM has developed a methodology to estimate the peak demand of the building which uses the metered consumption of the building, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 5: Electric Capacity Results

Maximum Building Capacity at Service Transformer	750 kW
Maximum Capacity at Switchgear	900 kW
Estimated Peak Demand	590 kW (from meter)
Remaining Capacity	**160 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge:	**$0.057/kWh**
DTE Electric Demand Charge:	**$6.15/kW/Month**
Average Dollar per kWh Used in Calculations:	**$0.11/kWh**

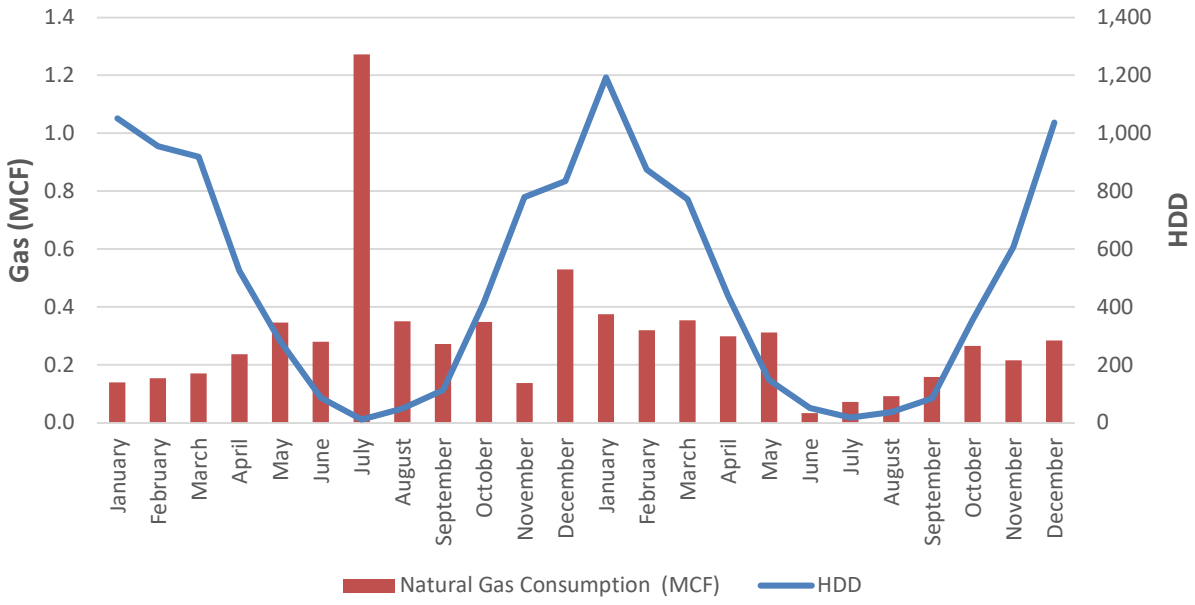
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows minimal correlation to weather data, as natural gas is primarily used for cooking. The annual usage for the baseline 12-month period from January to December 2024 is 2.8 MCF, which is insignificant compared to the total energy consumption of the facility. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: **$1.33/MCF (1000 cubic feet)**

Constellation NG Usage Charge (fixed Fee): **$3.48/dTh (decatherm, 10.38 MCF)**

Constellation NG Usage Charge (Day Gas): **$5.29/dTh (decatherm, 10.38 MCF)**

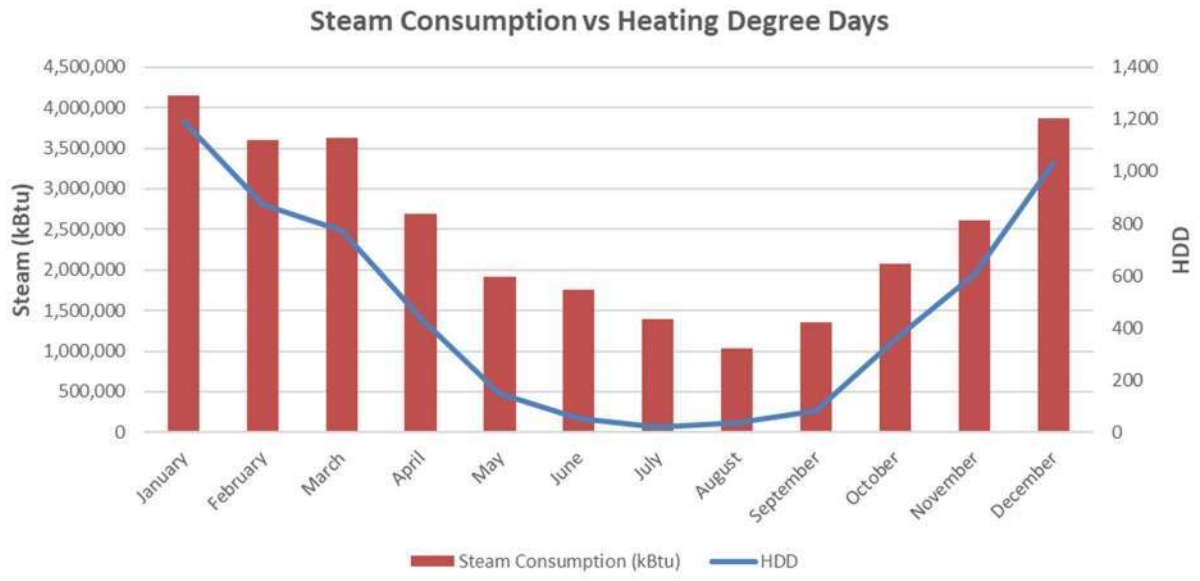
Average Dollar per MCF Used in Calculations: **$4.98/MCF**

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

3.5 Steam Usage Profile

Figure 4 shows the monthly steam usage profile for 2024 and local monthly weather data indicated by HDD. Steam usage shows a direct correlation to weather data, as steam is primarily used for space heating. The annual usage for the baseline 12-month period from January to December 2024 is 25,200 klbs. Detailed monthly steam usage and costs are in Appendix A.

Figure 4: Steam Usage Profile (January 2024 to December 2024)



3.5.1 Steam Rate Structure

Unlike electricity and natural gas, which are billed directly by external utilities, steam is an internal utility produced on campus. The cost allocation for steam is derived from the total natural gas cost at the central steam plant, as well as costs to operate the plant. Each steam-served building is billed proportionally based on its metered steam usage relative to the campus total. As a result, there are no separate delivery, demand, or third-party charges; the unit cost of steam reflects the cost of natural gas, plant operating cost and efficiency, and distribution system performance.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings.

Average Dollar per klb Used in Calculations: $10.00/thousand lbs

3.6 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$374,980
Natural Gas	$14
Steam	$251,996
Total	$626,989
ECI $/yr/sf	$2.34

3.7 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 5. Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 5: Map of eGRID Subregions

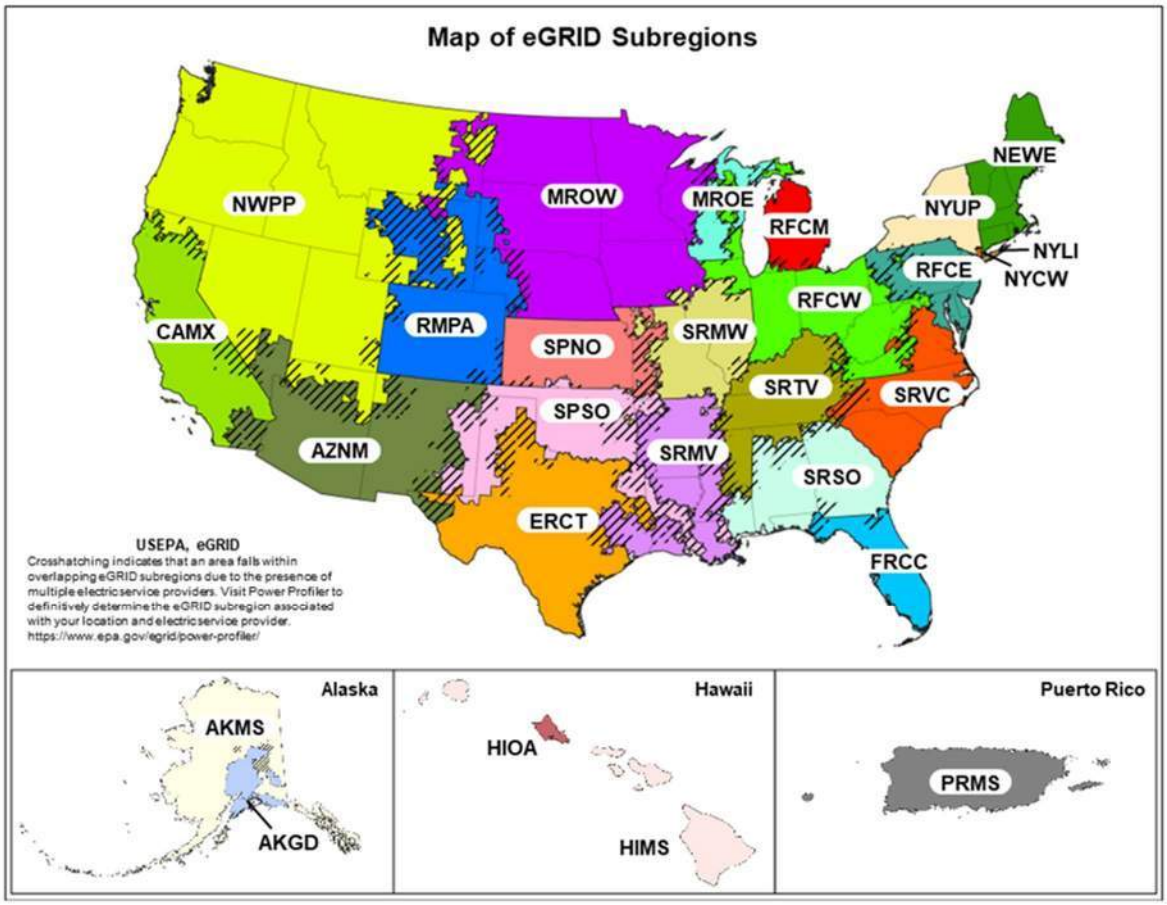
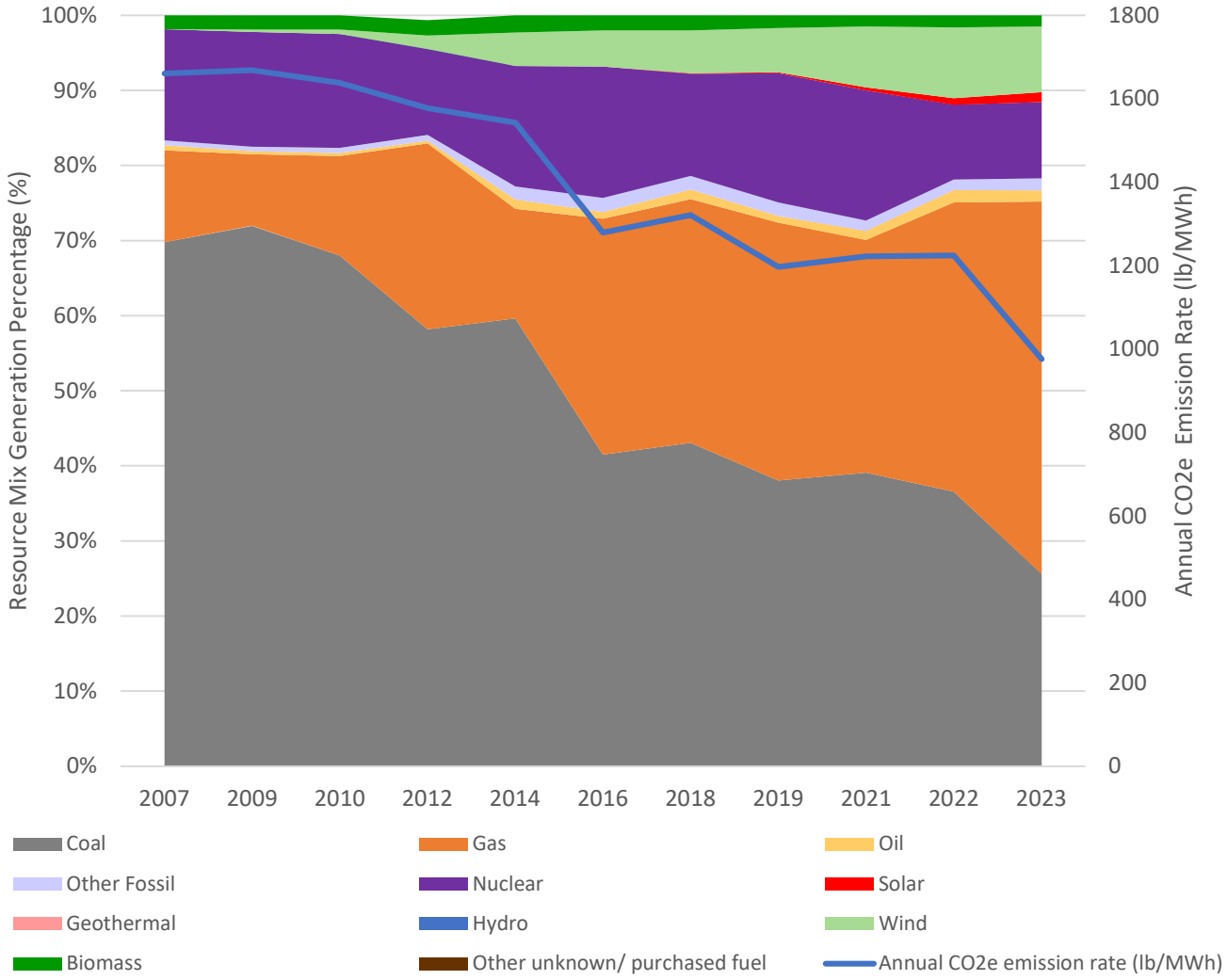


Figure 6 displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 6: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 63 percent of carbon emissions are attributed to steam and 37 percent are associated with electricity, with trace amounts associated with natural gas. Steam, natural gas combustion and imported electricity resulted in 2,612 tCO2e (campus-level Scope 1) and 1,509 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 4,123 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.8 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for the Law Enforcement Complex are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Law Enforcement Complex				**Electric EUI:**		43	kBTU/SF/yr
GFA:	267,798	SF			**Gas/steam EUI:**		112	kBTU/SF/yr
eGRID Subregion:	RFCM				**Current EUI**		156	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	3,408,905	kWh	3.412	11,631	*0.0004427*	1,509	$374,980	60%
Natural Gas	2.8	MCF	1.038	3	*0.05492058*	2	$14	0%
Steam	25,200	klbs	1194	30,088	*0.119*	2,999	$251,996	40%
		Totals		**41,722**		**4,509**	**$626,990**	**100%**

According to the US EPA, the average site energy use intensity for a prison/incarceration facility is 69.9 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 156 kBTU/SF, which is significantly higher than the national benchmark. It’s important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison and site visit observations indicates there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 7: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Parking	Parking		N/A	N/A	None Available
Public Services	Courthouse*		211.4	101.2	CBECS - Courthouse
	Drinking Water Treatment & Distribution (Average EUI presented in Energy per Flow in gallons per day)		5.90	2.27	AWWA - Water Treatment Plant
	Fire Station		124.9	63.5	CBECS - Fire Station/Police Station
	Library		143.6	71.6	CBECS - Library
	Mailing Center/Post Office		96.9	47.9	CBECS - Service
	Police Station		124.9	63.5	CBECS - Fire Station/Police Station
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Social/Meeting Hall		109.6	56.1	CBECS - Social/Meeting
	Transportation Terminal/Station		112.0	56.2	CBECS - Public Assembly
	Wastewater Treatment Plant* (Average EUI presented in Energy per Flow in gallons per day)		7.51	2.89	AWWA - Wastewater Plant
	Other - Public Services		89.3	40.1	CBECS - Other
Religious Worship	Worship Facility*		58.4	30.5	CBECS - Religious Worship
Retail	Convenience Store*	Convenience Store with Gas Station	883.5	350.9	Industry Survey
		Convenience Store without Gas Station			
	Mall	Enclosed Mall	170.7	65.7	CBECS - Enclosed Mall
		Lifestyle Center	228.8	103.5	CBECS - Strip Shopping Mall
		Strip Mall			
		Other - Mall	225.3	101.6	CBECS - Enclosed Mall and Strip Shopping Mall
	Retail Store*		120.0	51.4	CBECS - Retail Store
	Supermarket/Grocery Store*		444.0	196.0	CBECS - Grocery Store/Food Market
	Vehicle Dealership*		138.2	71.9	Industry Survey

3.9 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and estimated daily occupancy. Table 8 and Figure 7 and Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	0	19,641	23,451,853	88	2,337
Space Cooling	1,008,010	0	0	3,439,331	13	446
Fans	1,134,778	0	0	3,871,861	14	502
Pumps	213,719	0	0	729,211	3	95
DHW	0	0	5,558	6,636,515	25	661
Conveyance	24,415	0	0	83,302	0	11
Lighting	635,768	0	0	2,169,240	8	281
Plug Loads	73,733	0	0	251,577	1	33
Process Loads	10,950	0	0	37,361	0	5
Refrigeration	16,425	0	0	56,042	0	7
Cooking	197,100	3	0	675,392	3	87
Information Technology	94,007	0	0	320,752	1	42
TOTAL	**3,408,905**	**3**	**25,200**	**41,722,439**	**156**	**4,508**
Historical Billing	3,408,905	3	25,200			
Percent of Actual	100%	100%	100%			
per sqft	12.7	0.00	0.09			

Figure 8: Existing Electricity End Use Distribution

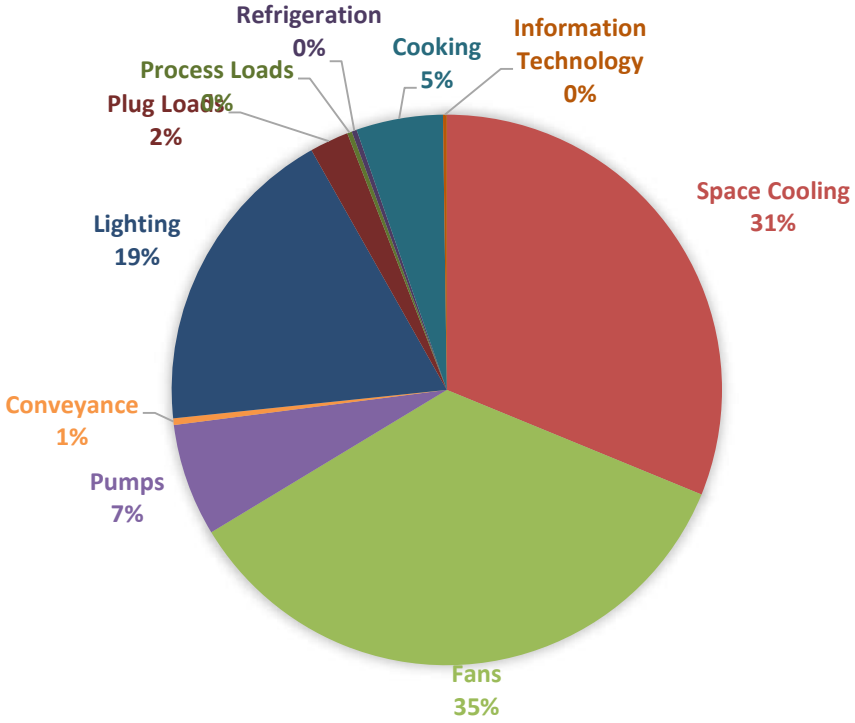
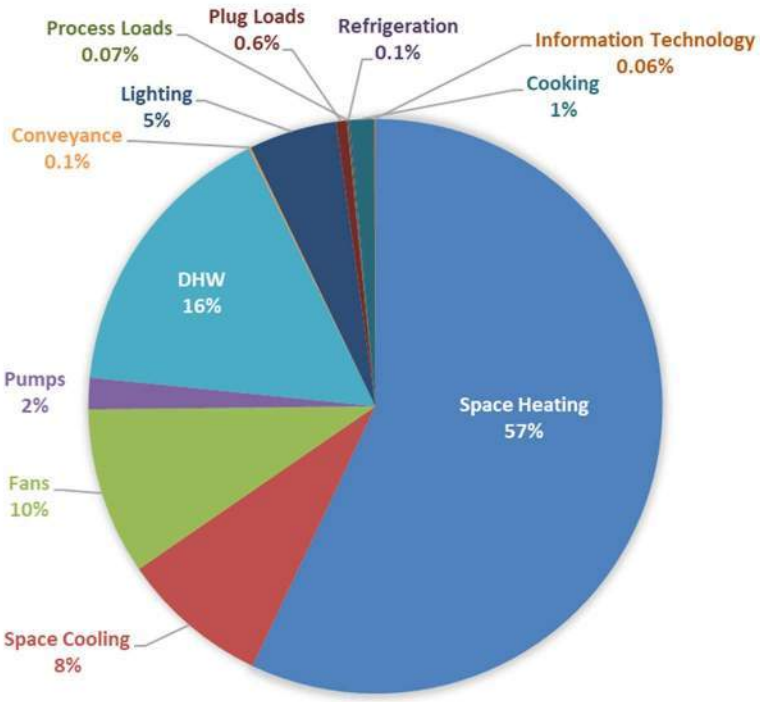


Figure 9: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – Building Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent. The Law Enforcement Complex building has a robust building automation system that can be leveraged to improve efficiency, however, capital investment into HVAC and replacement of existing pneumatic controls can further improve the impact of building optimization on the overall energy. In the short term, RCx is an extremely valuable measure that should be implemented to its fullest extent to ensure systems are operating effectively and efficiently. This can be completed for existing systems connected to the BAS or delayed until the remaining systems are upgraded and connected to the BAS system.



Image 1: Sample Control Graphics

The following list represents RCx opportunities that should be evaluated to validate operation, modify and/or repair if discrepancies identified if systems not scheduled for timely replacement. This effort will proactively improve building system operation and optimize energy usage.

- Test and balance air distribution systems and reduce duct static pressure setpoints.
- Reconfigure the condensate return system, avoid the steam trap submerge.
- Install DHW preheat system with condensate return.
- Test and repair leaky steam traps.
- Repair the steam trap serving the DHW HX.
- Adjust the timer or photocell controlling the wall packs on the roof.
- Reset server room temperature setpoint to 76°F.
- Replace filters more frequently.
- Insulate DHW pipes in the MER.
- Insulate bare hot water pipes serving the AHU.
- Reduce heating enabling setpoint to 57°F and disable to 60°F
- Upgrade the SW garage switch gear room ventilation system. The room is excessively hot.
- Divert the kitchen exhaust fan airstream far away from the AHU intakes. The kitchen exhaust is sucked by the RTU intakes.
- Connect the HV-9 to the BMS system.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 10% reduction in overall building electricity and 7.5% in the heating energy. RCx savings can range from 3%-25% of total building energy use.
- Implementation costs assume both investigation to uncover opportunities, and implementation costs to correct deficiencies.
- Project cost assumes $0.50 per square foot.
- Additional study of equipment capacity requirements could be performed as part of this measure.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: This measure proposes engaging a third-party contractor to determine if this building is eligible for the DTE RCx program and systematically evaluate and prioritize major HVAC and control systems and complete retro-commissioning to restore systems to their original design intent. This measure is recommended for implementation.

This measure also suggests that Oakland County increase their in-house capabilities to identify, correct, and maintain existing equipment to extend service life, maintain optimum cost of operation, and to reduce implementation costs for routine building improvements.

ECM Savings and ROM Cost:

Table 9: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M and Water Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
RCx	353,476	1,473	2,965	332	$0	$53,613	$133,989	2.5
Overall % Reduction	**10.4%**	**5.8%**	**7.1%**	**7.4%**	**--**	**8.6%**	**--**	**--**

4.2 ECM 2 – Install VFDs on Heating Hot Water Pumps

Variable Frequency Drives (VFDs) on pumps will provide a dynamic and energy-efficient solution by allowing precise control of pump speed, optimizing performance, and reducing unnecessary energy consumption during periods of lower demand. The existing 15 HP hot water pumps do not have VFDs and run at constant speed. This ECM proposes evaluating the heating hot water system pumps for feasibility to add VFDs to reduce pump energy and update the sequence of operation to optimize controls. This may be coupled with a routine upgrade of pumps as they near end of useful life to include premium efficiency motors and VFDs.



Image 2: Heating Hot Water Pumps

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- VFDs will be most effective when paired with a BAS to automatically control speeds.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed. VFDs will likely increase the service life of the equipment if properly selected and installed.
- The savings for this measure assume an average 30% reduction in equipment speed.
- If coupled with routine upgrades to include premium efficiency motors additional energy savings may be achieved.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the heating hot water system pumps for compatibility with a VFD and assess the usage pattern and energy consumption. Once this data is collected, select the appropriate type of VFD. Choose VFD based on compatibility with current systems, programmability, and reliability. Optimize and update controls sequence of operation. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 10: ECM 2 Savings and ROM Cost

Savings Summary								
ECM	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M and Water Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
VFDs on HHW Pumps	92,024	0	314	41	$0	$10,123	$44,165	4.4
Overall % Reduction	**2.7%**	**0.0%**	**0.8%**	**0.9%**	**--**	**1.6%**	**--**	**--**

4.3 ECM 3 – Install VFDs on Chilled and Condenser Water Pumps

Variable Frequency Drives (VFDs) on pumps will provide a dynamic and energy-efficient solution by allowing precise control of pump speed, optimizing performance, and reducing unnecessary energy consumption during periods of lower demand. The existing chilled and condenser water pumps are 25 HP and do not have VFDs and run at constant speed. This ECM proposes evaluating the cooling water system pumps for feasibility to add VFDs to reduce pump energy. This may be coupled with a routine upgrade of pumps as they near end of useful life to include premium efficiency motors and VFDs.



Image 3: Condenser Water Pumps

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- VFDs will be most effective when paired with a BAS to automatically control speeds.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed. VFDs will likely increase the service life of the equipment if properly selected and installed.
- The savings for this measure assume an average 30% reduction in equipment speed.
- If coupled with routine upgrades to include premium efficiency motors additional energy savings may be achieved.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the cooling water system pumps for compatibility with a VFD and assess the usage pattern and energy consumption. Once this data is collected, select the appropriate type of VFD. Choose VFD based on compatibility with current systems, programmability, and reliability. Optimize and update chiller and pump controls sequences of operation. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 11: ECM 3 Savings and ROM Cost

Savings Summary								
ECM	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M and Water Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
VFDs on CHW and CW pumps and optimize chiller plant	114,499	0	391	51	$0	$12,595	$45,375	3.6
Overall % Reduction	**3.4%**	**0.0%**	**0.9%**	**1.1%**	**--**	**2.0%**	--	--

4.4 ECM 4 - Upgrade Pneumatic Controls to DDC

Pneumatic controls upgrades refers to the process of upgrading antiquated pneumatic control systems and components to direct digital controls (DDC) and integrating it with a centralized control system. Pneumatic controls use compressed air to operate valves and dampers and are prone to operational and maintenance issues. Upgrading these antiquated controls to DDC will enhance the overall efficiency, functionality, and manageability of HVAC system operation. This measure directly produces electricity savings by eliminating the need for a compressed air system, but also indirectly contributes additional energy savings by enabling better control and functionality such as scheduling and optimization. The LEC has many different vintages of equipment, all with varying levels of deferred maintenance issues. This measure is recommended to be paired with an upgrade to the overall HVAC system to optimize the energy consumption of the existing systems.



Image 4: Pneumatic controls for air damper system

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- Upgrading pneumatic controls to DDC will improve existing control functionality.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed and improved.
- Energy savings assume significant increase in building efficiency through controls optimization measures, as well as the removal of the compressed air system and approximately 4 hours of daily operation to maintain system pressure.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.
- Implementation costs assume $3/sqft to install controllers, networking, actuation, and to provide required programming. This cost can vary greatly between implementation strategies and should be investigated further if implementation is considered.

Next Steps: Identify equipment to be connected to the central control system and engage a building controls integration company to plan and price the system integration. Coordinate with planned capital upgrades and renovations where possible to optimize benefits. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 12: ECM 4 Savings and ROM Cost

Savings Summary								
ECM	**Electric Savings (kWh)**	**Steam Savings (klbs)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M and Water Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
Pneumatic Controls Upgrade	233,291	1,155	2,176	241	$13,520	$37,216	$539,660	10.6
Overall % Reduction	**6.8%**	**4.6%**	**5.2%**	**5.3%**	**--**	**5.9%**	--	--

4.5 ECM 5 – Replace Water Cooled Refrigeration Units

There are two walk-in refrigerators/freezers that have conditioning units which use metered domestic cold water as the medium for removing heat. Once heat is added to the water, it is sent to the sewer to be removed from the building. While not inefficient in terms of energy, these systems use significant amounts of water which increase operating costs for both water and sewer charges. Replacing the water-cooled condenser systems with modern air-cooled condensers will reduce water consumption, while also slightly reducing energy consumption due to improvements in cooling system efficiency.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Water savings assume $0.021/gallon
- Energy savings are calculated based on an assumed increase in system COP, which overcomes the added energy to run an outdoor unit fan.
- Implementation costs assume demolition and patching of existing domestic water system.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Engage a design/build contractor to identify cost-effective implementation strategy. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 13: ECM 5 Savings and ROM Cost

Savings Summary								
ECM	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M and Water Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Retrofit water-cooled walk-ins with air-cooled systems.	5,505	0	19	2	$56,133	$606	$210,600	3.7
Overall % Reduction	**0.2%**	**0.0%**	**0.0%**	**0.1%**	**--**	**0.1%**	**--**	**--**

4.6 ECM 6 – Replace Water Cooled AC Units with Split Systems

There are two air conditioning units in the basement of the building serving the gym control booth which use metered domestic cold water as the condensing medium for removing heat. Once heat is added to the water, it is sent to the sewer to be removed from the building. While not inefficient in terms of energy, these system use significant amounts of water which increase operating costs for both water and sewer charges. Replacing the water cooled condenser systems with modern air cooled HVAC split systems will reduce water consumption, while also slightly reducing energy consumption due to improvements in cooling system efficiency.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Water savings assumes $0.021/gallon

- Energy savings are calculated based on an assumed increase in system COP, which overcomes the added energy to run an outdoor unit fan.
- Implementation costs assume demolition and patching of existing domestic water system.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Engage a design/build contractor to identify cost-effective implementation strategy. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 14: ECM 6 Savings and ROM Cost

Savings Summary								
ECM	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M and Water Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Retrofit AC in the GYM control booth with a split AC unit.	1,835	0	6	1	$18,711	$202	$77,440	4.1
Overall % Reduction	**0.1%**	**0.0%**	**0.0%**	**0.0%**	**--**	**0.0%**	**--**	**--**

4.7 ECM 7 – Install Motion Sensors in Offices

During the site audit, it was observed that lighting was left on in many unoccupied offices. This measure suggests adding lighting control through motion sensors in spaces that are not regularly occupied. Motion or occupancy sensors detect activity in spaces and automatically turn lighting on when needed. If no activity is detected, the sensors shut off the lighting to save energy. These controls can be easily integrated into the current lighting control circuits or fixtures.

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- Interior lights are assumed to operate an average of 14 hours per day 365 days per year, and the existing interior lighting power density is estimated to be 0.43 W/ft².
- Implementation is assumed to be one sensor per 500 square feet of office area. Office area is assumed to be 15% of the total building square footage.
- There will be no impact on the lighting equipment useful life.
- The savings for this measure assume a 50% reduction in lighting hours of operation.
- Implementation costs assume $250/zone for sensor installation.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the lighting system and determine the most cost-effective sensor locations for each zone. Install sensors in place of existing wall switches, or in ceiling panels with wiring connected to the lighting control circuit. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 15: ECM 7 Savings and ROM Cost

Savings Summary								
ECM	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M and Water Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Lighting Occupancy Sensors in Office Areas	44,162	0	151	20	$0	$4,858	$20,098	4.1
Overall % Reduction	**1.3%**	**0.0%**	**0.4%**	**0.4%**	**--**	**0.8%**	**--**	**--**

4.8 ECM 8 – Install LED Lighting on Interior Fixtures

This measure proposes upgrading all remaining fluorescent lighting to LED lightbulbs to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements. The Law Enforcement Complex is estimated to be approximately 40% fluorescent and 60% LED.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Estimated fluorescent fixture count of 1,280 based on extrapolation from site assessment and drawing review.
- Interior lights are assumed to operate an average of 14 hours per day 365 days per year, and the existing interior lighting power density is estimated to be 0.43 W/ft².
- This measure assumes lighting savings of approximately 0.16 W/ft² or approximately 35% reduction in interior lighting power.
- O&M savings assume an average cost of $4.29/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Conduct lighting assessment and determine actual fixture count for upgrade. The savings for this measure may be considerably higher if actual fluorescent fixture count is significantly higher than the estimate. Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 16: ECM 8 Savings and ROM Cost

Savings Summary								
ECM	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M and Water Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Replace fluorescent fixtures with LEDs	220,653	0	753	98	$5,494	$24,272	$192,000	6.5
Overall % Reduction	**6.5%**	**0.0%**	**1.8%**	**2.2%**	**--**	**3.9%**	**--**	**--**

4.9 ECM 9 – Install LED Lighting on Exterior Fixtures

This measure proposes upgrading all exterior lighting fixtures to LED lightbulbs with photocells to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements. High pressure sodium wallpacks were observed along the exterior of roofline and several were observed on during daylight hours.



Image 5: Exterior HPS lighting fixture on during day hours

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED exterior lighting will allow for greater control through daylight sensing.
- Assumes existing fixtures operate an average of 18 hours per day 365 days per year and new fixtures will operate an average of 12 hours per day 365 days per year.
- This measure assumes 16 fixtures are being retrofit, with a replacement wattage of 40W (100W HPS currently installed).
- Project cost assumes $500/fixture for material and labor.

- O&M savings assume an average cost of $21.46/lamp, which assumes a lamp life that is 70% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Confirm actual fixture counts, replacement selection, and implementation. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 17: ECM 9 Savings and ROM Cost

Savings Summary								
ECM	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M and Water Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Retrofit HPS wall packs on roof with LEDs	21,024	0	72	9	$0	$2,313	$9,600	3.6
Overall % Reduction	**0.6%**	**0.0%**	**0.2%**	**0.2%**	**--**	**0.4%**	**--**	**--**

4.10 ECM 10 – Install VFDs and Demand Control on Exhaust Fans

Multiple exhaust fans are present on the roof of the facility that are set to run continuously at constant speed. The demand for exhausting air in the occupied spaces is variable, and depends on usage of equipment that requires make-up air to ventilate spaces. For each exhaust system, demand based controls paired with Variable Frequency Drives (VFDs) can reduce the total air being exhausted from the building, which directly reduces the total air that requires heating and cooling in the building. Energy savings are calculated from an assumed usage schedule of equipment, such as the kitchen exhaust fan, which can be turned OFF if no cooking is being performed below. VFD control provides a dynamic and energy-efficient solution by allowing precise control of fan speed, optimizing performance, and reducing unnecessary energy consumption during periods of lower demand.



Image 6: Sample of Roof Exhaust Fans

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety, and should improve occupant thermal comfort.
- VFDs will be most effective when paired with a BAS to automatically control speeds.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed. VFDs will likely increase the service life of the equipment if properly selected and installed.
- Assumes 10 total exhaust fans with an average of 1HP motor each.
- Exhaust fans currently run 24/7 at constant speed.
- The savings for this measure assume an average 25% reduction in equipment speed.
- Implementation costs assume $2,500 to install VFD and configure controls.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the building exhaust systems and specify the specific equipment and control methodologies required to implement variable speed controls. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 18: ECM 10 Savings and ROM Cost

Savings Summary								
ECM	**Electric Savings (kWh)**	**Steam Savings (klbs)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M and Water Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
Upgrade Exhaust Fans with VFDs	29,845	191	330	36	$0	$5,193	$25,000	4.8
Overall % Reduction	**0.9%**	**0.9%**	**0.8%**	**0.8%**	**--**	**0.8%**	**--**	**--**

5 Measures Requiring Additional Consideration

This section provides details on measures that were analyzed but are not recommended for immediate implementation at this time. This includes measures that require further study, such as capital-intensive replacements of existing equipment, but are not justified through energy savings alone. This section may also include measures that conflict with building electrification plans, or projects that are simply not recommended due to being financially impractical or not being technically feasible.

Table 19: Proposed Energy Savings Summary

ECM #	Energy Conservation Measure Description	Year -1 Electricity Savings	Year -1 Gas Savings	District Steam Savings	O&M and Water Savings	Year - 1 Cost Savings	Project Cost (Est)	Simple Payback Period
No	Description	kWh/yr	MCF/yr	klbs/y	$	$/yr	$	Years
ECM 11	Install energy recovery wheels between the common area exhaust fans and all AHUs.	133,438	0	1,420	0	$28,882	$1,234,200	42.7
ECM 12	Convert dual duct air distribution systems to single duct.	330,903	0	4,806	0	$84,456	$2,397,918	28.4
ECM 13	Install sewage waste heat recovery with storage tanks to produce heating and domestic hot water. Existing Muffin industrial grinders can be utilized in the wastewater heat recovery process.	-188,353	0	2,018	0	-$535	$7,018	-13.1
ECM 14	Add insulation to the roof.	151,202	0	1,571	0	$32,345	$1,071,912	33.1

Project Descriptions:

- ECM 11 – Install Energy Recovery Wheels: The savings generated from this project did not justify the implementation costs. Additional investigation could be considered for specific systems but is not recommended at this time.
- ECM 12 – Convert dual duct to single duct HVAC: The savings generated from this project did not justify the implementation costs. Additional investigation could be considered for specific systems but is not recommended at this time.
- ECM 13 – Sewage Heat Recovery: The waste heat resource of the nearby sewer did not support the volume of heat needed and required redundant systems to be installed to supplement the heating system. High costs make this project not feasible.
- ECM 14 Roof Insulation: The savings generated from this project did not justify the implementation costs. Additional investigation could be considered for specific systems but is not recommended at this time. If the roofing is being replaced, additional insulation can be installed at that time with a much more economical payback.

6 Appendix A

Table 20: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Steam Consumption (klbs)	Steam Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	0.1	$1.0	-		132,401	$14,564	178	236	1,051	0
Feb-23	0.2	$1.0	-		132,401	$14,564	197	246	955	0
Mar-23	0.2	$1.0	-		200,823	$22,091	270	432	918	0
Apr-23	0.2	$1.0	-		204,621	$22,508	284	464	525	28
May-23	0.3	$1.0	-		285,297	$31,383	383	628	283	76
Jun-23	0.3	$1.0	-		280,883	$30,897	390	611	86	139
Jul-23	1.3	$5.0	-		343,711	$37,808	462	640	11	227
Aug-23	0.4	$1.0	-		371,702	$40,887	500	739	48	141
Sep-23	0.3	$1.0	-		286,378	$31,502	398	647	113	85
Oct-23	0.3	$1.0	-		259,548	$28,550	349	557	415	31
Nov-23	0.1	$1.0	-		577,050	$63,476	801	1,348	779	0
Dec-23	0.5	$3.0	-		804,145	$88,456	1,081	1,370	834	0
Jan-24	0.4	$2.0	3,478	$34,778	220,612	$24,267	297	393	1,194	0
Feb-24	0.3	$2.0	3,017	$30,174	189,069	$20,798	281	351	874	1
Mar-24	0.4	$2.0	3,039	$30,394	435,755	$47,933	586	937	771	2
Apr-24	0.3	$1.0	2,258	$22,580	177,102	$19,481	398	650	437	21
May-24	0.3	$1.0	1,607	$16,074	286,778	$31,546	385	631	148	98
Jun-24	0.0	$0.0	1,467	$14,673	306,656	$33,732	426	667	51	207
Jul-24	0.1	$0.0	1,167	$11,674	368,193	$40,501	495	685	18	251
Aug-24	0.1	$0.0	869	$8,686	293,635	$32,300	395	584	37	215
Sep-24	0.2	$0.0	1,131	$11,314	384,772	$42,325	534	870	84	112
Oct-24	0.3	$1.0	1,739	$17,392	278,221	$30,604	374	597	356	31
Nov-24	0.2	$1.0	2,190	$21,901	219,327	$24,126	305	512	607	4
Dec-24	0.3	$1.0	3,236	$32,356	248,785	$27,366	334	424	1,037	0
2023 Sum	4	$18.0	0	$0	3,878,960	$426,686			6,019	727
2024 Sum	3	$11.0	25,200	$251,996	3,408,905	$374,980			5,614	942

7 Appendix B

Table 21: Building Equipment List

Unit Tag	No of Units	Unit Name	Location	Unit Serves	Make	Model	Capacity	Units
RTU-1	1	Roof Top Unit	Main building roof	I Block	York	XTO-048X075-CAJA046A	4	TON
RTU-2	1	Roof Top Unit	Main building roof	I Block	York	XTO-048X075-CAJA046A	4	TON
RTU-3	1	Roof Top Unit	Main building roof	2nd fl Main	York	XTO-048X075-CAJA046A	4	TON
RTU-4	1	Roof Top Unit	Main building roof	2nd fl Main	York	XTO-048X075-CAJA046A	4	TON
RTU-5	1	Roof Top Unit	Main building roof	2nd fl Main	York	XTO-048X075-CAJA046A	4	TON
RTU-6	1	Roof Top Unit	Main building roof	2nd fl Main	York	XTO-048X075-CAJA046A	4	TON
RTU-7	1	Roof Top Unit	Main building roof	2nd fl Main	York	XTO-048X075-CAJA046A	4	TON
RTU-8	1	Roof Top Unit	Main building roof	2nd fl Main	York	XTO-048X075-CAJA046A	4	TON
RTU-9	1	Roof Top Unit	Main building roof	2nd fl Main	York	XTO-048X075-CAJA046A	4	TON
RTU-10	1	Roof Top Unit	Main building roof	2nd fl Main	York	XTO-048X075-CAJA046A	4	TON
RTU-11	1	Roof Top Unit	Main building roof	2nd fl Main	York	XTO-048X075-CAJA046A	4	TON
RTU-12	1	Roof Top Unit	Main building roof	2nd fl Main	York	XTO-048X075-CAJA046A	4	TON
AC-2	1	Air Handling Unit	MER	1st Fl				
AC-3	1	Air Handling Unit	MER	1st Fl				
AC-4	1	Air Handling Unit	MER	1st Fl		CS74MFCMP D		
AC-5	1	Air Handling Unit	MER	1st Fl NW Offices				
AC-6	1	Air Handling Unit	MER	Gun Range				
AC-7	1	Air Handling Unit	MER	Lobby				
AC-8	1	Air Handling Unit	MER	1st Fl				
AC-101	1	Air Handling Unit	Garage MER	Basement				
HV-5	1	Heated Vent	MER	Praying Room	York			
HV-9	1	Heated Vent	MER	Uniform Room	York			
K-AHU-1	1	Air Handling Unit	MER		Trane	MCCB014UA0C0UA		

Unit Tag	No of Units	Unit Name	Location	Unit Serves	Make	Model	Capacity	Units
AHU-14	1	Air Handling Unit	MER	Commissary	Greenheck	VFC-2400-20		
Annex AHU-1	1	Air Handling Unit	MER	1st fl West Cells and Mezz				
Annex AHU-2	1	Air Handling Unit	MER	1st fl North Cells and Mezz				
Annex AHU-3	1	Air Handling Unit	MER	Annex 2nd fl Mezz				
Annex AHU-4	1	Air Handling Unit	MER	Annex 2nd fl				
Annex AHU-5	1	Air Handling Unit	MER					
Annex AHU-6	1	Air Handling Unit	MER					
REF-1		Exhaust Fan	MER					
FCU	1	Fan Coil Unit	Kitchen	Kitchen		ME08BN21C		
CU-1	1	Condenser Unit	1st fl MER	IT Rooms	Arcoaire	N2A318AKA200	2.00	TON
CU-2	1	Condenser Unit	1st fl MER	IT Rooms	Mitsibushi	MUY-GE24NA	2.00	TON
CU-3	1	Condenser Unit	1st fl MER	IT Rooms				
CU-4	1	Condenser Unit	Garage		Carrier	38MARBQ36AA3	3.00	TON
CU-5	1	Condenser Unit	Garage		LG	LSU240HEV2	2.00	TON
UH-1	1	Unit Heater	N/A	N/A	N/A	N/A	N/A	N/A
UH-2	1	Unit Heater	N/A	N/A	N/A	N/A	N/A	N/A
UH-3	1	Unit Heater	N/A	N/A	N/A	N/A	N/A	N/A
UH-4	1	Unit Heater	N/A	N/A	N/A	N/A	N/A	N/A
UH-5	1	Unit Heater	N/A	N/A	N/A	N/A	N/A	N/A
UH-6	1	Unit Heater	N/A	N/A	N/A	N/A	N/A	N/A
CHWP-1, 2	2	Chilled water pumps	Basement MER				25	HP
CWP	1	Condenser water pump	Basement MER				25	HP
HHWP-1,2	2	Heating Hot Water Pumps	Basement MER				15	HP
N/A	20	Zone Pumps					1	HP
EFs	10	Exhasut fans					1	HP
Chiller #1, #2	2	Chiller (water cooled)		Whole building	McQuay	WMC290DBS-ER10	290	TON

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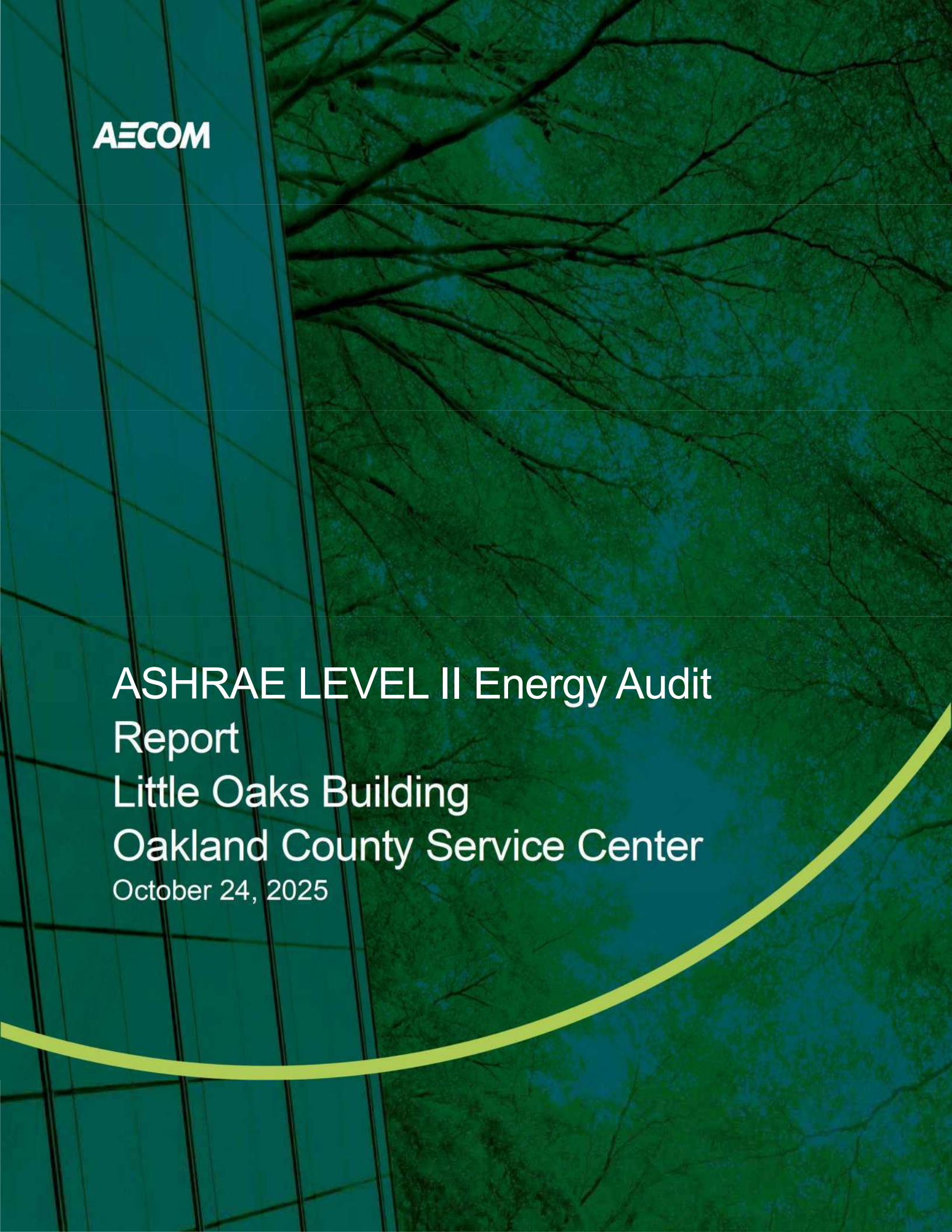

AECOM

ASHRAE LEVEL II Energy Audit Report
Little Oaks Building
Oakland County Service Center

October 24, 2025

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

Prepared for:
OAKLAND COUNTY, MI Government

Prepared by:
AECOM

Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Little Oaks Building, 30 East, in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation" or "Not Recommended" measures based on simple payback period or foreseen feasibility issues.

All identified energy reduction opportunities have been characterized in this report as ECMs regardless of scope and scale of capital investment. Additionally, AECOM recognizes that Oakland County wishes to pursue the future electrification of its facilities to the extent practical, as described in AECOM's Service Center-wide assessment report of future electrification options. The ECMs listed in this report address opportunities identified within existing conditions and existing energy infrastructure. The report's proposed ECMs may or may not be relevant to an energy infrastructure environment evolved from fossil fuel-driven energy infrastructure to fully electrically powered energy infrastructure.

The Oakland County Little Oaks Building is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Thursday June 5, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates three Energy Conservation Measures (ECMs) for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The three listed measures represent a projected 22% annual energy cost savings with an aggregate simple payback of 10.7 years. All three measures are prioritized as "Recommended" for implementation.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be "electrification-ready" to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE's prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Little Oaks Building Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	klbs/yr	MMBTU	MTCO2e	$/yr	$/yr	$	Years
1	Lighting Upgrades	LOW	R	27,550	8	0	0	94.00	12.20	$1,447	$3,030	$40,850	9.1
2	DHW Upgrades	LOW	R	3,035	0	0	0	10.36	1.34	$0	$334	$5,000	15.0
3	RCx	LOW	R	9,076	0	0	52	92.73	10.17	$0	$1,516	$11,354	7.5
Sum of Recommended Measures				39,661	8	0	52	197.08	23.71		$4,880	$52,204	10.7
Overall % Reduction				27%		0%	9.8%	16.0%	16.9%		22%	-	

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Little Oaks building is an on-site child-care facility within the Oakland County Service Center Campus. The building is 14,194 sqft, single story, and is occupied between 6am and 6pm Monday through Friday.

2.1 Building Systems

2.1.1 Building Envelope

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Brick, Vinyl Siding	Meets typical Energy Standard
Roof	Asphalt Shingle	Meets typical Energy Standard
Glazing	Double Pane	Meets typical Energy Standard

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The building's cooling is taken care of by chilled water generated by a brand new chiller which was recently installed. The chiller has a cooling capacity of 41 tons. The heating is taken care of by HHW generated by a steam to HHW heat exchanger. The heating capacity of the heat exchanger is 900000 BTUH. The HHW and CHW is fed to the AHU which has a cooling capacity of 517 MBH and a heating capacity of 697.5 MBH. The HHW is also fed to the baseboard heaters where perimeter heating is required. 12 pumps in total with a total motor input requirement of 11 HP. 2 serving primary hot water, 2 for baseboard heating, 1 pump for AHU, 1 CHWP, 1 DWHP, 2 submersible sanitary pumps, 1 domestic recirculating hot water pump and 2 pumps for site field drain.

The supply air is delivered via VAV's and perimeter heating is provided by baseboards.

There are 3 exhaust fans for the restrooms.

2.1.2.2 Plumbing

Steam to DW heat exchanger with a capacity of 300 MBH generates DHW which is stored in a tank with capacity of 42 Gallons.

2.1.2.3 Building Controls

The building is controlled by Niagara BAS.

2.1.3 Lighting Systems

All lighting fixtures are fluorescent. The fixtures include a mix of recessed, ceiling-mounted, and suspended types, depending on the area. The typical fixture wattage is approximately 32 watts for fluorescent fixtures and 12 W for LED fixtures.

Table 3: Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
Fluorescent Lights	190	2 lamp
LED CAN Lights	6	1 lamp

The total approximate quantity of light fixtures is 196. The approximate total wattage is 12,232 watts. The approximate area per drawing is 14,193 ft^2, with a lighting density of 0.861 W/ft^2.

2.1.4 Electrical Infrastructure

The main electrical service for the facility is fed from a 150 kVA transformer located outside the building. The service is rated at 208/120 volts, 3-phase, 4-wire, with a capacity of 600 amperes. The main switchboard is located in the mechanical room on the first floor. The utility meter number is 72850295, and the measured demand is 2261 × 120 kWh. There is a 50 kW generator located outside the building.

3 Utility Billing Analysis

3.1 Utility Type and Usage

Little Oaks receives electric service, is connected to the steam network, and is not connected to natural gas service. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

Direct steam meter data was not available for Little Oaks, annual steam usage was estimated using a square-foot ratio with the Central Garage.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

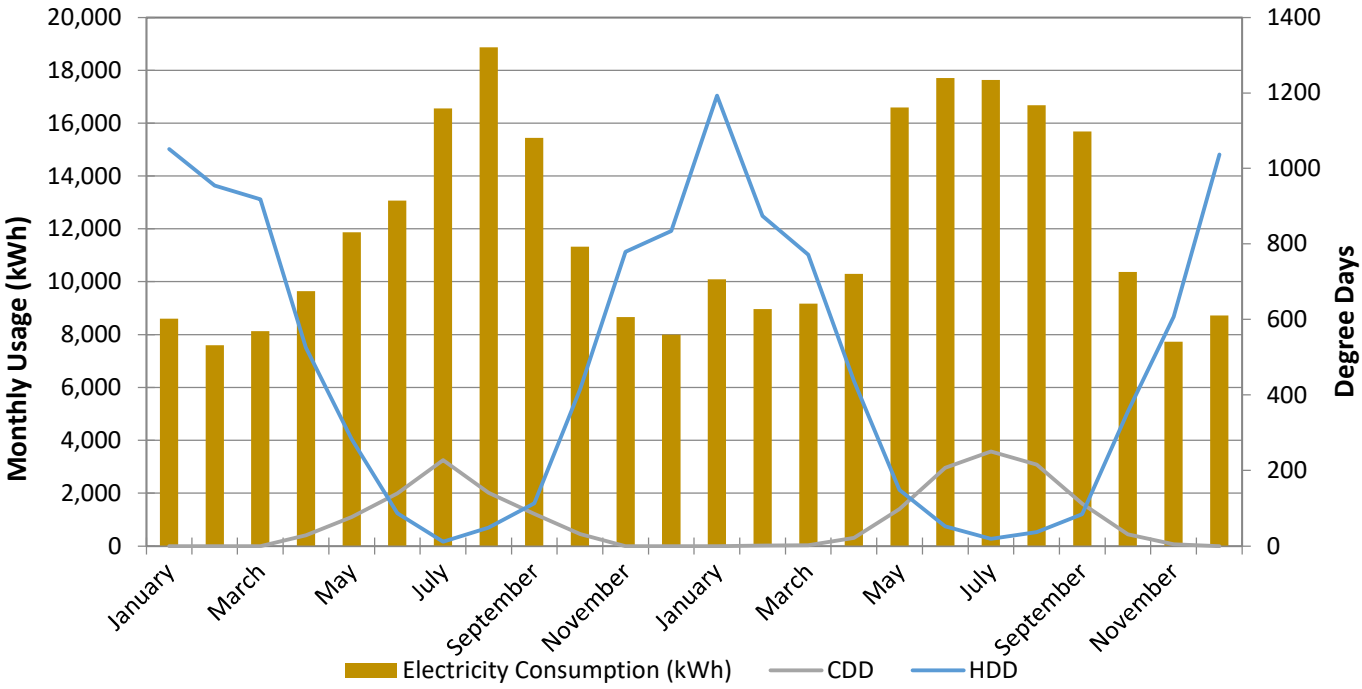
Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	149,613 kWh	510	$16,457	$0.11/kWh	0.0004427	66
Steam	528 klb	630	$5,277	$10/klb	0.1190000	63
Total	--	1,141	$21,734	--	--	129

** Steam (1 klb = 1194000 Btu); Electricity (1 kWh = 3413 Btu)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a direct correlation to weather data, specifically CDD, indicating that electricity is primarily used for space cooling. The annual usage for the baseline 12-month period from January to December 2024 is 149,613 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

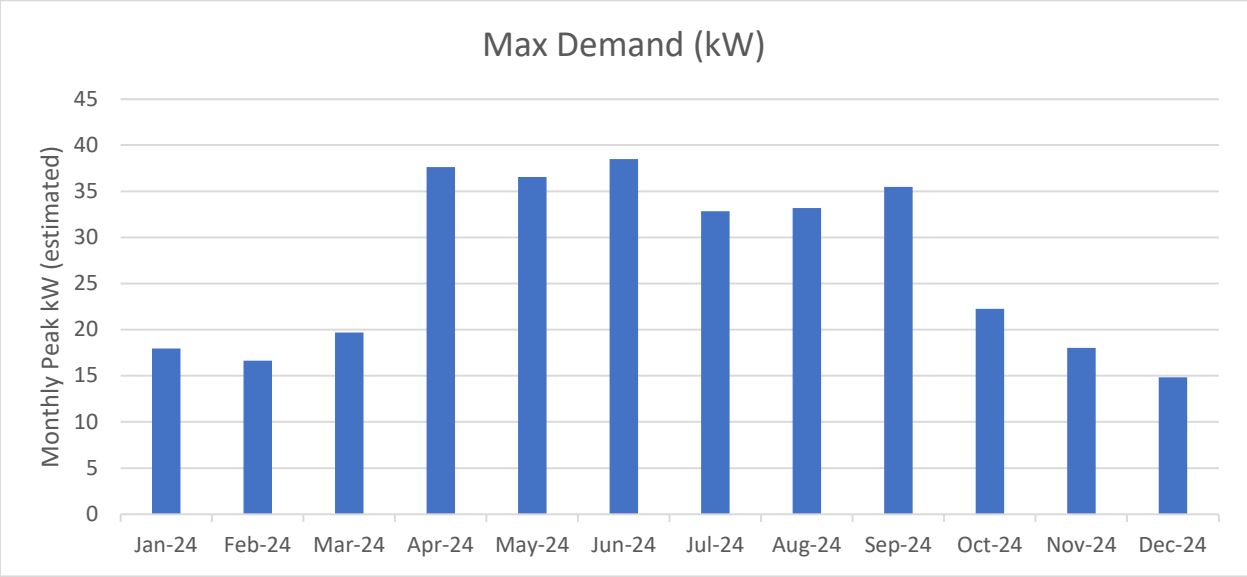
The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 5: Electrical Capacity Analysis

Maximum Building Capacity at Service Transformer	150 kW
Maximum Capacity at Switchgear (A*V*Ph)	216 kW
Estimated Peak Demand	38 kW (estimated)
Remaining Capacity	**112 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge: **$6.15/kW/Month**

Average Dollar per kWh Used in Calculations: **$0.11/kWh**

Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

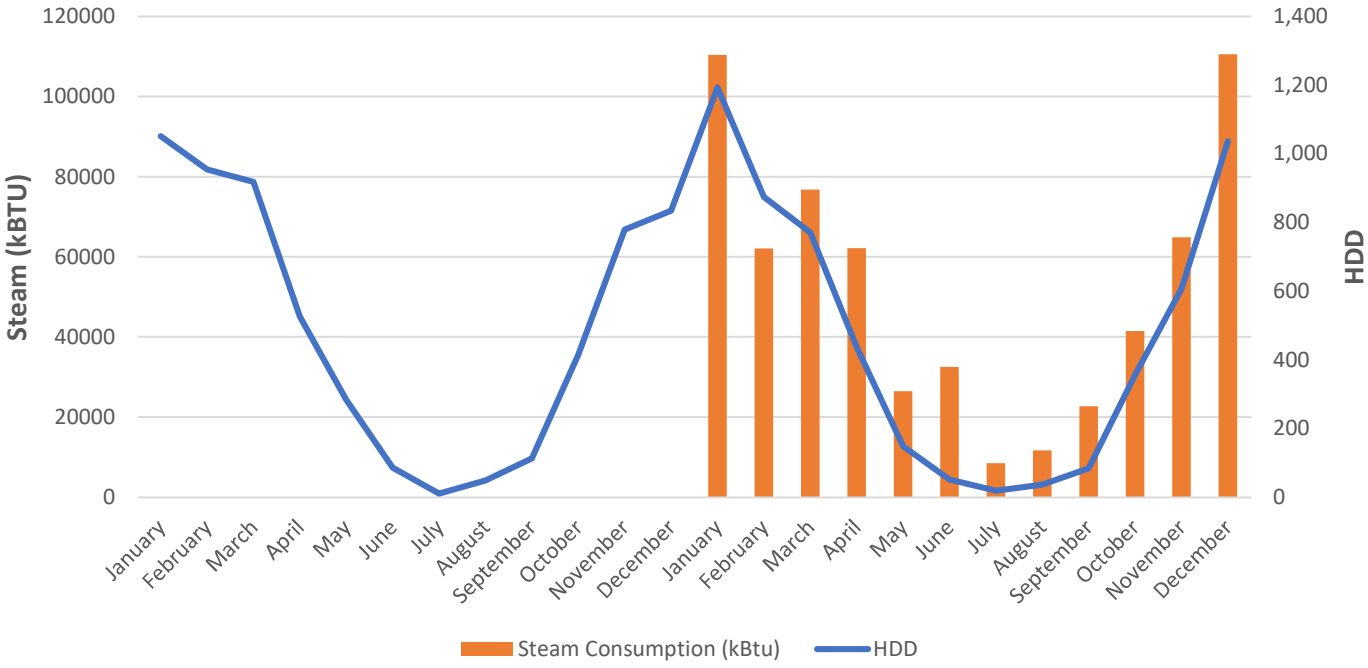
Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Steam Usage Profile

Since direct steam meter data for this building was not available, annual steam usage was estimated by extrapolating from another campus building with similar occupancy and system characteristics. A square-foot ratio method was applied, scaling steam consumption from the reference building to match this building's gross floor area.

Figure 3 compares the monthly steam usage profile for 2024 with local monthly weather data for 2023 – 2024 indicated by HDD. Steam data for 2023 is not available. Steam usage shows a direct correlation to weather data, as steam is primarily used for space heating. The annual usage for the baseline 12-month period from January to December 2024 is 528 klbs. Detailed monthly steam usage and costs are in Appendix A.

Figure 3: Steam Usage Profile (January 2023 to December 2024)



3.4.1 Steam Rate Structure

Unlike electricity and natural gas, which are billed directly by external utilities, steam is an internal utility produced on campus. The cost allocation for steam is derived from the total natural gas cost at the central steam plant, as well as costs to operate the plant. Each steam-served building is billed proportionally based on its metered steam usage relative to the campus total. As a result, there are no separate delivery, demand, or third-party charges; the unit cost of steam reflects the cost of natural gas, plant operating cost and efficiency, and distribution system performance.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings.

Average Dollar per klb Used in Calculations: $10.00/thousand lbs

3.5 Energy Cost Index

The energy cost analysis is based on the information provided by an annual purchase request statement for 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$16,457
Steam	$5,277
Total	$21,734
ECI $/yr/sf	$1.53

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4. Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

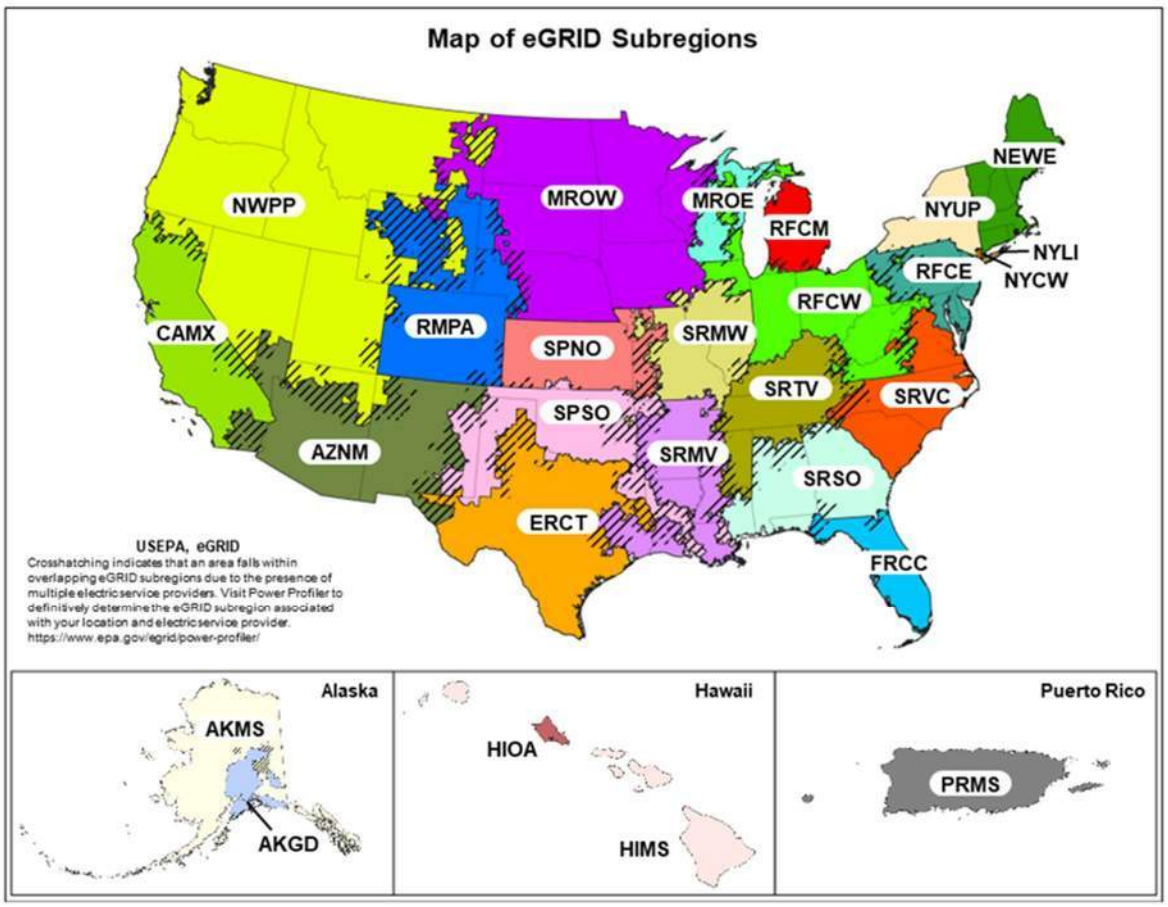
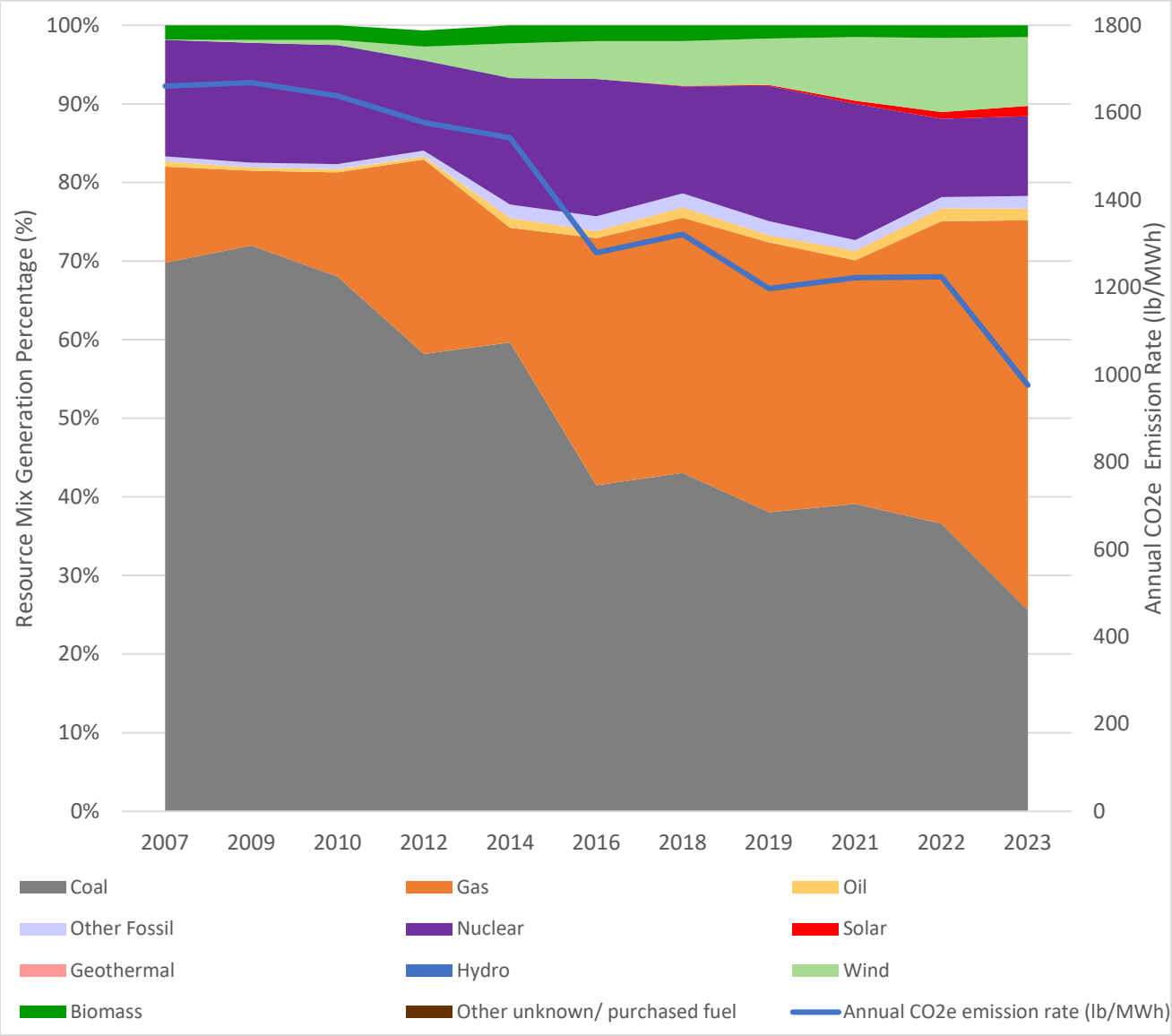


Figure 5 displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 55 percent of carbon emissions are attributed to steam and

45 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 63 tCO2e (campus-level Scope 1) and 66 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 129 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and steam usage for Little Oaks are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Little Oaks Building					**Electric EUI:**	36	kBTU/SF/yr
GFA:	14,193	SF				**Steam EUI:**	44	kBTU/SF/yr
eGRID Subregion:	RFCM					**Current EUI**	80	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	149,613	kWh	3.412	510	0.0004427	66	$16,457	76%
Steam	528	klbs	1194	630	0.1190000	63	$5,277	24%
		Totals		1,141		**129**	$21,735	100%

According to the US EPA, the average site energy use intensity for a pre-school/daycare is 64.8 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 80 kBTU/SF, which is higher than the national benchmark. There are opportunities to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

U.S. National Median Reference Values for All Portfolio Manager Property Types

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Banking/Financial Services	Bank Branch *		209.9	88.3	CBECS - Bank/Financial
	Financial Office*		116.4	52.9	CBECS - Office & Bank/Financial
Education	Adult Education		110.4	52.4	CBECS - Education
	College/University		180.6	84.3	CBECS - College/University
	K-12 School*		104.4	48.5	CBECS - Elementary/Middle & High School
	Pre-school/Daycare		131.5	64.8	CBECS - Preschool
	Vocational School		110.4	52.4	CBECS - Education
	Other - Education				
Entertainment/Public Assembly	Convention Center		109.6	56.1	CBECS - Social/Meeting
	Movie Theater		112.0	56.2	CBECS - Public Assembly
	Museum				
	Performing Arts				
	Recreation	Bowling Alley	112.0	50.8	CBECS - Recreation
		Fitness Center/Health Club/Gym			
		Ice/Curling Rink			
		Roller Rink			
		Swimming Pool			
		Other - Recreation			
	Social/Meeting Hall		109.6	56.1	CBECS - Social/Meeting

3.8 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of occupants. Table 8 and Figure 6 and Figure 7 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	0	514	613,934	43.3	0.0
Space Cooling	33,082	0	0	112,875	8.0	19.3
Fans	38,354	0	0	130,865	9.2	22.3
Pumps	19,326	0	0	65,941	4.6	11.2
SHW/DHW	4,721	0	14	32,280	2.3	2.7
Conveyance	0	0	0	0	0.0	0.0
Lighting	37,577	0	0	128,212	9.0	21.9
Plug Loads	8,219	0	0	28,045	2.0	4.8
Process Loads	8,333	0	0	28,434	2.0	4.9
Refrigeration	0	0	0	0	0.0	0.0
Cooking	0	0	0	0	0.0	0.0
Information Technology	0	0	0	0	0.0	0.0
TOTAL	149,613	0	528	0	0.0	**0.0**
Historical Billing	**149,613**	**0**	**528**			
Percent of Actual	100%	0%	100%			
per sqft	**10.54**	**0.00**	**0.04**			

Figure 7: Existing Electricity End Use Distribution

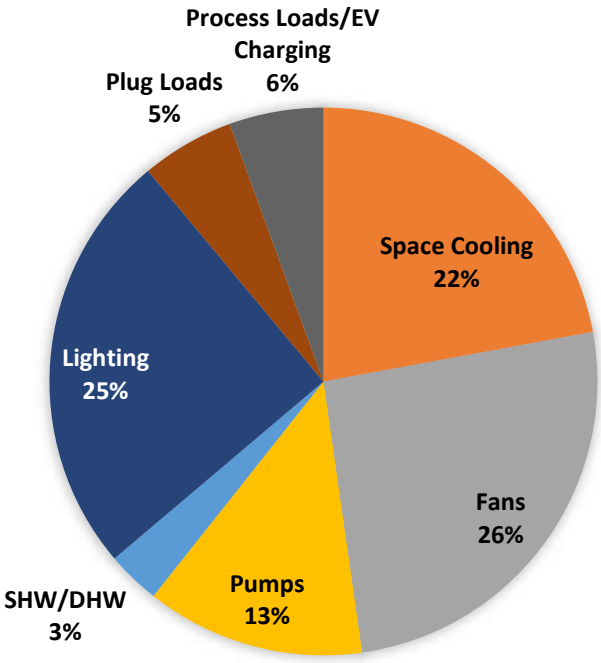
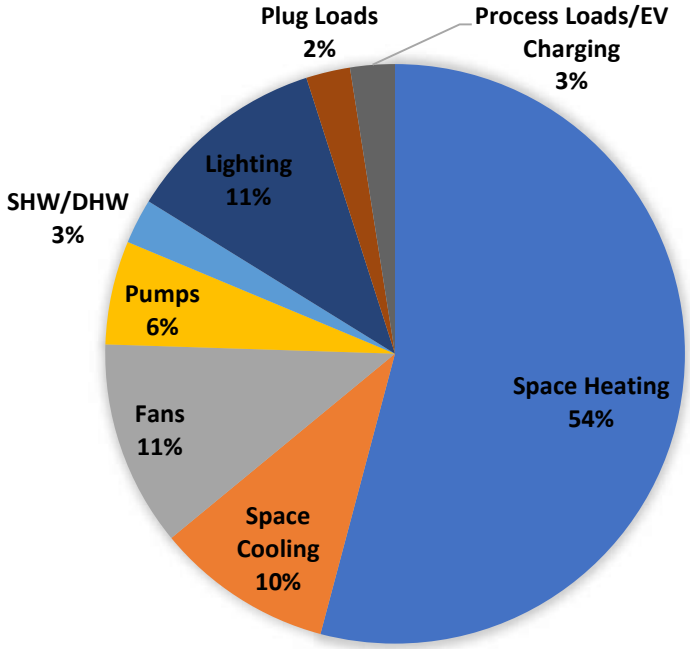


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – LED Lighting

This measure proposes upgrading all remaining fluorescent lighting to Light-emitting diode (LED) lightbulbs with motion sensors and dimming functionality where appropriate to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements. Incorporating lighting controls allows for better management and customization of lighting systems, leading to reduced energy consumption, and increased overall efficiency by limiting the time lighting is on to only when necessary. For indoor lighting, lighting controls consist of occupancy, daylighting, timers, scheduling, and dimming features to optimize light levels based on external lighting availability and usage of a space. For outdoor lighting, the lighting controls consist of motion sensors, photocells, and timers to turn the lighting ON/OFF. The current lighting in Little Oaks is approximately 3% LED and 97% fluorescent and the estimated wattage is approximately 0.86 W/ft^2. See Section 2.1.3 for the lighting counts used to estimate energy consumption.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.



Figure 9: Example Fixture with Integrated Occupancy Controls

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Lights are assumed to be on 12 hours per day for 256 days of the year.
- This measure assumes lighting savings of approximately 0.54 W/ft².
- LED upgrades cost $215/fixture, which include integrated control sensors and no additional wiring and control circuits. Low-cost fixtures and external controls can be used as an alternative to this implementation method. This measure assumes all fluorescent lamps are converted to LEDs, estimated at 190 total fixtures.
- O&M savings assume an average cost of $3.81/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, the subsequent steps would involve conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. Following this assessment, a controls contractor can be engaged to install the lighting controls and assist building engineers in configuring the schedule to optimize lighting usage. Provided below are the rebate opportunities for LED lighting upgrades and lighting controls from DTE. This measure is recommended for implementation.

ECM Savings and ROM Cost:

	Savings Summary							
ECM	Steam Savings (klbs)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost ($)	Simple Payback (Yrs)
LED Upgrade	0	27,550	94	12	$1,447	$3,030	$40,850	9.1
Overall % Reduction	**0%**	**17%**	**8%**	**9%**		**12%**	**--**	**--**

4.2 ECM 2 – Domestic Hot Water Upgrades

Domestic hot water systems provide heated water for uses such as handwashing, cleaning, showering, cooking, and laundry. This can represent a significant portion of a building's overall energy usage. Maintaining proper water temperature and control is not only critical for energy efficiency but also for health and safety – temperatures must be 140F to prevent bacteria growth such as Legionella, yet low enough to prevent scalding and prevent excessive energy use. This measure proposes replacing the existing Rheem 42-gallon electric resistance storage water heater with a high-efficiency air source heat pump (ASHP) water heater. Heat pump water heaters use electricity to transfer heat from the surrounding air into the water tank, rather than generating heat directly through resistance. With a coefficient of performance (COP) of 2.8, the ASHP water heater can provide the same hot water output while using significantly less electricity.

In addition to reducing energy costs, the ASHP water heater aligns with facility goals to improve building system performance, reduce operating costs, and lower greenhouse gas emissions.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Domestic hot water use assumed 1.5 gallons hot water/person per occupied day, 80% water heater efficiency, and 10,000 BTU/day standby losses.
- The ASHP water heater calculation assumes a COP of 2.8.
- A unit cost of $5,000 per 80-gallon water heater was used to estimate costs.
- This measure does not support electrification readiness as the existing domestic hot water heater is already electric.
- There are no O&M savings associated with this measure.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Perform a site survey to confirm the number of heaters needed and requirements, then install new instantaneous electric water heaters under each bathroom and break room sink. Next, disable and drain existing DHW heater and remove or cap off existing DHW piping to accommodate the new heaters. The existing system may be retained as backup if desired.

Provide electrical work as needed according to product size and voltage. This measure is recommended for implementation with further study.

ECM Savings and ROM Cost:

	Savings Summary							
ECM	Steam Savings (klbs)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost ($)	Simple Payback (Yrs)
DHW Upgrade	0	3,035	10	1	$0	$334	$5,000	15
Overall % Reduction	0.0%	2.0%	0.9%	1.0%		1.9%		

4.3 ECM 3 – Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems such as HVAC, lighting, controls, and other energy-consuming equipment to improve operational efficiency and restore systems to their original design intent.

Observations from the site visit and high-level review of the Limbach BAS system indicate that not all systems are operating optimally or consistently communicating with the BAS. Specific opportunities for this facility include:

- Confirm proper scheduling of the chiller to avoid unnecessary off-hour operation.
- Review HHW distribution to AHU and baseboard heating loops for opportunities to optimize setpoints and minimize simultaneous heating and cooling.
- Calibrate sensors, actuators, and flow meters to ensure accurate control of HHW and CHW distribution, particularly for the 12 total pumps.
- Optimize supply air delivery through VAV boxes and verify perimeter baseboard heating controls.
- Evaluate exhaust fan scheduling and operation.

While each of these individual examples are minor concerns, these illustrate an opportunity to systematically evaluate all major systems to identify and resolve similar operational discrepancies to optimize system performance and reduce energy usage. The following list represents RCx opportunities that should be evaluated to validate operation, modify and/or repair if discrepancies identified if systems not scheduled for timely replacement. This effort will proactively improve building system operation and optimize energy usage.

RCx Opportunities to Evaluate

- Optimize HVAC scheduling and occupied/unoccupied setpoints.
- Eliminate simultaneous heating and cooling through BAS control adjustments.
- Test, adjust, and balance airside systems.
- Restore equipment to automatic control.
- Replace or calibrate faulty sensors, actuators, and/or flow meters.
- Repair or replace malfunctioning steam traps (if any identified in HHW or DHW systems).
- Hot water and chilled water supply temperature reset.

- Discharge air temperature reset.
- Outside air temperature lockouts and damper control.
- Duct static pressure reset and economizer repair.
- Demand-controlled ventilation (if compatible with BAS and occupancy).
- Seal AHU air leaks and repair/replace missing insulation on HHW piping.
- Upgrade pneumatic controls (if any remain) to DDC and integrate with BAS.

Assumptions

- Implementation of this measure will not adversely affect occupant health or safety.
- RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 10% reduction in estimated heating and cooling end use energy consumption.
- Project cost is estimated at $0.80 per square foot of building area, which assumes that this building will be bundled together with other buildings to take advantage of bulk pricing.
- This measure supports electrification readiness indirectly by ensuring electric systems are optimized and operating efficiently.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Identify remaining equipment to be connected to the central control system and engage a building controls integration company to plan and cost the system integration. Coordinate with planned capital upgrades and renovations where possible to optimize benefits. This measure is recommended for implementation.

ECM Savings and ROM Cost

	Savings Summary							
ECM	**Steam Savings (klbs)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost ($)**	**Simple Payback (Yrs)**
RCx	52	9,076	93	10	$0	$1,516	$11,354	7.5
Overall % Reduction	9.8%	6.1%	8.1%	7.9%		6.9%		

5 Considered But Not Currently Recommended

No additional ECMs have been considered.

6 Appendix A

Table 9: Monthly Utility Data (2023 to 2024)

Month	Steam Consumption (klbs)	Steam Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	-	$4,694	8,602	$923	12	15	1,051	0
Feb-23	-	$4,765	7,600	$716	12	14	955	0
Mar-23	-	$2,369	8,127	$729	11	17	918	0
Apr-23	-	$1,811	9,636	$848	11	22	525	28
May-23	-	$1,208	11,864	$936	13	26	283	76
Jun-23	-	$582	13,073	$979	16	28	86	139
Jul-23	-	$870	16,552	$1,340	18	31	11	227
Aug-23	-	$624	18,875	$1,500	22	38	48	141
Sep-23	-	$708	15,442	$1,421	25	35	113	85
Oct-23	-	$1,209	11,321	$921	21	24	415	31
Nov-23	-	$2,829	8,656	$665	15	20	779	0
Dec-23	-	$2,979	7,995	$568	12	14	834	0
Jan-24	92	$3,857	10,091	$233	11	18	1,194	0
Feb-24	52	$3,706	8,959	$916	14	17	874	1
Mar-24	64	$3,412	9,165	$739	13	20	771	2
Apr-24	52	$784	10,291	$1,061	12	38	437	21
May-24	22	$480	16,595	$1,441	23	37	148	98
Jun-24	27	$453	17,701	$1,626	22	38	51	207
Jul-24	7	$375	17,636	$1,571	25	33	18	251
Aug-24	10	$238	16,681	$1,534	24	33	37	215
Sep-24	19	$642	15,688	$1,258	22	35	84	112
Oct-24	35	$747	10,363	$984	22	22	356	31
Nov-24	54	$1,341	7,726	$833	14	18	607	4
Dec-24	93	$1,889	8,717	$733	11	15	1,037	0
2023 Sum	62,123	24,648	137,743	$11,546			6,019	727
2024 Sum	51,067	17,924	149,613	$12,929			5,614	942

**Steam costs estimated using $10/klb*
***Steam consumption estimated using square footage ratio to the Central Garage*

7 Appendix B

Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Capacity 2	Approx Year Installed	Condition
AHU-1	1	Air handling units (HHW, CHW)			39T6WB4E–REJHU–AB	697.5 MBH (Heating)	517 MBH (Cooling)		
CH-1	1	Chiller		York		41 TON			
HX-1	1	Steam to HHW heat exchanger				900 MBH			
BB-1	1	Baseboard heaters							
	12	Pumps	2 serving primary hot water, 2 for baseboard heating, 1 pump for AHU, 1 CHWP, 1 DWHP, 2 submersible sanitary pumps, 1 domestic recirculating hot water pump and 2 pumps for site field drain.			11 HP			
EF-1	3	Exhaust fan				2 HP	1.5 TON		
	1	DHW		Lochinvar	RJS120	119 Gal			
	1	Air compressor			3JR82A	2 HP			
AHU-1	1	Electric water heater		Rheem	XE30S06ST45U0	42 Gal	30 Gal		

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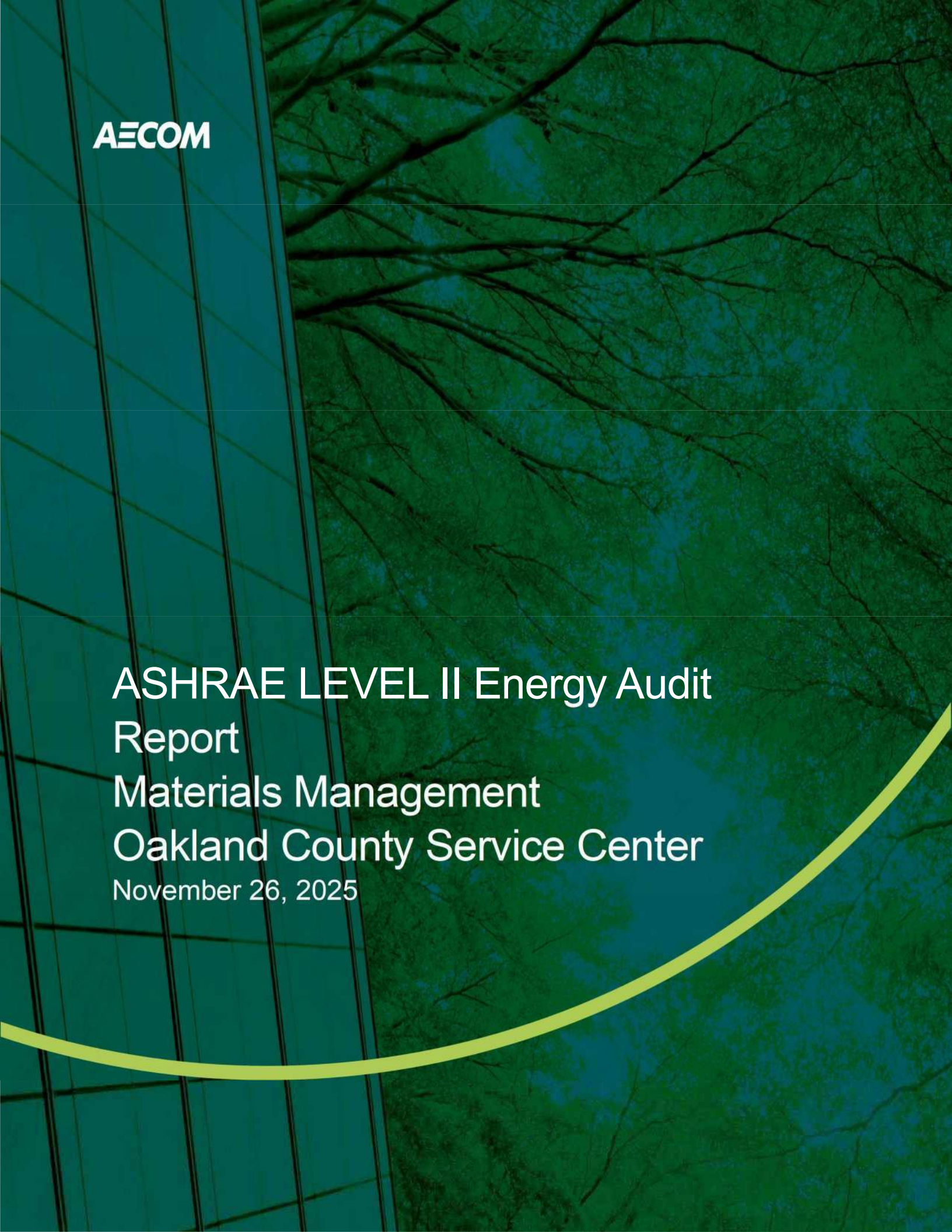

AECOM

ASHRAE LEVEL II Energy Audit Report
Materials Management
Oakland County Service Center

November 26, 2025

Quality information

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Prepared by:
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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Materials Management Building in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Materials Management Building is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Tuesday April 8, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates four ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The two recommended measures represent a projected 22.7% annual energy cost savings with an aggregate simple payback of 4.5 years. Two measures are prioritized as "Recommended" for implementation while two measures were considered but have significant payback periods and may be considered in the future as part of a major renovation project.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be "electrification-ready" to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE's prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Materials Management Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	MTCO2e	$/yr	$/yr	$	Years
1	Lighting Upgrades & Controls	LOW	R	31,756	11	0	0	108.35	14.06	$1,127	$3,493	$34,400	7.4
2	HVAC Scheduling & Setback	HIGH	R	9,348	0	511	0	562.47	32.21	$0	$3,575	$2,500	0.7
Sum of Recommended Measures				**41,105**	**11**	**511**	**0**	**671**	**46**	**$1,127**	**$7,068**	**$36,900**	**4.5**
Overall % Reduction				**22.8%**	**33%**	**25%**	**0%**	**22.5%**	**1.6%**	**--**	**22.7%**	**--**	**--**
Measures Requiring Additional Consideration													
3	BAS Controls Integration and Retro-Commissioning	N/A	NR	4,216	0	226	0	249.32	14.3	$0	$1,591	$62,505	39.3
4	Building Envelope Improvements	N/A	NR	0	0	590	0	612.75	32.4	$0	$2,941	$123,240	41.9

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Materials Management Building, constructed in 1967, serves as a key facility for warehousing, mailroom operations, and office spaces. The building does not have a Building Automation System (BAS), and its mechanical systems are operated using local controls. The HVAC system primarily consists of overhead heaters, baseboard hot water heaters, and air handling units, with natural gas serving as the main energy source for heating and domestic hot water.

The building is divided into several functional spaces, with the Warehouse occupying 70% of the building, and the mailroom covering 20%. These spaces are primarily heated by overhead heaters controlled by local smart thermostats. The offices, which make up 10% of the building, have a main unit with a timer control. The building's HVAC system operates 24/7 in the warehouse and mailroom, while the offices are controlled by a timed system. The heating and cooling setpoints for occupied spaces are maintained by local thermostats, with no automatic setbacks when spaces are unoccupied.

2.1 Building Systems

2.1.1 Building Envelope

The building has one above-grade floor, comprised of 70% warehouse and 30% office space. The window/wall ratio for the office is estimated to be about 10%, while the warehouse has dock doors but no windows.

The office has brick veneer and the warehouse is comprised of concrete blocks painted beige. The roof exterior was not assessed during the site visit, however interior photos show metal framing, and satellite photos show likely asphalt roofing material. The roof insulation levels are unknown at this stage; however, it is assumed to be a minimum of R20 providing a moderate level of thermal resistance.

Table 2:. Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Concrete block with brick face, not insulated	Poor to Moderate – based on a visual inspection
Roof	The roof was not accessible during the site visit	Unknown
Glazing	Glass block in office areas only	Unknown

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The building is equipped with six gas-fired unit heaters, which provide heating for the entire building. Three of these units are manufactured by Trane and the other three by Sterling. These units operate on natural gas and are in good condition. They maintain temperature throughout

the building and operate year-round to meet heating demand. The gas-fired unit heaters are controlled locally and provide efficient heating across various spaces.

The building originally had cooler/freezer condensing units manufactured by Bohn and Bally. The Bally units are abandoned and no longer in use. These units operated with R12 refrigerant. The Bohn units, however, are still in service and operate with R22 and R404 refrigerants. These systems were previously used for cooling purposes, with the Bohn units having cooling capacities ranging from 6.73 kBTU to 13.9 kBTU. These units are powered by 208V, 3-phase electrical supply. Currently, the Bohn units are still active, while the Bally units are fully decommissioned and no longer provide cooling.

The building also includes two split system direct expansion (DX) and hot water heating air handling units (AHUs) serving various spaces, such as the Fixed Assets Room and offices. The air handling units were added after the original construction of the building. It appears that the original building was not insulated. It's unclear if insulation was added per code when air conditioning was installed.

Heating hot water for baseboard heaters is provided by a HydroTherm boiler, 500 MBH input (380 MBH output) and a ½ HP recirculating pump. The boiler has a 54°F outdoor air lockout controller.

2.1.2.2 Plumbing

A gas-fired, 40 MBH water heater with a 40-gallon storage tank is used for domestic hot water needs. There is a 1/12 horsepower recirculation pump for the domestic water heating system.

2.1.2.3 Building Controls

Building is not controlled by a central building automation system. Local control is via thermostats. Some systems have programmable thermostats and some are older non-programmable style. There is no interlock to prevent heaters from operating when overhead doors are open.

2.1.3 Lighting Systems

The lighting system consists of 32W fluorescent fixtures, installed throughout the facility based on spatial and functional needs. Fixtures are recessed, ceiling-mounted, or suspended.

Based on the drawings, the total number of lighting fixtures is 160. There are 110 fixtures of 4 lamps, 34 fixtures of 2 lamps, and 16 downlights.

Table 2: Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
Fluorescent Lights	110	4 lamp
Fluorescent Lights	34	2 lamp
Downlights	16	-

The approximate total wattage is 16,768 watts. The approximate area per drawing is 20,562 ft^2. The calculated lighting density is 0.81 W/ft^2.

2.1.4 Electrical Infrastructure

The facility is served by a transformer with a noted capacity of 300 kVA or 500 kVA, located outdoors. There is a discrepancy between the actual transformer capacity and what is shown on the one-line diagram, which should be verified. The main service is rated at 480/277V, 400A, 3-phase, and a single line diagram is available. The meter shows a spot demand measurement of 32 kW and 57 kW. Backup power is provided by a 165 kW (200 kVA) generator at 480V. The generator is connected through a 100A, 480V, 4-wire disconnect and includes a 200A generator plug. The recorded energy use is 215,141 kWh.

3 Utility Billing Analysis

3.1 Utility Type and Usage

Materials Management receives electric service, natural gas service, and is not connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed includes the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

Table 3 summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 3: Total Energy Usage and GHG Emissions (2024)

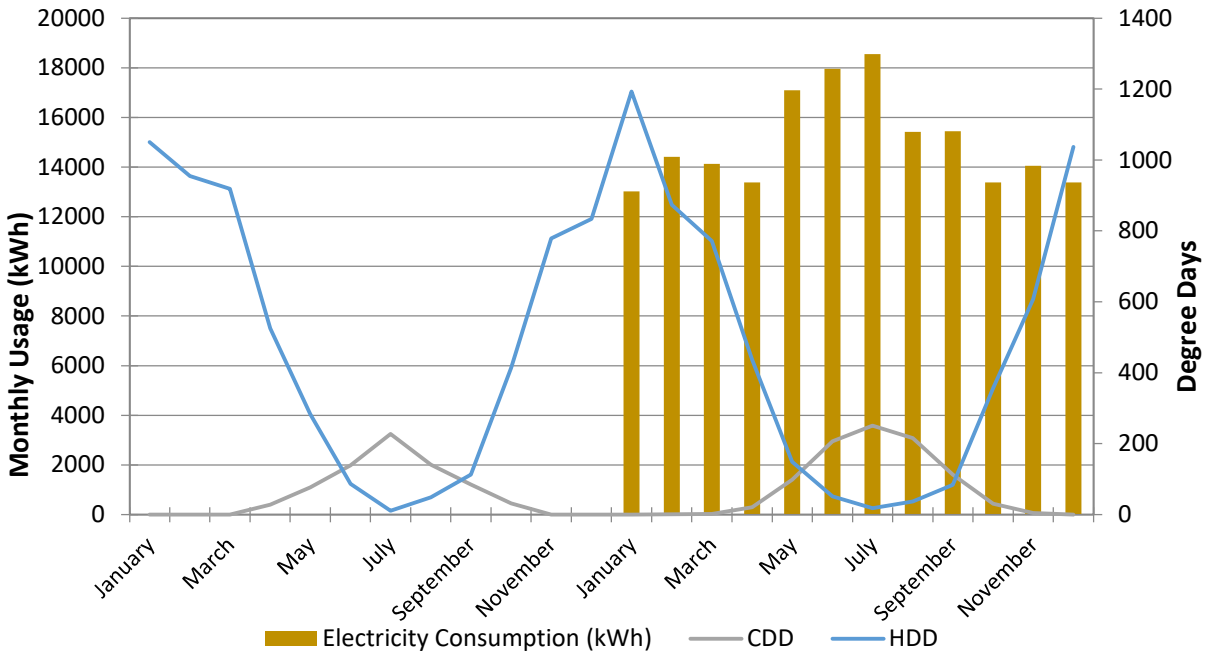
Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	180,208 kWh	615	$19,823	$0.11	0.0004427	80
Natural Gas	2,282 MCF	2,369	$11,672	$4.98	0.0549206	125
Total	**--**	**2,984**	**$31,195**	**--**	**--**	**205**

**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a slight correlation to weather data, indicating increased electricity use for air conditioning during summer months. Analysis shows an increase of 43% between the highest usage and lowest usage months. The annual usage for the baseline 12-month period from January to December 2024 is 180,208 kWh. Electricity data was only available for 2024. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

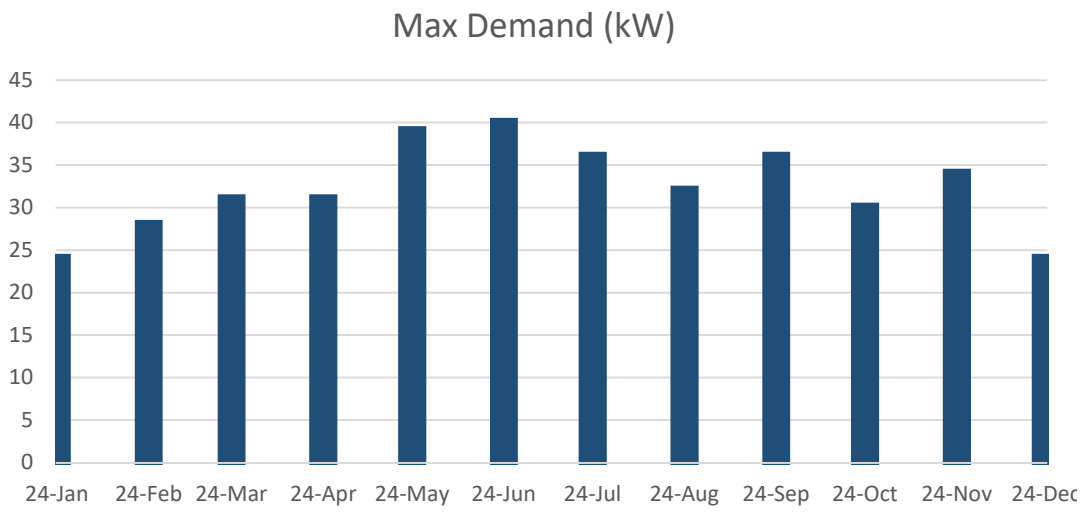
The Materials Management building did not provide utility bills for electrical analysis to be completed. Figure 2 is provided based on the spot measurements during the electrical survey and the average Peak/Average Demand rating for the master meter. No monthly peaks are provided for this building due to missing data.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 4: Electric Capacity Results

Maximum Building Capacity at Service Transformer	300 kW
Maximum Capacity at Switchgear (A*V*Ph)	320 kW
Estimated Peak Demand	100 kW (estimated)
Remaining Capacity	**200 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge:	**$0.057/kWh**
DTE Electric Demand Charge:	**$6.15/kW/Month**
Average Dollar per kWh Used in Calculations:	**$0.11/kWh**

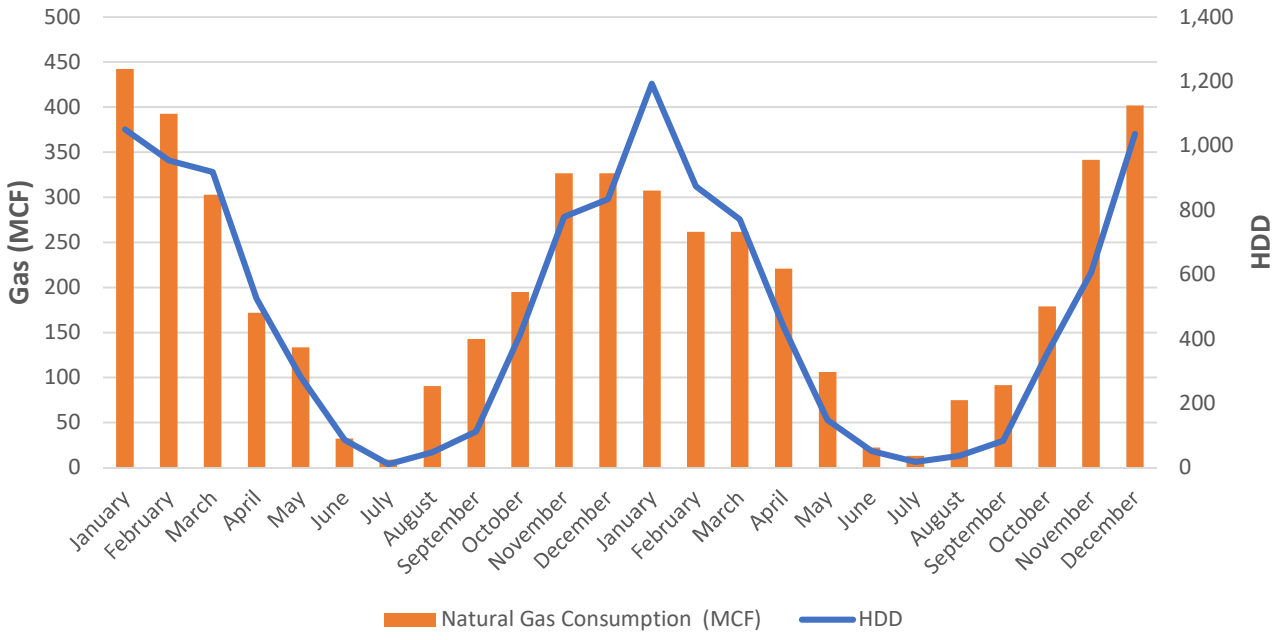
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows a direct correlation to weather data, as natural gas is primarily used for space heating. The annual usage for the baseline 12-month period from January to December 2024 is 2,282 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: **$1.33/MCF (1000 cubic feet)**

Constellation NG Usage Charge (fixed Fee): **$3.48/dTh (decatherm, or 1.038 MCF)**

Constellation NG Usage Charge (Day Gas): **$5.29/dTh (decatherm, or 1.38 MCF)**

Average Dollar per MCF Used in Calculations: **$4.98/MCF**

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 5.

Table 5: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$19,823
Natural Gas	$11,372
Total	$31,195
ECI $/yr/sf	$1.50

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is

represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

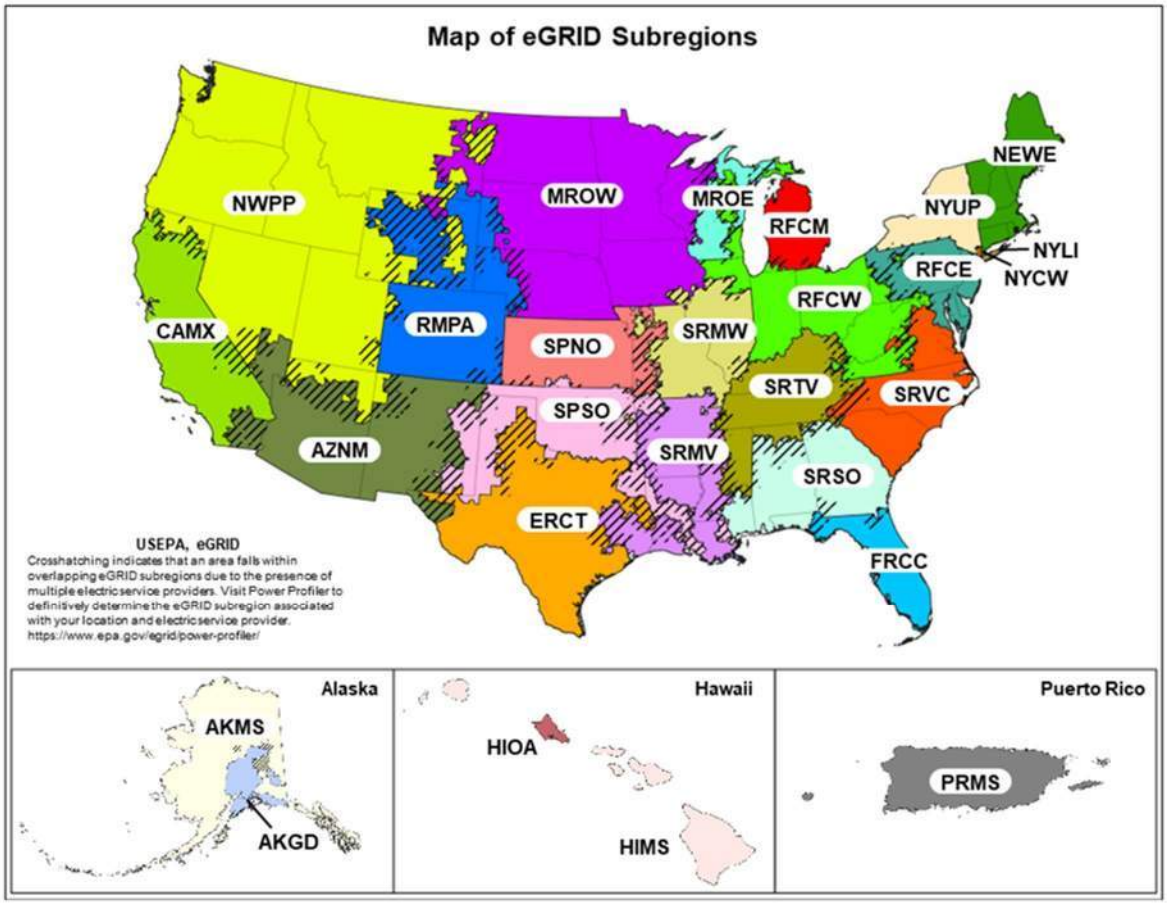
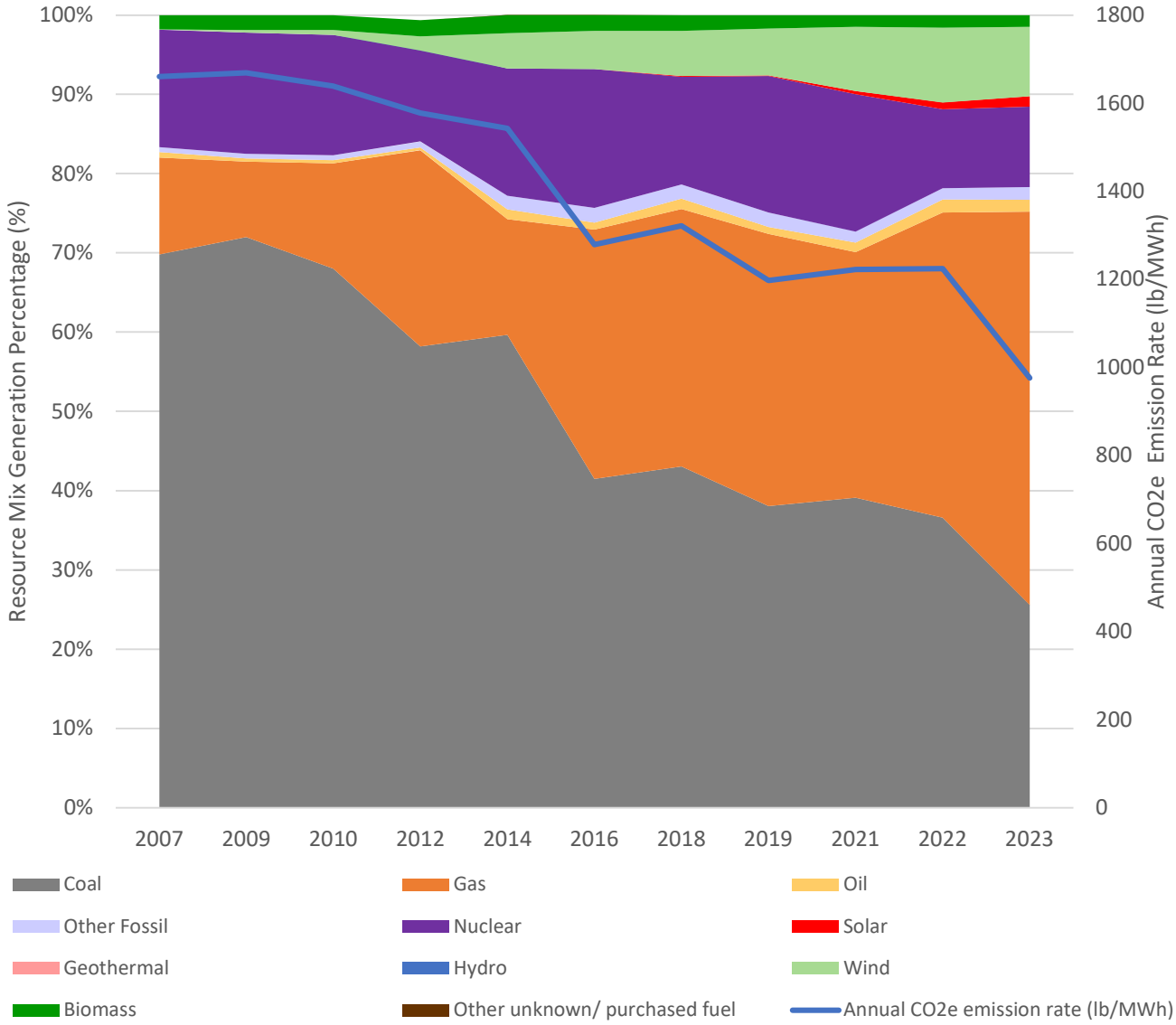


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 61 percent of carbon emissions are attributed to natural gas and 39 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 125 tCO2e (campus-level Scope 1) and 80 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 205 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for Materials Management are converted to kBTUs units, summed, and divided by the total square footage.

Table 6: Annual Utility Summary (2024)

Building:	Materials Management				**Electric EUI:**		30	kBTU/SF/yr
GFA:	20,835	SF			**Gas EUI:**		114	kBTU/SF/yr
eGRID Subregion:	RFCM				**Current EUI**		143	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	180,208	kWh	*3.412*	615	*0.0004427*	80	$19,823	64%
Natural Gas	2,282	MCF	*1.038*	2,369	*0.0549206*	125	$11,372	36%
Steam	0	klbs	*1194*	0	*0.1190000*	0	$0	0%
Totals				**2,984**		**205**	$31,195	100%

According to the US EPA, the average site energy use intensity for a service facility is 47.9 kBTU/SF. However, the total EUI for the existing condition of the building is calculated as 143 kBTU/SF, which is significantly higher than typical buildings. This is predominantly due to high natural gas usage for space heating. It's important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison indicates there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
	Wholesale Club/Supercenter*		120.0	51.4	CBECS - Retail Store
Technology/Science	Data Center* (Average PUE presented in place of EUI: PUE = Total Energy / IT Energy)		1.82	1.82	EPA - Data Center
	Laboratory		318.2	115.3	CBECS - Laboratory
	Other – Technology/Science		89.3	40.1	CBECS - Other
Services	Data Center* (Average PUE presented in place of EUI: PUE = Total Energy / IT Energy)		1.82	1.82	EPA - Data Center
	Personal Services (Health/Beauty, Dry Cleaning, etc.)		96.9	47.9	CBECS - Service
	Repair Services (Vehicle, Shoe, Locksmith, etc.)				
	Other - Services				
Utility	Drinking Water Treatment & Distribution (Average EUI presented in Energy per Flow in gallons per day)		5.90	2.27	AWWA - Water Treatment Plant
	Energy/Power Station		89.3	40.1	CBECS - Other
	Wastewater Treatment Plant* (Average EUI presented in Energy per Flow in gallons per day)		7.51	2.89	AWWA - Wastewater Plant
	Other - Utility		89.3	40.1	CBECS - Other
Warehouse/Storage	Self-Storage Facility		47.8	20.2	CBECS – Non-refrigerated Warehouse
	Warehouse/Distribution Center	Distribution Center*	52.9	22.7	CBECS – Non-refrigerated Warehouse & Distribution Center
		Non-Refrigerated Warehouse*			
		Refrigerated Warehouse*	235.6	84.1	CBECS – Refrigerated Warehouses
Other	Other		89.3	40.1	CBECS - Other

3.8 End Use Distribution

Table 7 shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees. Table 7 and Figure 7 and Figure 8 show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 7: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	2,263	0	2,349,337	113	124
Space Cooling	36,000	0	0	122,832	6	16
Fans	46,742	0	0	159,483	8	21
Pumps	1,582	0	0	5,399	0	1
SHW/DHW	0	19	0	19,763	1	1
Conveyance	0	0	0	0	0	0
Lighting	43,254	0	0	147,582	7	19
Plug Loads	41,708	0	0	142,308	7	18
Process Loads	4,951	0	0	16,892	1	2
Refrigeration	5,971	0	0	20,375	1	3
Cooking	0	0	0	0	0	0
Information Technology	0	0	0	0	0	0
TOTAL	**180,208**	**2,282**	**0**	**2,983,970**	**143**	**205**
Historical Billing	180,208	2,282	0			
Percent of Actual	100%	100%	0%			
per sqft	8.6	0.1	0.0			

Figure 7: Existing Electricity End Use Distribution

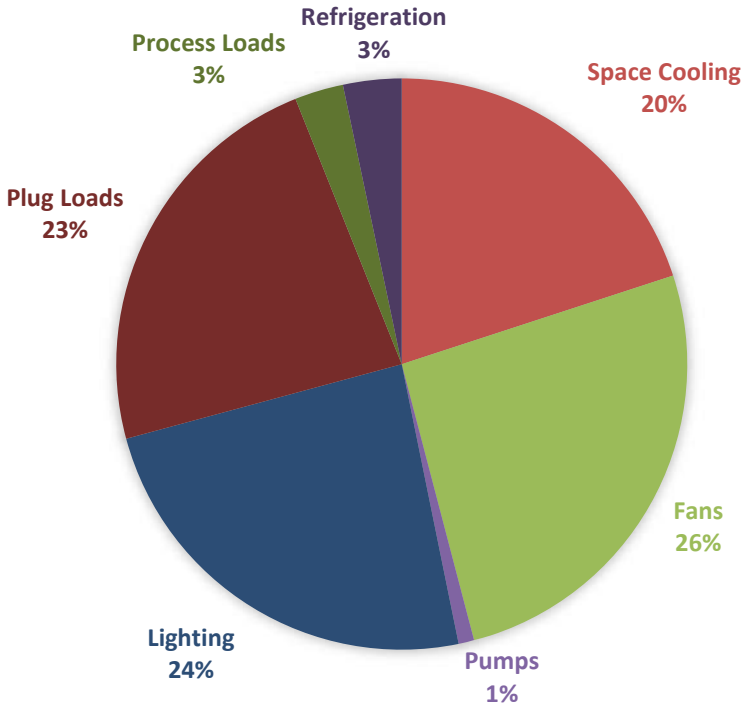
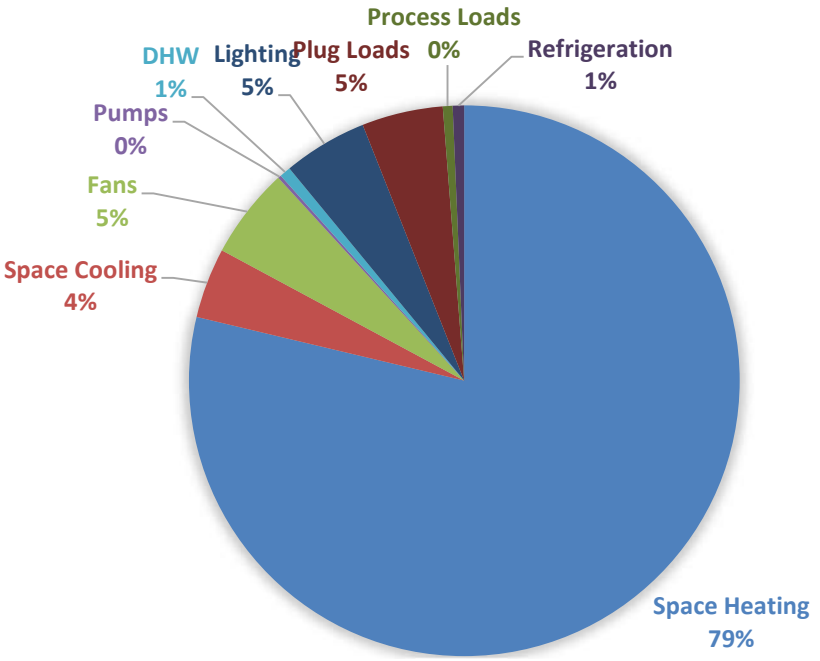


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – Lighting Upgrades

This measure proposes upgrading all fluorescent lighting to LEDs with motion sensors and dimming functionality where appropriate to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements. Incorporating lighting controls allows for better management and customization of lighting systems, leading to reduced energy consumption, and increased overall efficiency by limiting the time lighting is on to only when necessary. For indoor lighting, lighting controls consist of occupancy, daylighting, timers, scheduling, and dimming features to optimize light levels based on external lighting availability and usage of a space. For outdoor lighting, the lighting controls consist of motion sensors, photocells, and timers to turn the lighting ON/OFF. The current lighting in Materials Management is 100% fluorescent and the estimated wattage is approximately 0.81 W/ft². See Section 2.1.3 for the lighting counts used to estimate energy consumption.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.



Figure 9: Example Fixture with Integrated Occupancy Controls

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Lights are assumed to be on 10 hours per day for 256 days of the year.
- This measure assumes lighting savings of approximately 0.50 W/ft² or approximately 60% reduction in interior lighting power and a 30% reduction in hours of operation for adding new controls.
- O&M savings assume an average cost of $2.15/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- LED upgrades cost $215/fixture, which include integrated control sensors and no additional wiring and control circuits. Low-cost fixtures and external controls can be used as an alternative to this implementation method. This measure assumes all fluorescent lamps are converted to LEDs, estimated at 160 total fixtures.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 8: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
LED Upgrade	0	31,756	108	14	$1,127	$3,493	$34,400	7.4
Overall % Reduction	0.0%	11.4%	2.3%	0.0%	--	7.2%	--	--

4.2 ECM 2 – HVAC Scheduling and Setback

Implementing standardized setpoints and occupancy schedules for the HVAC system can reduce energy consumption in the Materials Management Building by avoiding unnecessary heating or equipment operation during unoccupied periods. Currently, the AHUs, baseboard heaters in the office area and overhead heaters in the garage areas are locally controlled by several different types and vintages of thermostats. They appear to not have set schedules or are operating in “hold” or manual mode resulting in continuous operation to maintain occupied temperatures.

This measure proposes enabling occupied and unoccupied setpoints and schedules for both the office and garage HVAC systems. By aligning HVAC operation with actual building use, the systems can “coast” to unoccupied setpoints during evenings, weekends, and holidays, minimizing wasted energy while maintaining occupant comfort during working hours.



Figure 10: Examples of existing local controls

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume existing systems maintain occupied setpoints continuously and HVAC schedules and setpoints are implemented to operate an average of 12 hours per weekday and setback to 60°F /80°F when unoccupied.

- A total programming and equipment cost of $2,500 was assumed.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Survey existing control functionalities to determine if existing thermostats have appropriate scheduling and setpoint functionality. Replace with programmable thermostats if needed. Establish seasonal setpoints (generally targeting 68–74°F when occupied and 55–60°F when unoccupied) and configure HVAC schedules accordingly. Verify and monitor system operation to ensure savings are achieved. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 9: ECM 2 Savings and ROM Cost

Savings Summary								
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
HVAC Setback	511	9,348	562	32	$0	$3,575	$2,500	1
Overall % Reduction	22.4%	5.2%	19%	16%	--	12%	-	-

5 Measures Requiring Additional Consideration

This section provides additional information about projects that have been evaluated but are not currently recommended for implementation due to poor economics, feasibility issues, conflicts with other projects already recommended, or requirements for additional study that may impact feasibility. Equipment electrification projects, which have longer paybacks, may be listed here but will be expanded upon in the final Electrification Plan for each building. All electrification projects that are required for campus electrification are not included in the energy audit reports. This report includes two measures that are included in this category. The measure summaries are given below:

5.1 ECM 3 – BAS Controls Integration and Retro-Commissioning

This combined measure involves installing a building automation system (BAS) and completing retro-commissioning (RCx) once the BAS is operational. Together, these steps enable centralized control, improve system coordination, and ensure building operations are optimized for efficiency and reliability.

BAS Integration

Materials Management currently operates with local controls. This ECM includes BAS integration to enable consistent scheduling, setpoint management, alarming, trend logging, and coordinated operation across systems that today run largely stand-alone.

Retro-Commissioning

With the BAS in place, commissioning will verify sequences of operation, tune control loops, and correct long-standing operational issues. This is especially important at Materials Management where there is no way to prevent heating when overhead doors are open and baseboard heaters operate 24/7.

The following list represents commissioning opportunities that should be evaluated to validate operation, repair if discrepancies identified or implement if not active and feasible for major HVAC systems. This effort will proactively improve building system operation and optimize energy usage.

- Optimize HVAC scheduling in non 24/7 occupied spaces
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water supply reset

- Discharge air setpoint reset
- Outside air temperature lockouts

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 5% reduction in estimated cooling, fan, and pump end use consumption and 10% in estimated heating end use energy consumption.
- Project cost is estimated at $3 per square foot of building area.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Identify remaining equipment to be connected to the central control system and engage a building controls integration company to plan and cost the system integration. Coordinate with planned capital upgrades and renovations where possible to optimize benefits. This measure is recommended for further consideration, as the local thermostat control may be a sufficient and cost-effective way to improve energy efficiency by implementing HVAC schedules and setpoints without major system upgrades. However, if a major renovation should occur or equipment is replaced, modern BAS-integrated controls should be included.

ECM Savings and ROM Cost

Table 10: ECM 3 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Controls Integration & RCx	226	4,216	249	14	$0	$1,591	$62,505	39
Overall % Reduction	10%	2.3%	8.4%	7.0%	--	5.1%	-	-

5.2 ECM 4 – Building Envelope Improvements

Effective insulation and a well-sealed building envelope are critical for managing the transfer of heat between the exterior and interior environments. In Michigan, where seasonal temperature variations can be significant, improving building envelope integrity not only reduces energy consumption for heating and cooling but also helps maintain a consistent and comfortable indoor environment for staff. In addition to insulation, proper vapor sealing prevents moisture intrusion and minimizes indoor air quality issues related to high humidity. As building energy codes and insulation standards have evolved, older buildings can greatly benefit from upgrades that align with modern requirements, enhancing their energy efficiency. This measure includes adding insulation to walls and interior roof or attic spaces. These steps not only reduce energy usage and associated emissions but also lower heating capacity requirements, making them an essential precursor to any major HVAC system upgrades.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- This measure assumes energy savings due to improved R-value and thermal performance. R-values were assumed based on observations and building age. The wall and attic R-value is assumed to improve from R-6 to R-12 and R-10 to R-30, respectively. Air sealing is assumed to reduce infiltration.
- A unit cost of $2 per square foot of insulated area was assumed.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Conduct a comprehensive survey to confirm the dimensions of walls and roof requiring upgrade, type and quantity of insulation required to meet modern energy code requirements, and/or areas requiring air sealing. This measure is not currently recommended for implementation due to the payback but should be considered as part of any major renovation project.

ECM Savings and ROM Cost:

Table 11: ECM 4 Savings and ROM Cost

Savings Summary								
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
Building Envelope Improvements	590	0	613	32	$0	$2,941	$123,240	42
Overall % Reduction	26%	0%	21%	16%	--	9.4%	--	--

6 Appendix A

Table 12: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	442	$2,717	-	-	-	-	1,050.9	0
Feb-23	392	$2,294	-	-	-	-	954.6	0
Mar-23	303	$922	-	-	-	-	918.4	0
Apr-23	172	$595	-	-	-	-	525.3	28.1
May-23	134	$400	-	-	-	-	283.4	76.3
Jun-23	32	$80	-	-	-	-	86.3	139.1
Jul-23	9	$36	-	-	-	-	11.3	226.9
Aug-23	91	$261	-	-	-	-	48.3	140.6
Sep-23	143	$405	-	-	-	-	112.5	84.9
Oct-23	195	$562	-	-	-	-	414.5	31.1
Nov-23	326	$1,218	-	-	-	-	779.2	0
Dec-23	326	$1,611	-	-	-	-	834.1	0
Jan-24	307	$1,354	13,016	$1,899	17.5	23	1,193.6	0
Feb-24	262	$1,425	14,408	$1,766	21.4	27	873.9	1
Mar-24	262	$1,481	14,136	$1,828	19.0	30	771.2	2.1
Apr-24	221	$460	13,384	$2,050	18.6	30	437.1	20.9
May-24	106	$216	17,096	$2,100	23.0	38	148.4	98
Jun-24	23	$73	17,960	$2,382	24.9	39	51.4	206.7
Jul-24	13	$42	18,552	$2,413	24.9	35	18.4	250.9
Aug-24	75	$160	15,416	$2,400	20.7	31	36.6	215.4
Sep-24	92	$222	15,440	$2,057	21.4	35	84.0	112.3
Oct-24	179	$480	13,376	$1,805	18.0	29	356.0	30.7
Nov-24	342	$1,182	14,048	$1,516	19.5	33	606.9	4.2
Dec-24	402	$893	13,376	$1,758	18.0	23	1,036.8	0
2023 Sum	2,566	$11,101	0	$0			6,019	727
2024 Sum	2,282	$7,988	180,208	$23,975			5,614	942

7 Appendix B

Table 13: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity	Units	Approx Installed Year
GUH	3	Gas fired unit heaters		Trane	GHND025ABB20000A	250 in, 200 out	MBH	
GUH	3	Gas fired unit heaters		Sterling	TF100A1`NS111	100 in, 81 out	MBH	
CU	1	Cooler, freezer condensing unit		Bohn	BHT020H2CF	7	MBH	
CU	1	Cooler, freezer condensing unit	Not in use	Bally	PN-200-3			
CU	1	Cooler, freezer condensing unit		Bohn	BCH0035MCACZA0000	13.9	MBH	
	1	Boiler	Heating water	HydroTherm	MR-500B-PV	500	MBH (in)	1987
P1	1	Recirculation Pump				0.5	HP	
		Water Heater		American Water Heater Company	G62 40T40 400	40	MBH	2018
P2	1	Recirculation Pump				0.0833	HP	
		Walk-in Freezer	Not in use					
		Air compressor	Printing Machinery			5	HP	
1	AHU-1		Fixed Assets Rooms	Trane	TWE 180B400AB	6750	CFM	1990
1	Condensing Unit-2		Office	Bryant	580JE12D180G2A0AAA	12	TON	2011
1	Condensing Unit-1		Fixed Assets Rooms	Trane	Unknown	15	TON	
1	AHU-2		Office	Unknown	Unknown			

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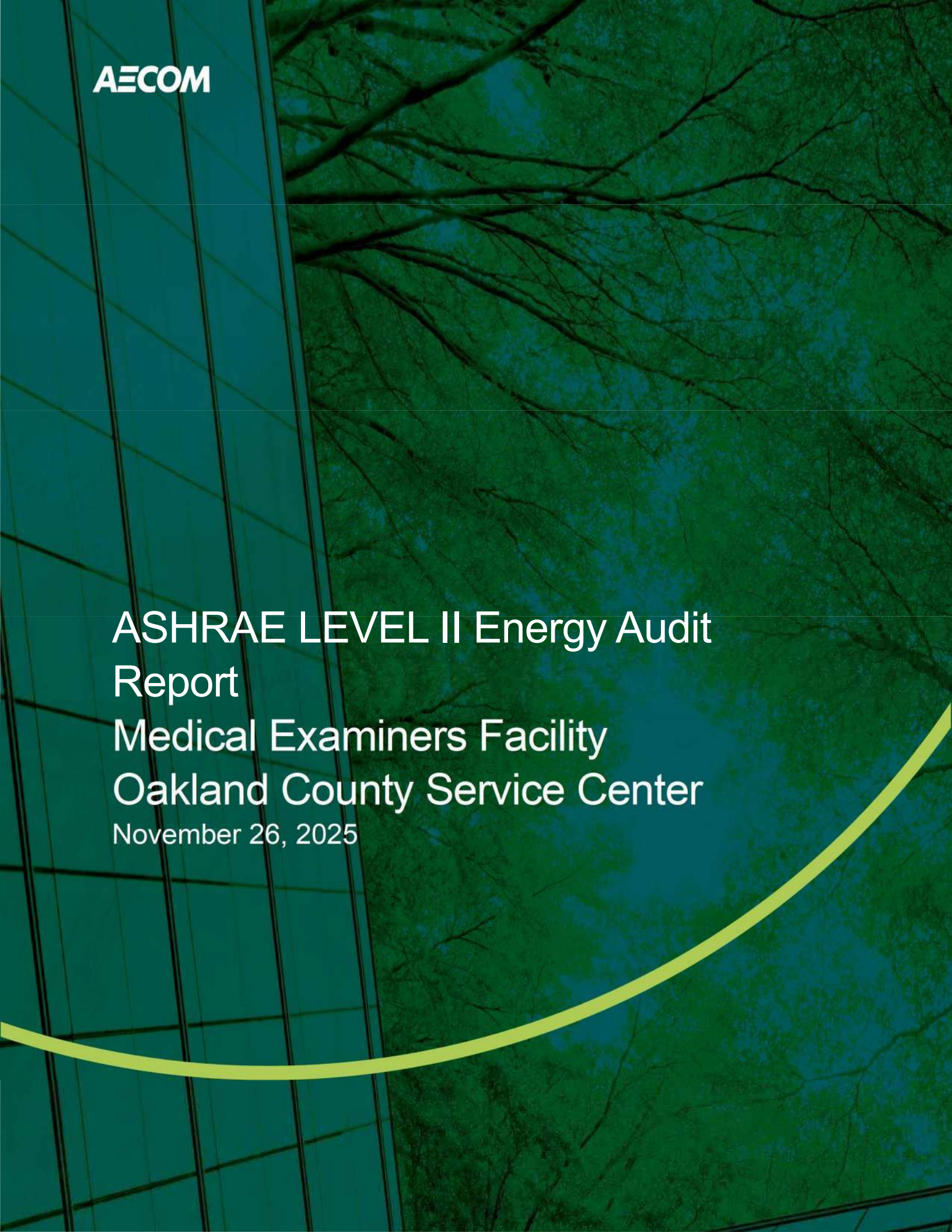

AECOM

ASHRAE LEVEL II Energy Audit Report

Medical Examiners Facility
Oakland County Service Center

November 26, 2025

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

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OAKLAND COUNTY, MI Government

Prepared by:
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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Medical Examiners Facility in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Medical Examiners Facility is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Friday April 11, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates four ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The four listed measures represent a projected 22% annual energy cost savings with an aggregate simple payback of 4.4 years. All four measures are prioritized as "Recommended" for implementation.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be "electrification-ready" to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE's prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Medical Examiners Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	MTCO2e	$/yr	$/yr	$	Years
1a	Lighting Upgrades & Controls	LOW	R	56,723	19	0	0	194	25.1	$2049	$6,239	$86,215	10.4
1b	Controls on Existing LEDs	HIGH	R	3,525				12	1.6	$0	$388	$3,338	8.6
2	HVAC Scheduling and Setback	MED	R	88,652	0	382	0	699	60.2	$0	$11,655	$4,000	0.3
3	Retro-commissioning	HIGH	R	37,096	0	142	0	274	24.2	$0	$4,787	$19,340	4.0
4	VFDs on HW Pumps	LOW	R	52,181	0	0	0	178	23.1	$0	$5,740	$13,200	2.3
Sum of Recommended Measures				238,176	19	524	0	1,356	134	$2,049	$28,809	$126,093	4.4
Overall % Reduction				23%		18%		21%	21%	--	22%	--	--

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Medical Examiner's facility is 38,680 ft^2 and operates as a medical office building, with offices, meeting rooms and specialty spaces including pathology and autopsy spaces. As built drawings located during the site visit indicated the year of construction for the building being 1999. An assessment of the Building Management System (BMS) indicated that heating and cooling is provided to the facility 24 hours per day, seven days per week. It is understood that the facility is occupied during a standard office building schedule Monday to Friday, however there are several specialty spaces that require specific temperatures to be maintained and may be needed at short notice outside of normal occupied business hours.

2.1 Building Systems

2.1.1 Building Envelope

The building is partially two above-grade floors. The window/wall ratio is estimated to be about 10%. The windows appear to be in good condition. The exterior walls are brick masonry and the roofing system comprises insulation installed above a concrete deck, overlaid with a black tar membrane. The roof insulation levels are unknown at this stage; however, it is assumed to be a minimum of R20 providing a moderate level of thermal resistance.

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Masonry construction	Good
Roof	Flat roof with black membrane	Good
Glazing	Double-pane with a low to medium window to wall ratio	Good to Moderate

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

Six air handling units (AHUs) serve the facility. AHU-1 serves autopsy procedure spaces and is 100% outdoor air (OA) system. AHU-1A serves autopsy offices and is also 100% OA. AHU-2 serves the second floor lab areas, AHU-3 serves office areas, AHU-4 serves the intake/discharge dock, and AHU-5 serves the mechanical room. AHU-1 and 1A have VFDs on the supply fan and AHU-2 and AHU-3 have VFDs on the supply and return fans which vary fan speed with load. AHU-4 and AHU-5 are constant volume.

One 250-ton air cooled chiller outside the building provides chilled water to the AHUs. The chiller operates when the outside temperature is above 60°F. The chiller provides 44°F chilled water which is distributed through two 25 HP chilled water pumps with VFDs to the AHUs.

One natural gas fired Bryan steam boiler with an output of 6,400 MBH provides heat to the building. The steam pressure alarm is triggered if the system pressure drops below 7 pounds

per square inch (PSI) or goes above 25 PSI. While the facility produces steam for space heating, the steam is converted to hot water at two heating hot water (HHW) heat exchangers (HX) to provide HHW to the AHUs, baseboards and reheat coils. The HHW is distributed throughout the facility by two primary heating hot water pumps that serve the six AHUs, two reheat pumps with a 7 horsepower (HP) motor each that serve the variable air volume (VAV) reheat, and two baseboard pumps with a 5 HP motor each. For all the pumps, one pump runs as the lead and one as a lag and they are alternated weekly. The heat exchangers share the load equally.

The total cooling capacity of the existing systems is 270 tons, and the heating capacity of the systems is 6400 MBH.

Three large exhaust fans (EF) serve the facility. EF-1 is a 20 HP fan that serves the autopsy room, the 20 HP EF-2 provides general exhaust for the autopsy suite, and the 10 HP EF-3 serves the toxicology floor. Facility staff are planning to replace EF-2 since the bearings are worn out. These exhaust fans have VFDs and are controlled by the BMS to modulate the speed and controls are assumed to be integrated with AHU-1, 1A and 2.

2.1.2.2 Plumbing

One old Raypak domestic hot water heater provides approximately 128°F hot water to two (2) 115-gallon hot water storage tanks. The hot water system was noted by facility staff as being oversized for the facility, which primarily utilizes hot water for handwashing and infrequent showers.

2.1.2.3 Building Controls

The entire building is controlled by Niagara BMS with a mix of pneumatic controls, Modicon and Niagara. The AHU schedules observed in the BMS indicate the building HVAC systems are scheduled to operate in occupied mode 24/7. The BMS sequences and setpoints indicate several optimization sequences are enabled including outside air lockouts, airside economizing, and hot water reset, however the team was unable to verify if they are all working as intended. The BMS sequence of operation indicates there is a hot water reset schedule from 120° to 180°F but the outside air parameters are unclear and hot water supply setpoint was observed at 180°F when the outside temperature was 40°F. The hot water system is enabled below 90°F with the primary and reheat pumps operating continuously and the baseboard pumps are enabled below 55°F. AHU-2 and AHU-3 are enabled to utilize airside economizing when the outside temperature is below 52°F and the chiller has an outside air lockout of 60°F. Overall the BMS functionality and sequences appear to be in good operating condition and the most significant opportunity for savings is HVAC scheduling and setback when the building is unoccupied.

2.1.2.4 Additional Information

The freezer room, which is used to keep medicine, has four freezers each with two fans each. The chiller room has two chiller units with three fans each. The door to the freezer is through the chiller. The above chiller and freezer units have their respective condensing units on the roof. These condensing units were found to be near or past their expected useful life and in poor condition, with some missing protective covers that allowed leaves to build inside the units. Another large chiller room, which is used to keep bodies, has 2 chiller units with 5 fans each. The capacity of the roof top chiller units serving this space is unknown.

2.1.3 Lighting Systems

During the site visit, lighting fixtures were found to be recessed, ceiling-mounted, suspended, or lay-in, depending on the room layout. On the first floor, all fixtures are fluorescent, while on the second floor, approximately 70% of the fixtures are light emitting diode (LED).

Table 3: Lighting Summary

First Floor	
Total Fixtures	Lamps per Fixture
186	3 lamp
107	2 lamp
69	1 lamp
Second Floor	
Total Fixtures	Lamps per Fixture
114	3 lamp
11	2 lamp
3	1 lamp

There are 362 fixtures on the first floor and 128 fixtures on the second floor. The total approximate quantity of light fixtures in the building is 498 with a total of 1,208 lamps. The approximate total wattage is 35,118 watts, and the approximate area per drawing is 38,680 ft^2. The calculated lighting density is 0.91 W/ft^2.

2.1.4 Electrical Infrastructure

The facility's main electrical service is supplied by two 750 kVA transformers located outside. The service is rated at 480/277V, 2000A, 3-phase. A one-line diagram is available. Demand readings from the meter indicate FEEDER (C) usage of 39,460 Wh and FEEDER (D) usage of 653,034 Wh, Backup power is provided by a 200 kW generator.

Also, it includes several transformers with the following capacities: 30 kVA, 45 kVA (two units), 75 kVA, 150 kVA (located in the Mechanical Room), and 225 kVA.

3 Utility Billing Analysis

3.1 Utility Type and Usage

The Medical Examiner's Facility receives electric service, natural gas service, and is not connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed includes the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

Table 4 summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	1,052,256 kWh	3,590	115,748	$0.11	0.0004427	466
Natural Gas	2,904 MCF	3,014	$14,468	$4.98	0.0549206	159
Total	--	6,604	$130,216	--	--	625

**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*

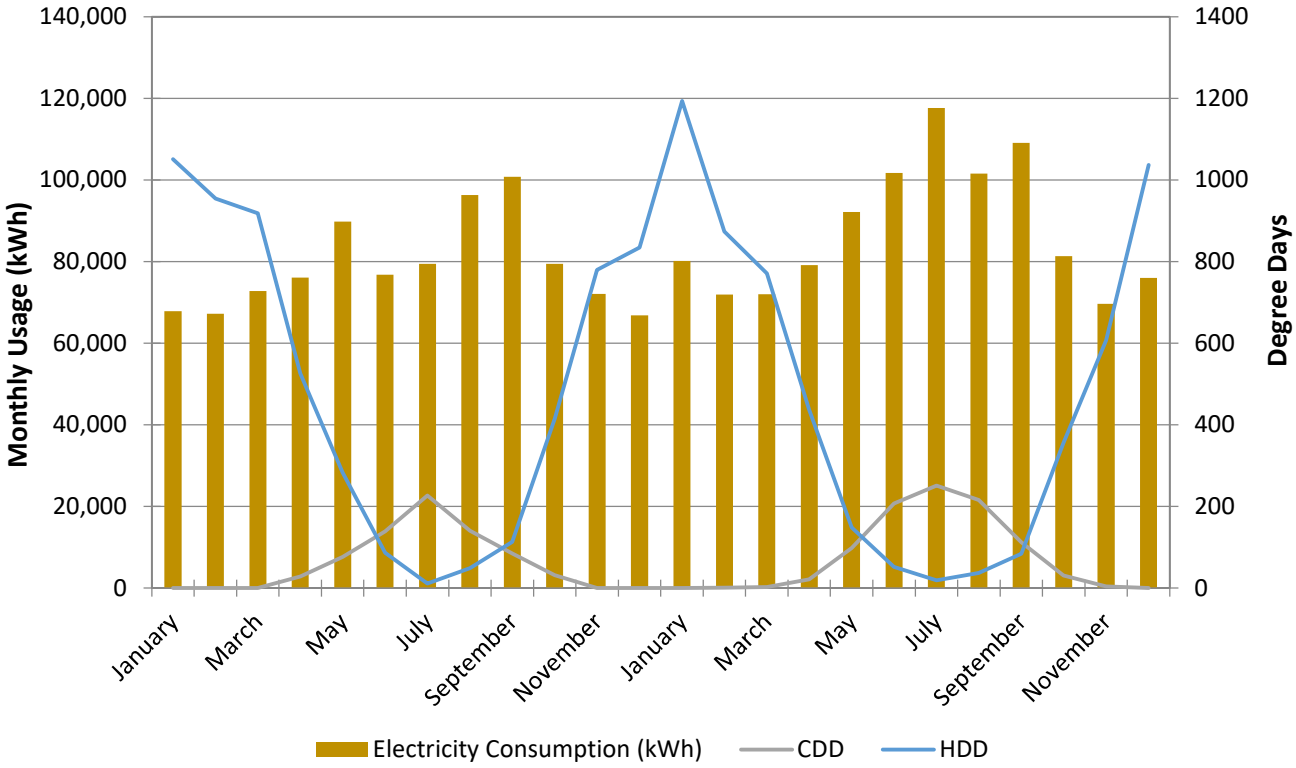
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a strong correlation to weather data, indicating air conditioning use during summer months. 2024 shows a 69% difference in usage between the highest usage in July and the lowest usage in November. The annual usage for the baseline 12-month period

from January to December 2024 is 1,052,256 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

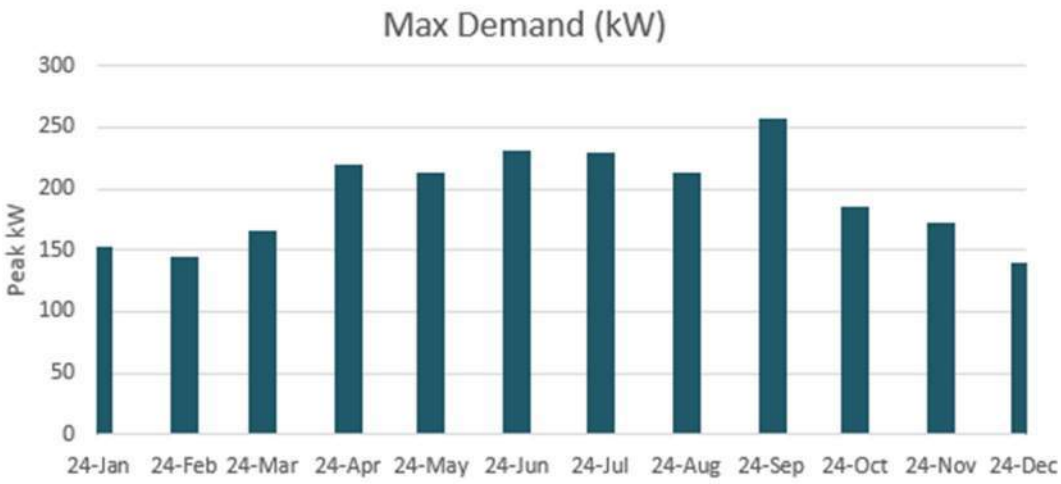
The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 5: Electric Capacity Results

Maximum Building Capacity at Service Transformer	1500 kW
Maximum Capacity at Switchgear (A*V*Ph)	1660 kW
Estimated Peak Demand	246 kW (estimated)
Remaining Capacity	**1254 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge: **$6.15/kW/Month**

Average Dollar per kWh Used in Calculations: $0.11/kWh

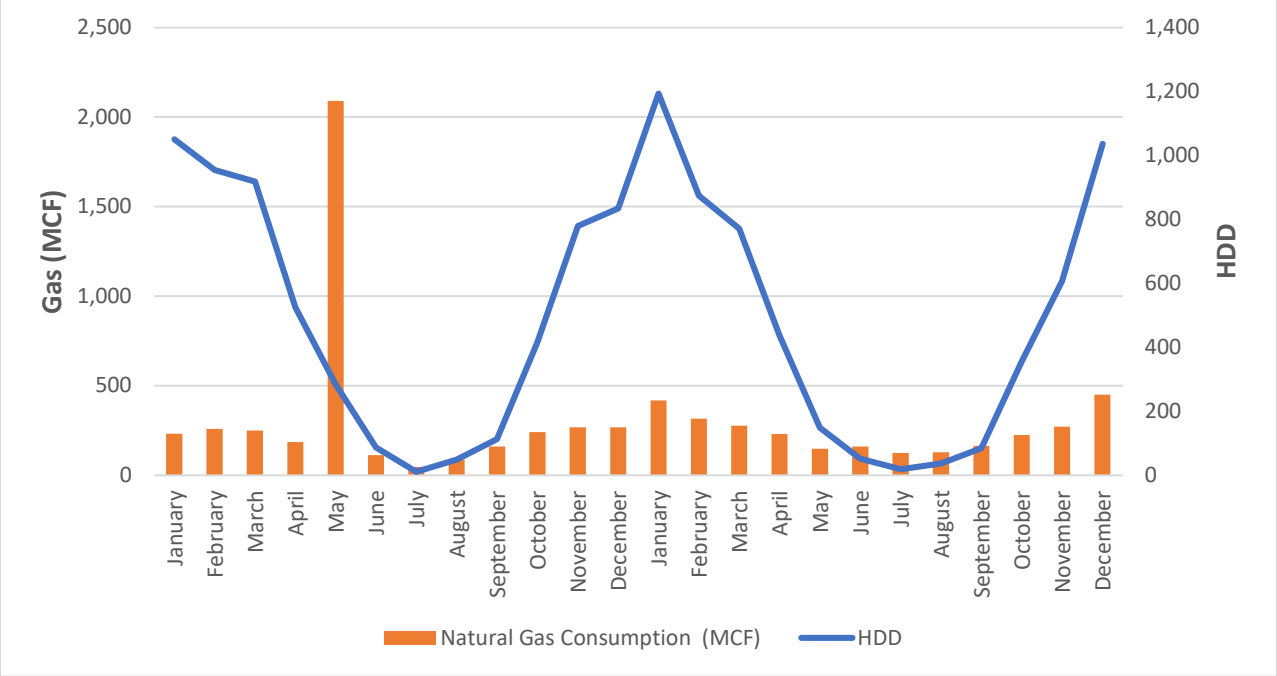
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows a major anomaly in May 2023, which skews the perception of the graph. Otherwise, the natural gas profile follows a direct correlation to weather data, as natural gas is primarily used for space heating. The annual usage for the baseline 12-month period from January to December 2024 is 2,904 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): $3.48/dTh (decatherm, or 1.038 MCF)

Constellation NG Usage Charge (Day Gas): $5.29/dTh (decatherm, or 1.038 MCF)

Average Dollar per Unit Used in Calculations: $4.98/MCF

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$115,748
Natural Gas	$14,468
Total	$130,216
ECI $/yr/sf	$3.37

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4. Each emissions factor is based on

the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

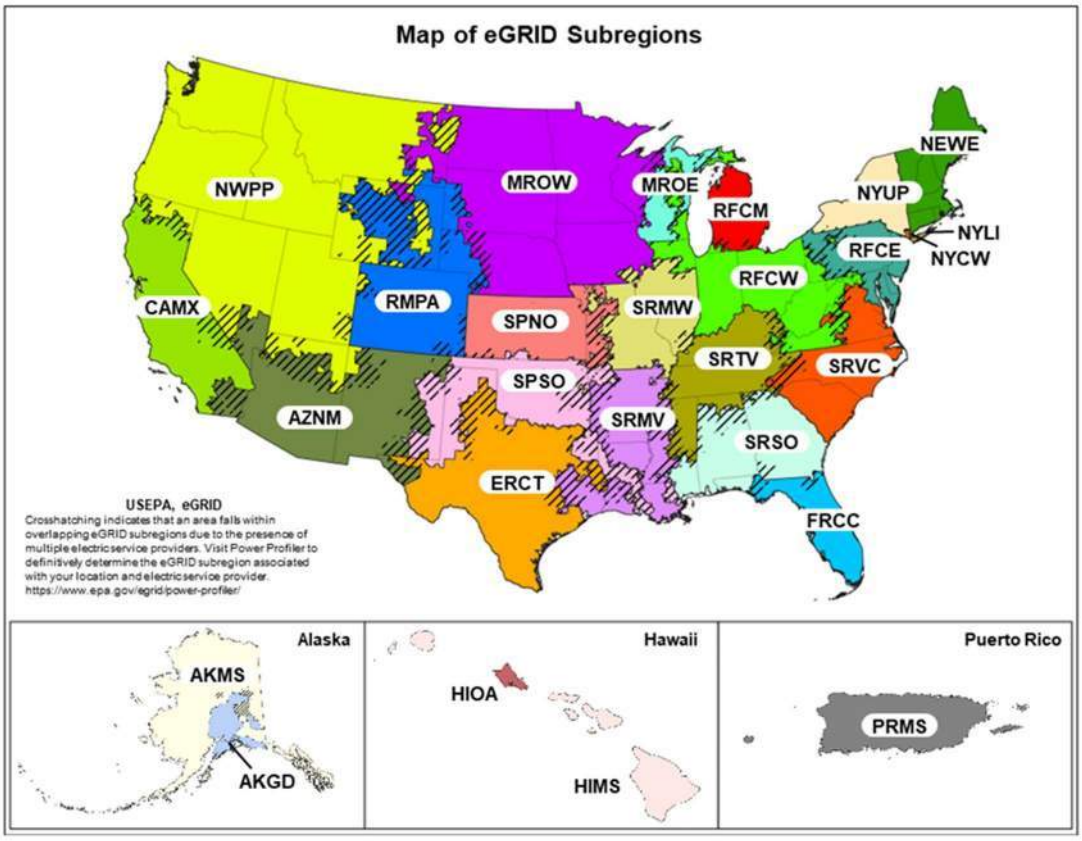
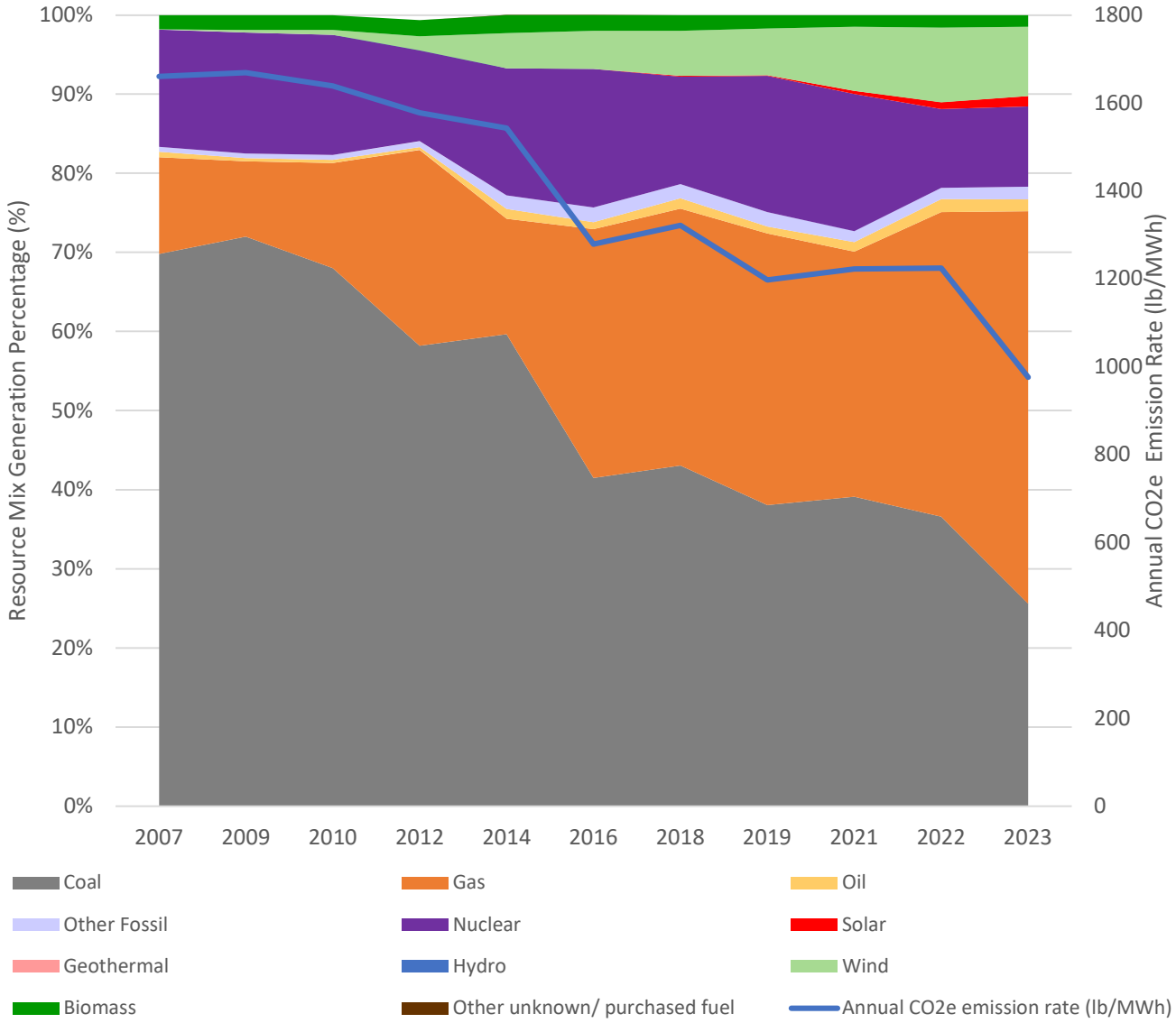


Figure 5 displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 26 percent of carbon emissions are attributed to natural gas and 74 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 159 tCO2e (campus-level Scope 1) and 466 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 625 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for Medical Examiners Facility are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Medical Examiners Facility					**Electric EUI:**	93	kBTU/SF/yr
GFA:	38,680	SF				**Gas EUI:**	78	kBTU/SF/yr
eGRID Subregion:	RFCM					**Current EUI**	171	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	1,052,256	kWh	*3.412*	3,590	*0.0004427*	466	$115,748	89%
Natural Gas	2,904	MCF	*1.038*	3,014	*0.0549206*	159	$14,468	11%
Steam	0	klbs	*1194*	0	*0.1190000*	0	$ -	0%
		Totals		**6,604**		**625**	**$130,216**	**100%**

According to the US EPA, the average site energy use intensity for a typical facility categorized under Other/Specialty Hospital is 206.7 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 171 kBTU/SF, which is slightly below the national benchmark. It's important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison indicates there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient

3.8 End Use Distribution

Table 8 shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees. Table 8 and Figure 7 and Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	2,836	0	2,943,603	76	156
Space Cooling	231,264	0	0	789,073	20	102
Fans	372,763	0	0	1,271,866	33	165
Pumps	137,894	0	0	470,494	12	61
DHW	0	68	0	70,597	2	4
Conveyance	0	0	0	0	0	0
Lighting	90,017	0	0	307,137	8	40
Plug Loads	12,740	0	0	43,469	1	6
Process Loads	44,337	0	0	151,279	4	20
Refrigeration	168,192	0	0	573,871	15	74
Cooking	0	0	0	0	0	0
Information Technology	0	0	0	0	0	0
TOTAL	**1,057,207**	**2,904**	**0**	**6,621,389**	**171**	**628**
Historical Billing	1,052,256	2,904	0			
Percent of Actual	100%	100%	0%			
per sqft	27	0.1	0			

Figure 7: Existing Electricity End Use Distribution

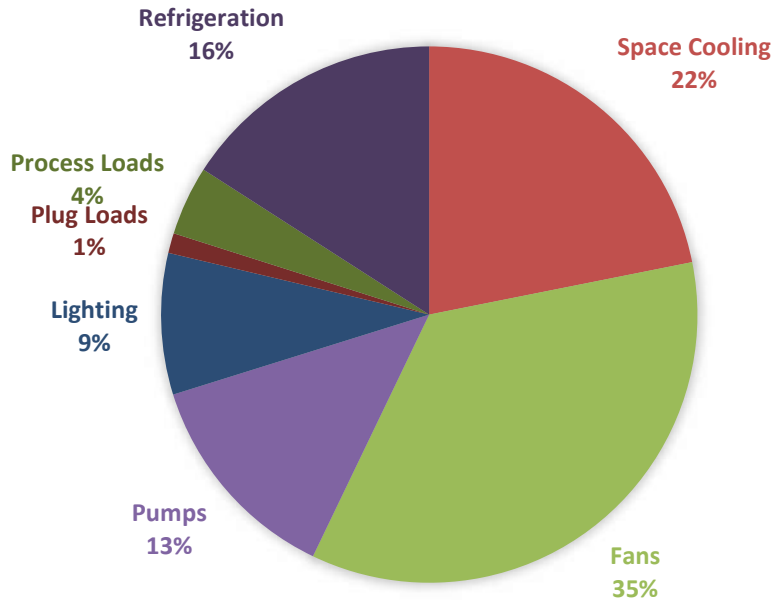
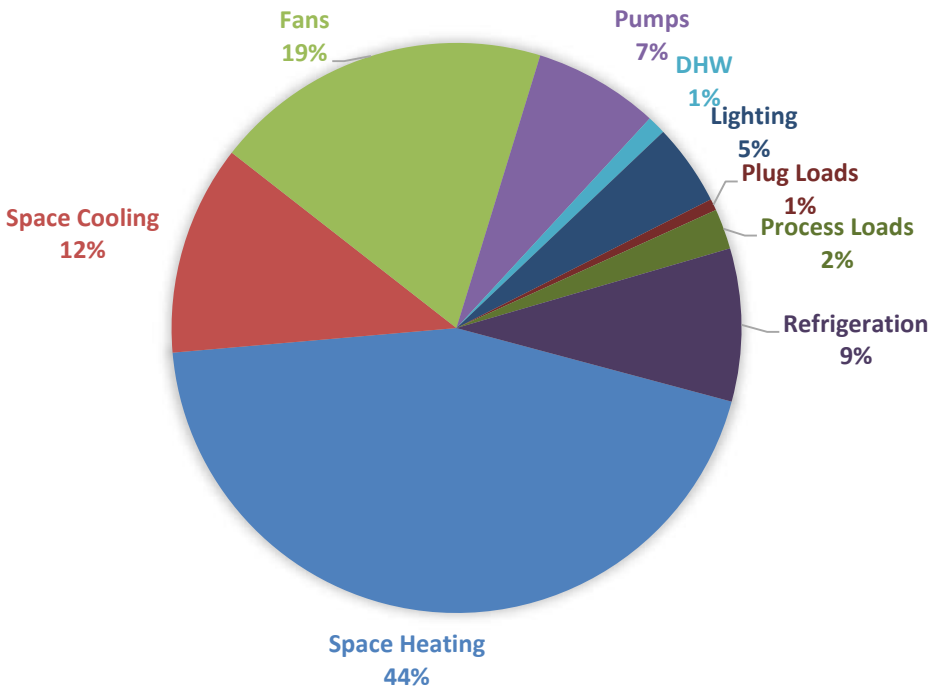


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – Lighting Upgrades and Controls

This measure proposes upgrading all remaining fluorescent lighting LEDs with motion sensors and dimming functionality where appropriate to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements. Incorporating lighting controls allows for better management and customization of lighting systems, leading to reduced energy consumption, and increased overall efficiency by limiting the time lighting is on to only when necessary. For indoor lighting, lighting controls consist of occupancy, daylighting, timers, scheduling, and dimming features to optimize light levels based on external lighting availability and usage of a space. For outdoor lighting, the lighting controls consist of motion sensors, photocells, and timers to turn the lighting ON/OFF. The current lighting in the Medical Examiners Facility is approximately 19% LED and 81% fluorescent and the estimated wattage is approximately 0.91 W/ft². See Section 2.1.3 for the lighting counts used to estimate energy consumption.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.



Figure 9: Example Fixture with Integrated Occupancy Controls

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Interior lights are assumed to be on 10 hours per day for 256 days of the year.
- This measure assumes a 0.48 W/ft² or approximately 50% reduction in interior lighting power and a 30% reduction in hours of operation for adding new controls.
- O&M savings assume an average cost of $2.15/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- LED upgrades cost $215/fixture, which include integrated control sensors and no additional wiring and control circuits. Low-cost fixtures and external controls can be used as an alternative to this implementation method. This measure assumes all fluorescent lamps are converted to LEDs, estimated at 401 total fixtures.
- Lighting controls for existing LEDs assume $250/sensor and approximately one sensor for every four fixtures with approximately 20% of existing fixtures already LED.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, the subsequent steps would involve conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. Following this assessment, a controls contractor can be engaged to install the lighting controls and assist building engineers in configuring the schedule to optimize lighting usage. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 9: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**Annual Utility Cost Savings ($)**	**O&M Savings ($)**	**Est Project Cost ($)**	**Simple Payback (Yrs)**
LED Upgrade & Controls	0	56,723	194	25	$6,239	$2,049	$86,215	10.4
Lighting Controls on Existing LEDs	0	3,525	12	1.6	$388	$0	$3,338	8.6
Total	**0**	**60,248**	**206**	**27**	**$6,627**	$2,049	$89,553	10.3 (AVG)
Overall % Reduction	**0%**	**5.7%**	**3%**	**4%**	**5%**	**--**	**--**	**--**

4.2 ECM 2 – HVAC Scheduling and Setback

Implementing standardized setpoints and occupancy schedules for the HVAC system can reduce energy consumption in the Medical Examiner's Facility by avoiding unnecessary heating or ventilation operation during unoccupied periods. Currently, systems operate 24/7 to maintain occupied conditions, even during nights, weekends, and holidays when spaces may be unoccupied.

This measure proposes enabling occupied and unoccupied setpoints and schedules for the HVAC system, allowing heating and ventilation equipment to "coast" toward setback temperatures during typical unoccupied periods. For example, space temperatures could be allowed to drift to 60°F heating setpoints during unoccupied hours while maintaining normal comfort setpoints when the building is occupied.

Because the facility may receive urgent calls at any time (e.g., the need to store bodies or respond to incidents outside of normal hours), the HVAC system must retain local override functionality. Local override controls can allow staff to temporarily return systems to occupied mode to ensure ventilation and temperature requirements are met whenever the building is unexpectedly in use.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume an HVAC setback of an average of 6 hours/day.
- A total programming cost of $1,500 and $500 each for local override control (for each AHU) was assumed.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Survey existing control functionalities to confirm ability to program occupied/unoccupied schedules and install local overrides (if current thermostats do not have

appropriate override functionality). Establish seasonal setpoints (generally targeting 68–74°F when occupied and 55–60°F when unoccupied). Configure schedules in the BMS, and test override controls to confirm staff can activate ventilation and heating systems as needed. Verify and monitor to ensure proper operation. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 10: ECM 2 Savings and ROM Cost

	Savings Summary							
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
HVAC Scheduling	382	88,652	699	60	$0	$11,665	$4,000	0.3
Overall % Reduction	13%	8.4%	10.6%	9.6%	--	9.0%	--	--

4.3 ECM 3 – Retro-commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and restore systems to their original design intent. In the Medical Examiner's Facility, HVAC systems currently operate 24/7 to maintain occupied setpoints, even during periods of limited or no occupancy. This results in excess heating and ventilation energy use. Beyond HVAC scheduling, which is proposed in ECM X, RCx presents an opportunity to verify and optimize systems and sequences to ensure systems operate efficiently while still supporting the unique operational requirements of the facility.

Observations from the site visit and high-level review of the BMS system indicate that there may be optimization opportunities. A few examples include:

- The BMS sequence of operation indicates there is a hot water reset schedule which adjusts between 120F and 180F and baseboard supply reset of 140F to 160F based on the outdoor air temperature. The primary hot water, reheat, and baseboard setpoints were observed at 180F when the outdoor air temperature was 40F. This indicates the reset schedule may not be enabled or operating as originally intended.
- Review and optimize general occupied/unoccupied setpoints.
- Calibrate sensors and confirm equipment is responding appropriately to programmed setpoints, sequences, and lockouts.
- Review system operation to identify and resolve simultaneous heating and cooling (primarily in the summer months when the chiller is operational and reheat is active).

While each of these individual examples are minor concerns, these illustrate an opportunity to systematically evaluate all major systems to identify and resolve similar operational discrepancies to optimize system performance and reduce energy usage. The following list represents RCx opportunities that should be evaluated to validate operation, modify and/or

repair if discrepancies identified if systems not scheduled for timely replacement. This effort will proactively improve building system operation and optimize energy usage.

- Optimize HVAC scheduling where appropriate
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water and chilled water supply reset
- Discharge air setpoint reset
- Outside air temperature lockouts
- Outside air damper control
- Duct static pressure reset
- Repair airside or waterside economizing
- Demand-controlled ventilation
- Repair/seal AHU air leaks
- Repair or replace missing or damaged insulation on hot water, steam, and/or condensate pipes

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 5% reduction in estimated heating, cooling, fan, and pump end use energy consumption. This is conservative but assumes significant savings in ECM 2.
- Project cost is estimated at $0.5 per square foot of building area.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: This measure proposes engaging a third-party contractor to determine if this building is eligible for the DTE RCx program and systematically evaluate and prioritize major HVAC and control systems and complete retro-commissioning to restore systems to their original design intent. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 11: ECM 3 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
RCx	142	37,096	274	24	$0	$5,640	$19,340	0.3
Overall % Reduction	4.9%	3.5%	4.1%	3.9%	--	3.7%	--	--

4.4 ECM 4 - Variable Frequency Drives for Hot Water Pumps

Variable Frequency Drives (VFDs) on pumps will provide a dynamic and energy-efficient solution by allowing precise control of pump speed, optimizing performance, and reducing unnecessary energy consumption during periods of lower demand. Currently, there are three sets of constant volume hot water pumps including the primary distribution pumps, reheat pumps, and baseboard pumps. These range in size from 5 HP to 10 HP each and operate in lead/lag mode. Two 25 HP chilled water pumps have VFDs. The BMS setpoints and sequences indicate the primary and reheat pumps run 24/7 when the outdoor air temperature is below 90°F and the baseboard pumps when the outdoor air temperature is below 55°F. This ECM proposes installing VFDs on each of the hot water system pumps to modulate pump speed as needed to meet heating requirements which will reduce pump energy.

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- VFDs will be most effective when paired with a BMS to automatically control speeds.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed. VFDs will likely increase the service life of the equipment if properly selected and installed.
- The savings for this measure assume an average 15 to 25% reduction in equipment speed.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the hot water system pumps (primary, reheat, and baseboard) for compatibility with a VFD and assess the usage pattern and energy consumption. Once this data is collected, select the appropriate type of VFD. Choose VFD based on compatibility with current systems, programmability, and reliability. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 12: ECM 4 Savings and ROM Cost

	Savings Summary							
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
VFDs on HW Pumps	0	52,181	178	23	$0	$5,740	$13,200	4.4
Overall % Reduction	0%	5.0%	2.7%	3.7%	--	4.4%	--	--

5 Considered But Not Currently Recommended

No additional ECMs have been considered.

6 Appendix A

Table 13: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	231	$1,419	67,862	2,399	91	121	1,051	0
Feb-23	259	$1,512	67,200	2,685	100	125	955	0
Mar-23	248	$756	72,734	2,578	98	156	918	0
Apr-23	186	$643	76,089	1,926	106	173	525	28
May-23	2,091	$6,253	89,785	21,704	121	198	283	76
Jun-23	111	$274	76,805	1,151	107	167	86	139
Jul-23	46	$185	79,443	479	107	148	11	227
Aug-23	86	$249	96,329	895	129	192	48	141
Sep-23	159	$452	100,778	1,655	140	228	113	85
Oct-23	239	$690	79,430	2,484	107	171	415	31
Nov-23	268	$999	72,083	2,779	100	168	779	0
Dec-23	266	$1,314	66,841	2,765	90	114	834	0
Jan-24	417	$1,837	80,168	4,330	108	143	1,194	0
Feb-24	315	$1,713	71,924	3,265	107	134	874	1
Mar-24	276	$1,565	71,952	2,870	97	155	771	2
Apr-24	230	$479	79,130	2,384	128	209	437	21
May-24	147	$300	92,167	1,531	124	203	148	98
Jun-24	160	$517	101,723	1,657	141	221	51	207
Jul-24	123	$399	117,600	1,280	158	219	18	251
Aug-24	127	$271	101,547	1,319	136	202	37	215
Sep-24	163	$394	109,092	1,687	152	247	84	112
Oct-24	225	$602	81,306	2,332	109	175	356	31
Nov-24	271	$938	69,635	2,814	97	163	607	4
Dec-24	450	$1,001	76,012	4,673	102	129	1,037	0
2023 Sum	4,191	$14,746	945,379	$43,500			6,019	727
2024 Sum	2,904	$10,016	1,052,256	$30,142			5,614	942

7 Appendix B

Table 14: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity	Units	Approx Year Installed
AHU-1	1	Air handling unit (HHW, CHW), 100% OA	Autopsy procedures	Carrier	39TH21HA-15187-B	8400	CFM	
AHU-1A	1	Air handling unit (HHW, CHW)	AUTOPSY SUITE	Carrier	39TU21HA-15187-B	9500	CFM	
AHU-2	1	Air handling unit (HHW, CHW)	2ND FLOOR MECH	Carrier	39TR32A-15188-NB	14220	CFM	
AHU-3	1	Air handling unit (HHW, CHW)	ADMINISTRATION	Carrier	39TR32A-15189-NB	16150	CFM	
AHU-4	1	Air handling unit (HHW, CHW)	INTAKE DISCHARGE DOCK	Carrier	39TH07HA-151871-B	4500	CFM	
AHU-5	1	Air handling unit (HHW, CHW)	MECH ROOM			3500	CFM	
CHILLER 1	1	Air cooled chiller	Entire building	Trane	RTAF250EUAFHXUA2NT4X1NXNCCV1HBXBCXXAX1XXXX0	250	TON	2018
CHP-1,2	2	CHW pumps w/ VFD	AHUs	Baldor	EM2531T-G	25	HP	
N/A	1	Steam boiler (NG)	Entire building	BRYAN BOILERS	RV800-S-15-FDG-LX	6400 out	MBH	1998
HX1 ,2	2	Steam to HHW heat exchanger				334	TON	
	1	Domestic hot water heater		Raypak	H30403	327.18 out	MBH	
EF-1	1	Exhaust Fan	AUTOPSY ROOM	Loren Cook	170 MH SD	20	HP	
EF-2	1	Exhaust Fan	AUTOPSY SUITE GENERAL EXHUAST	Loren Cook	150 MH SD	20	HP	
EF-3	1	Exhaust Fan	TOXOCOLOGY FLOOR	Loren Cook	130 MH SD	10	HP	
	2	2 Chiller Units (3 fans each)	Chiller Room	Bohn	ADT156AJ	1.3	TON	
	4	4 Freezer units (2 fans each)	Freezer Room	Bohn	LET090BJ	0.75	TON	

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity	Units	Approx Year Installed
	2	2 Chiller Units (5 fans each)	Chiller Room (cadavers)			1.3	TON	
P-1, P-2	2	HHW pumps w/ VFDs				5	HP	
RH-1, RH-2	2	VAV reheat pumps				7	HP	
BB-1, BB-2	2	Baseboard pumps				5	HP	
	1	Air compressor	HVAC controls	Powerex	AD050402	5	HP	

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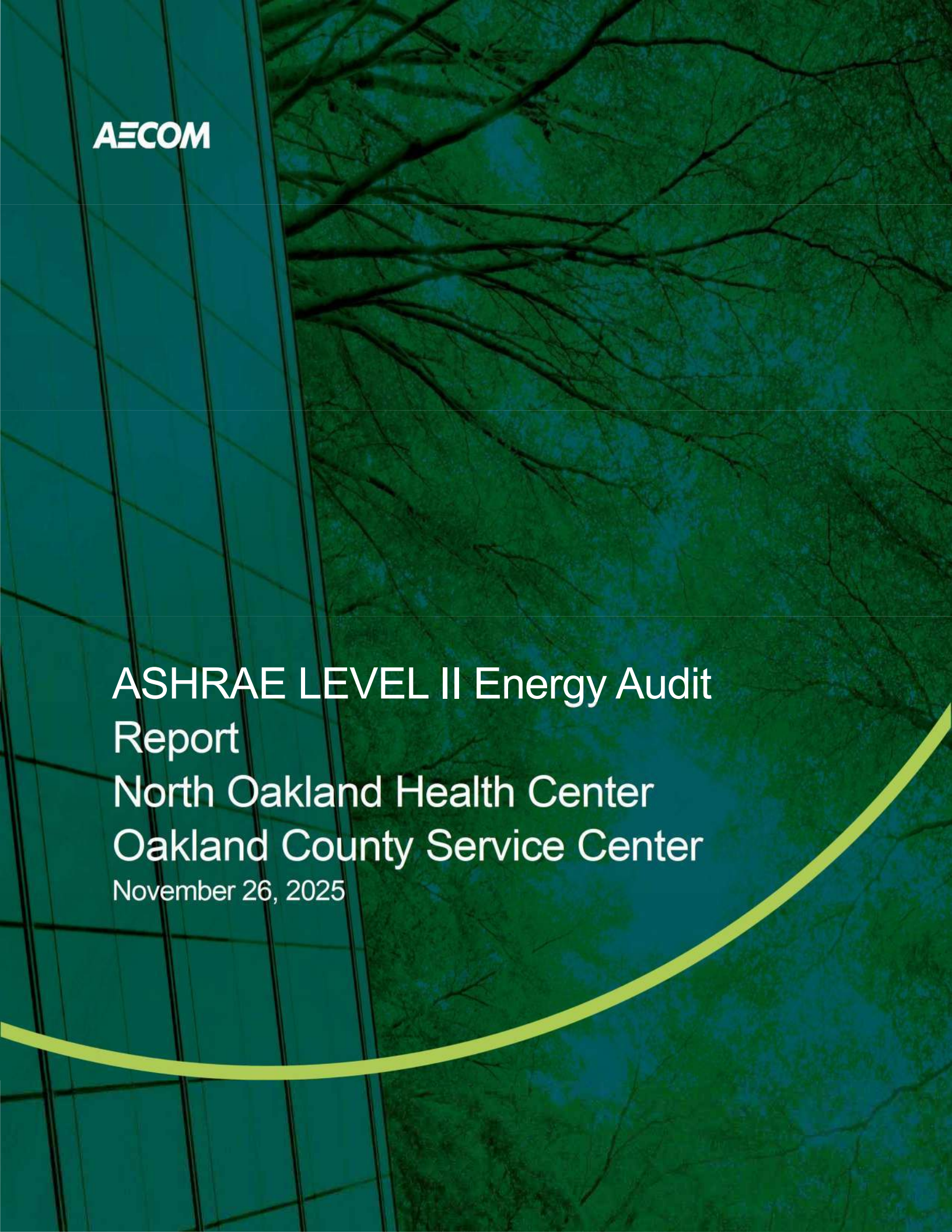

AECOM

ASHRAE LEVEL II Energy Audit Report
North Oakland Health Center
Oakland County Service Center

November 26, 2025

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

Prepared for:
OAKLAND COUNTY, MI Government

Prepared by:
AECOM

Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County North Oakland Health Center in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County North Oakland Health Center is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Thursday April 10, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates four ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The four listed measures represent a projected 32% annual energy cost savings with an aggregate simple payback of 5.6 years. All four measures are prioritized as "Recommended" for implementation.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be "electrification-ready" to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE's prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: North Oakland Health Center Proposed Energy Savings Summary

ECM #	Measure Description	Priority	Measure Status	Year -1 Electricity Savings	Demand Reduction	District Steam Savings	Total Energy Saved	Year - 1 GHG Savings	O&M and Water Savings	Year - 1 Cost Savings	Project Cost (Est)	Simple Payback Period
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	klbs/yr	MMBTU	MTCO2e	$/yr	$/yr	$	Years
1	Retro-Commissioning	HIGH	R	21,215	0	228	319.6	36.5	$0	$4,611	$29,419	6.4
2a	LED Upgrade	MED	R	160,199	42	0	546.6	70.9	$6,938	$17,622	$150,750	6.1
2b	Occupancy Sensors	LOW	R	34,302	0	0	117.0	15.2	$0	$3,773	$62,813	16.6
3	HVAC Scheduling and Setback	HIGH	R	74,028	0	455	796.4	87.0	$0	21,395	$1,500	0.1
4	Install VFDs on Pumps	MED	R	33,560	0	0	114.5	14.9	$0	$8,458	$18,900	5.1
Sum of Recommended Measures				**323,304**	**42**	**683**	**1,894**	**224**	**$6,938**	**$42,395**	**$263,381**	**6.2**
Overall % Reduction				38%	21%	21%	28%	30%	--	34%	--	--

Notes
Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

North Oakland Health Center is approximately 151,000 ft^2 and operates as a medical building providing primary case and dental services. The building includes offices, meeting rooms, conference rooms, patient exam rooms and other specialty medical facilities. The Health Center consists of a main building and an addition. The addition was added in 1972, but the main building was constructed in 1926. An assessment of the Building Management System (BMS) indicated that heating and cooling is provided to the facility 24hrs per day, seven days per week. The Health Center is open to the public Monday through Friday, with operational hours of 10:30am to 7:00pm on Mondays, and 8:30am to 5:00pm the remainder of the week.

2.1 Building Systems

2.1.1 Building Envelope

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Masonry construction on original building. Addition has glass exterior on side with other sides being slab construction.	For the original building - good appearance from visual inspection, however older construction and may not be adequately insulated. Good condition for the recent addition.
Roof	Roof was not accessible during the site visit.	The roof of the North Oakland Health Center consists of a 0.09 mil EPDM membrane, installed over a combination of decking types, including concrete, lightweight concrete, wood, and metal.
Glazing	Double-pane with a low to medium window to wall ratio. While the addition has a glass exterior, the interior occupied is not fully exposed to the exterior window.	Moderate.

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The North Oakland Health Center is comprised of two sections, one is two floors and the other is four floors. The buildings air handling units (AHUs) are old and towards the end of their expected useful life. AHU-1 serves variable air volume (VAV) terminal units throughout the basement, first floor and second floor. AHU-2 partially serves VAV terminal units throughout the east side of the 1st and 2nd floor and the 3rd and 4th floors. Two 120-ton air-cooled York chillers provide chilled water to the AHUs for space cooling. The chillers have two 15 horsepower (HP) pumps which operate in lead/lag mode at constant speed when the outdoor temperature is above the enable setpoint. Additional cooling for a temperature-controlled room is provided through a cassette air conditioning (AC) unit with an outdoor condensing unit. The cooling capacity of the systems which operate this building is around 250 tons.

To provide heat to the facility, there is a steam to hot water heat exchanger which supplies heating hot water to the AHU's as well as the baseboards via multiple distribution loops including a south-west, south-east, and north baseboard loop and separate loop to AHU-1 and AHU-2. The pumps for these loops are estimated to range in size from 3 HP to 7.5 HP and appear to all be constant speed. The heating capacity of the heat exchanger is unknown.

2.1.2.2 Plumbing

One 80-gallon domestic water tank that is supplied with hot water through a steam to hot water heat exchanger serves the majority of the building's domestic water needs. A small electric domestic hot water heater also serves some areas of the facility.

2.1.2.3 Building Controls

The building is primarily controlled by a fully direct digital controls (DDC) Niagara BMS. There are local controls for the baseboard heating system, however the steam valves that generate the hot water for the baseboard heaters are controlled by the BMS and shut when the outside temperature is above 55°F to reduce the impact of simultaneous heating and cooling. However, at least one of the hot water distribution pumps was set to hand which overrides BMS control (southeast zone). The heating system also has a main outdoor air reset sequence which adjusts the zone hot water supply temperature from 145°F to 180°F depending on the outdoor air temperature between 25°F and 65°F and a zone hot water supply temperature for the SW and SE baseboards from 130°F to 160°F depending on the outdoor air temperature between 25°F and 55°F. The chillers and pumps have an outdoor enable setpoint of 60°F and a chilled water supply setpoint of 44°F.

The AHUs appear to be equipped with airside economizing and discharge air temperature reset schedules to optimize energy efficiency. However, AHU-2 appears t

2.1.3 Lighting Systems

Based on the site visit, lighting fixtures throughout the building are installed in recessed, ceiling-mounted, or suspended configurations, selected according to the functional needs and layout of each area. The lighting system is primarily fluorescent fixtures rated at 32W.

The quantity of fixtures listed in the table represents an approximation for the whole building.

Table 3: Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
Fluorescent Lights	830	2 lamps
Fluorescent Lights	5	4 lamps
Fluorescent Lights	120	3 lamps
Fluorescent Lights	50	1 lamp
Non-LED Exit Lights	65	-

The total approximate quantity of the building is 1070 light fixtures. The approximate total wattage is 68,960 watts. The approximate area per drawing is 84,054 ft^2. The lighting density is calculated as 0.82 W/ft^2.

An office lights schedule operates from 5:30 AM to 8:30 PM Monday to Saturday and 7:30 AM to 4:00 PM on Sunday in the BMS. However, it's unclear if this controls the whole building or just a section of lighting. This should be evaluated with the LED upgrade ECM to determine the most effective lighting control strategy.

2.1.4 Electrical Infrastructure

The facility is powered by a 750 KVA transformer located in the electrical room. The main electrical service operates at 13,200V stepped down to 480/277V, with a service rating of 1200A, 3-phase. The meter number is IQ DP-4000, and it shows a recorded demand rate of 2112.36 kW/h. The building is also equipped with backup power, supplied by a 450-kW generator.

3 Utility Billing Analysis

3.1 Utility Type and Usage

North Oakland Health Center receives electric service and is connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

Steam usage is metered and billed to the building based on the cost to generate the utility. Steam is the primary heating source for the building.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed included the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Steam:** Oakland County Internal Tracking

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

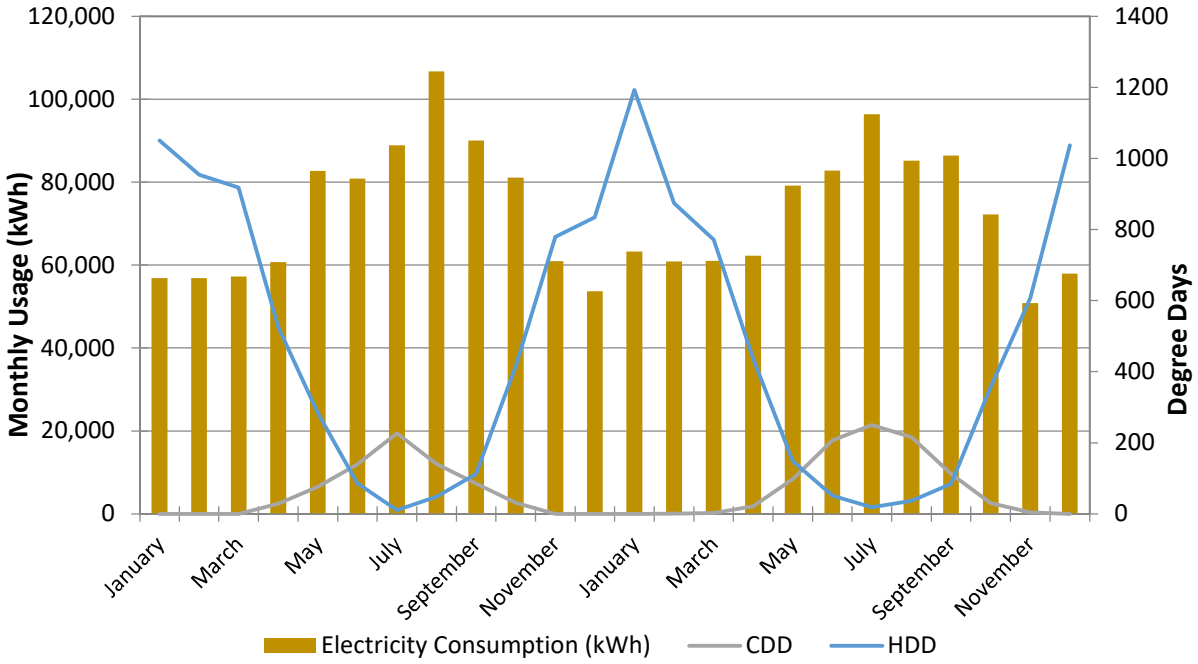
Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	858,336 kWh	2,929	$94,417	$0.11/kWh	0.0004427	380
Steam	3,196 klbs	3,816	$31,960	$10.00/klbs	0.119	380
Total	**--**	**6,745**	**$126,377**	**--**	**--**	**760**

** Steam (1 klb = 1194000 Btu); Electricity (1 kWh = 3413 Btu)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a correlation to weather data, indicating a significant seasonal cooling load. The annual usage for the baseline 12-month period from January to December 2024 is 858,336 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 5: Electrical Capacity Results

Maximum Building Capacity at Service Transformer	750 kW
Maximum Capacity at Switchgear (A*V*Ph)	1000 kW
Estimated Peak Demand	195 kW (estimated)
Remaining Capacity	**555 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge:	**$0.057/kWh**
DTE Electric Demand Charge:	**$6.15/kW/Month**
Average Dollar per kWh Used in Calculations:	**$0.11/kWh**

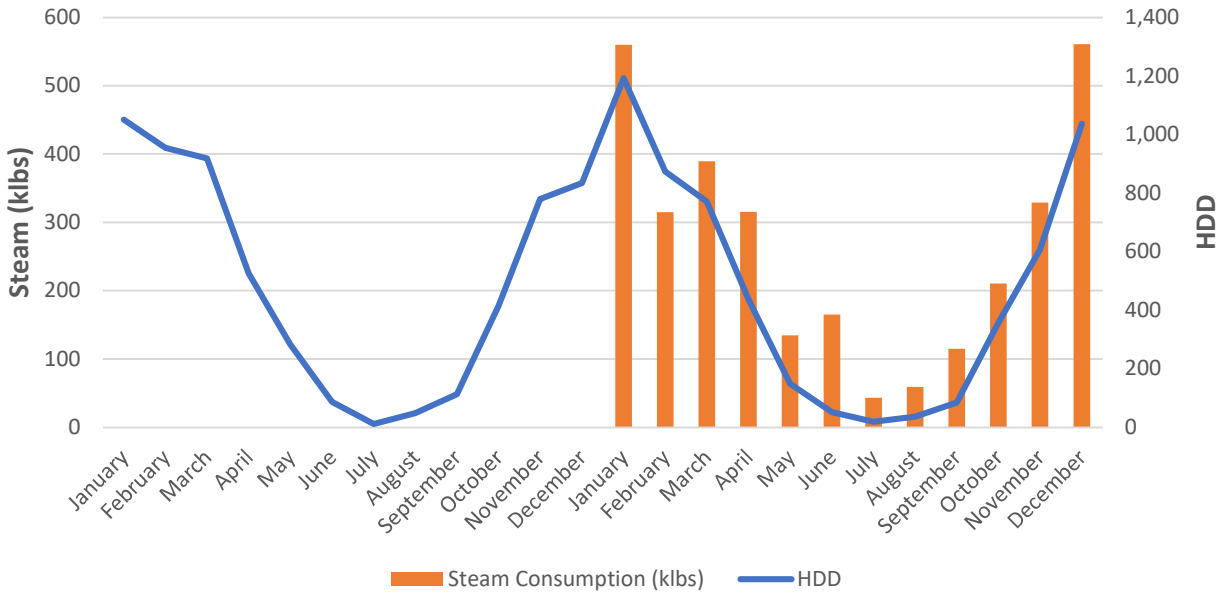
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Steam Usage Profile

Figure 3 shows the monthly steam usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Steam usage shows a minor correlation to weather data, as steam is used to produce heating hot water for space heating. The significant baseload usage, particularly evident in the summer, is due to domestic hot water usage for bathrooms. The annual usage for the baseline 12-month period from January to December 2024 is 3,196 klbs. Detailed monthly steam usage and costs are in Appendix A.

Figure 3: Steam Usage Profile (January 2024 to December 2024)



3.4.1 Steam Rate Structure

Unlike electricity and natural gas, which are billed directly by external utilities, steam is an internal utility produced on campus. The cost allocation for steam is derived from the total natural gas cost at the central steam plant, as well as costs to operate the plant. Each steam-served building is billed proportionally based on its metered steam usage relative to the campus total. As a result, there are no separate delivery, demand, or third-party charges; the unit cost of steam reflects the cost of natural gas, plant operating cost and efficiency, and distribution system performance.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings.

Average Dollar per klb Used in Calculations: $10.00/thousand lbs

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$94,417
Steam	$31,960
Total	$126,377
ECI $/yr/sf	$1.50

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

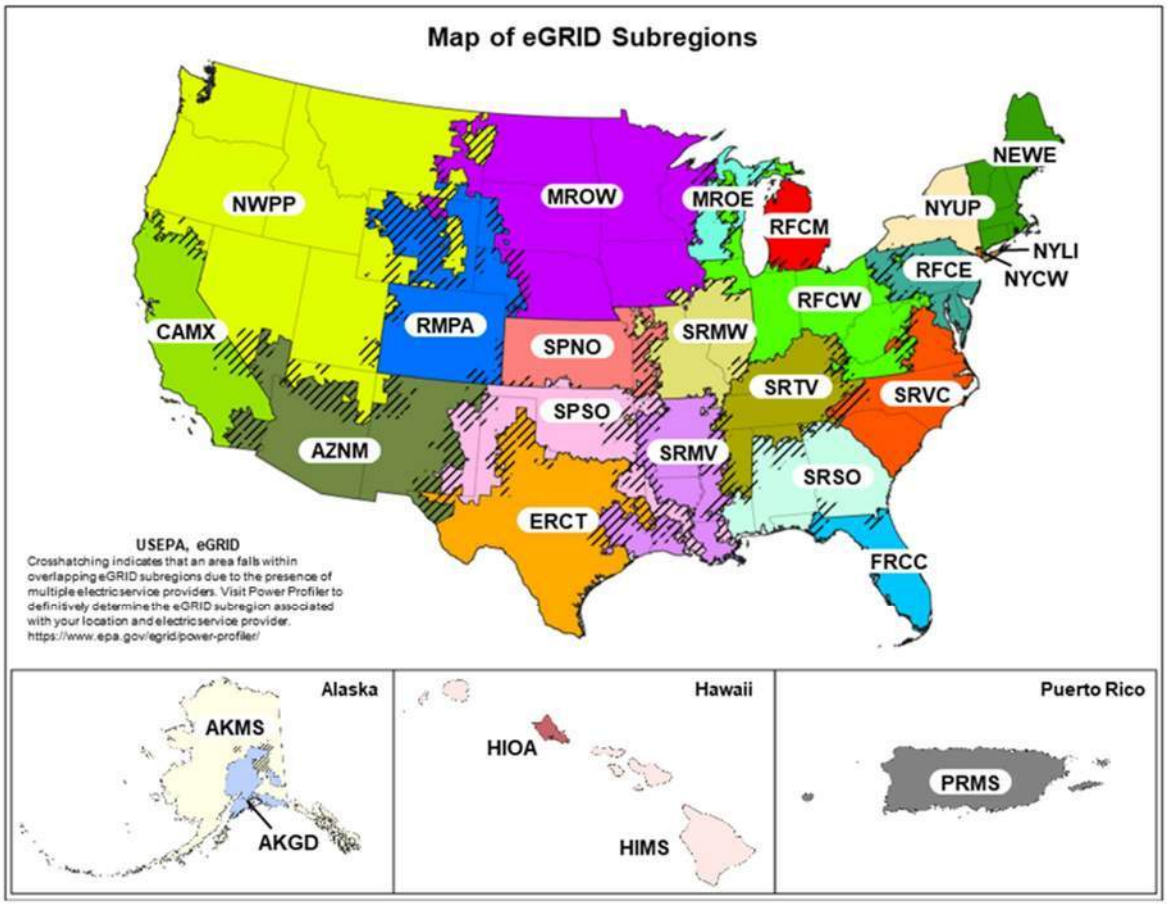
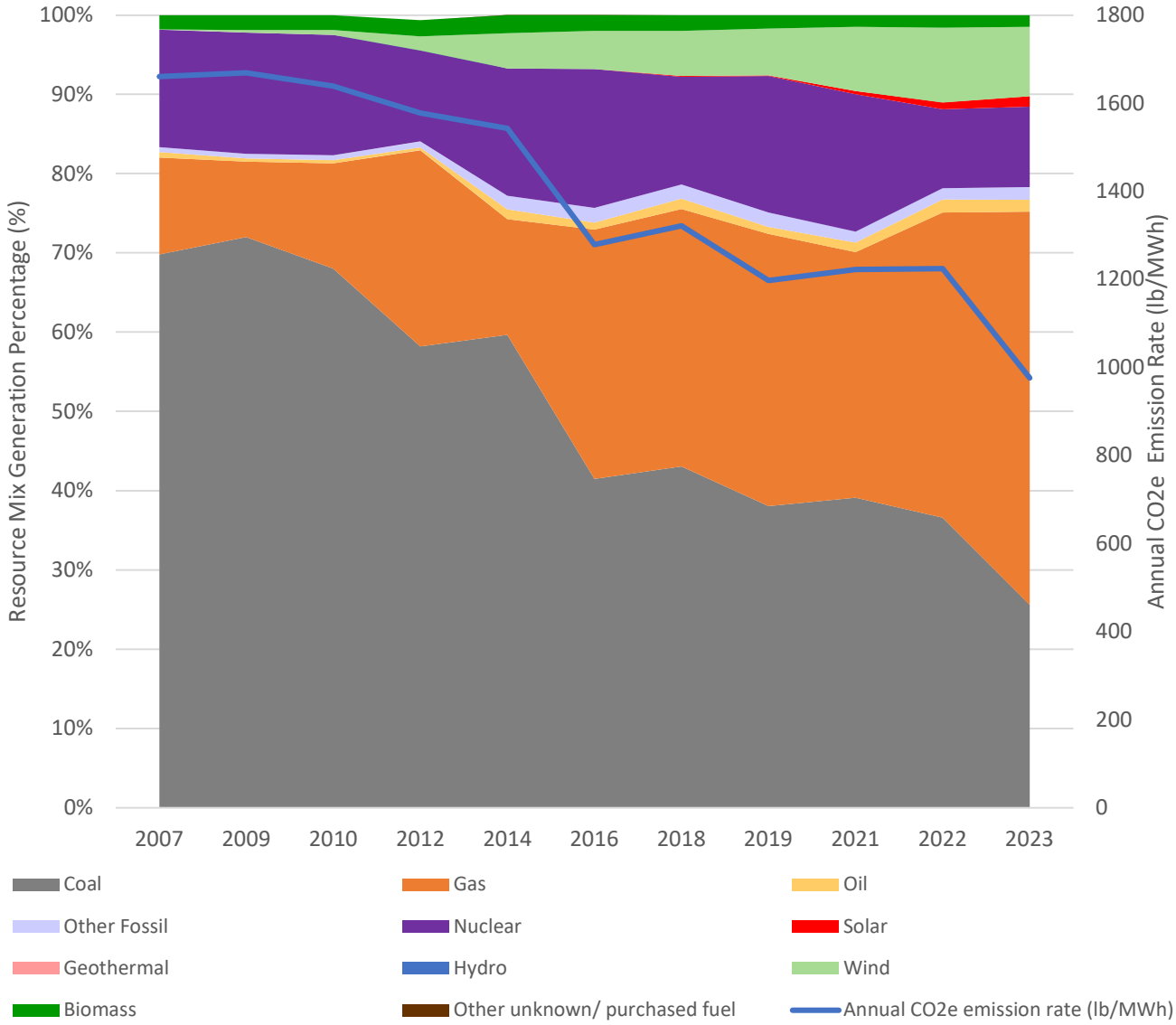


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 63 percent of carbon emissions are attributed to steam and 37 percent are associated with electricity. Steam combustion and imported electricity resulted in 641 tCO2e (campus-level Scope 1) and 380 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 1,021 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for North Oakland Health Center are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	North Oakland Health Center				**Electric EUI:**	35	kBTU/SF/yr
GFA:	84,054	SF			**Steam EUI:**	45	kBTU/SF/yr
eGRID Subregion:	RFCM				**Current EUI**	80	kBTU/SF/yr
Annual Utility Summary							
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	858,336	kWh	3.412	2,929	0.0004427	380	$94,417	75%
Steam	3,196	klbs	1194	3,816	0.119	380	$31,960	25%
			Totals	**6,745**	**-**	**760**	**$126,377**	**100%**

According to the US EPA, the average site energy use intensity for a medical office is 97.7 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 80 kBTU/SF, which is lower than the national benchmark. However, there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient

3.8 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees and visitors. Table 8 and Figure 6 and Figure 7 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (klbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	0	3,036	3,625,223	43	361
Space Cooling	244,300	0	0	833,552	10	108
Fans	180,006	0	0	614,181	7	80
Pumps	69,217	0	0	236,167	3	31
DHW	0	0	160	190,801	2	19
Conveyance	17,904	0	0	61,088	1	8
Lighting	274,538	0	0	936,725	11	122
Plug Loads	68,371	0	0	233,281	3	30
Process Loads	0	0	0	0	0	0
Refrigeration	4,000	0	0	13,648	0	2
Cooking	0	0	0	0	0	0
Information Technology	0	0	0	0	0	0
TOTAL	**858,336**	**0**	**3,196**	**6,744,666**	**80**	**760**
Historical Billing	858,336	0	3,196			
Percent of Actual	100%	0%	100%			
per sqft	10.2	0	0.04			

Figure 7: Existing Electricity End Use Distribution

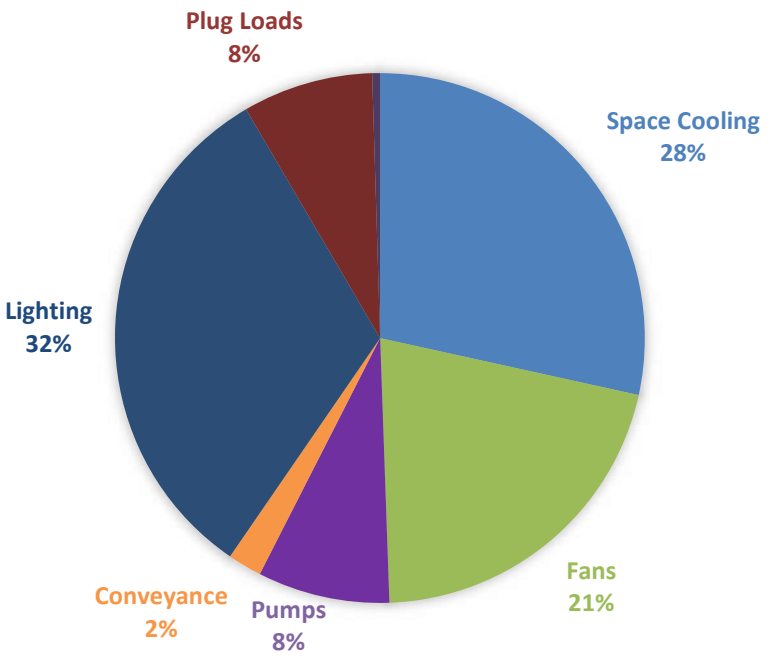
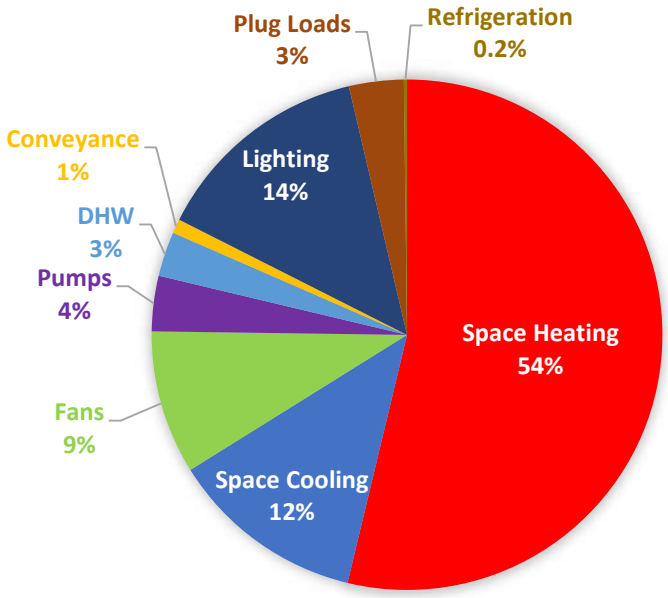


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent. North Oakland Health Center currently utilizes a building controls system which allows for advanced control of HVAC systems and scheduling. However, RCx is an extremely valuable measure that should be implemented to its fullest extent to ensure systems are operating effectively and efficiently.

Observations from the site visit and high-level review of the BAS system indicate that not all systems are operating optimally or communicating with the BAS. A few examples include:

- At least one hot water pump was observed in “hand” or manual mode which overrides automatic control. This should be restored to automatic control.
- North baseboard hot water pump has an alarm.
- AHU-2 damper positions and mixed air temperature could be optimized to better align to the effective discharge air setpoint to reduce unnecessary heating. The outdoor air damper appears open beyond the minimum resulting in unnecessary heating to meet the discharge air setpoint.
- Room 184 appears to be overheating (likely due to baseboard sensor or control) as setpoint is 69 and space temperature is 75 with cooling only VAV 100% open.
- Several VAVs show zone state “satisfied” and zone setpoint of 0 and damper positions 0% and airflow 0 CFM. If accurate, these areas may not be receiving adequate ventilation air which is an indoor air quality (IAQ) concern, especially in a medical building. These units should be evaluated to ensure proper operation and ventilation to these spaces. See screenshot example.

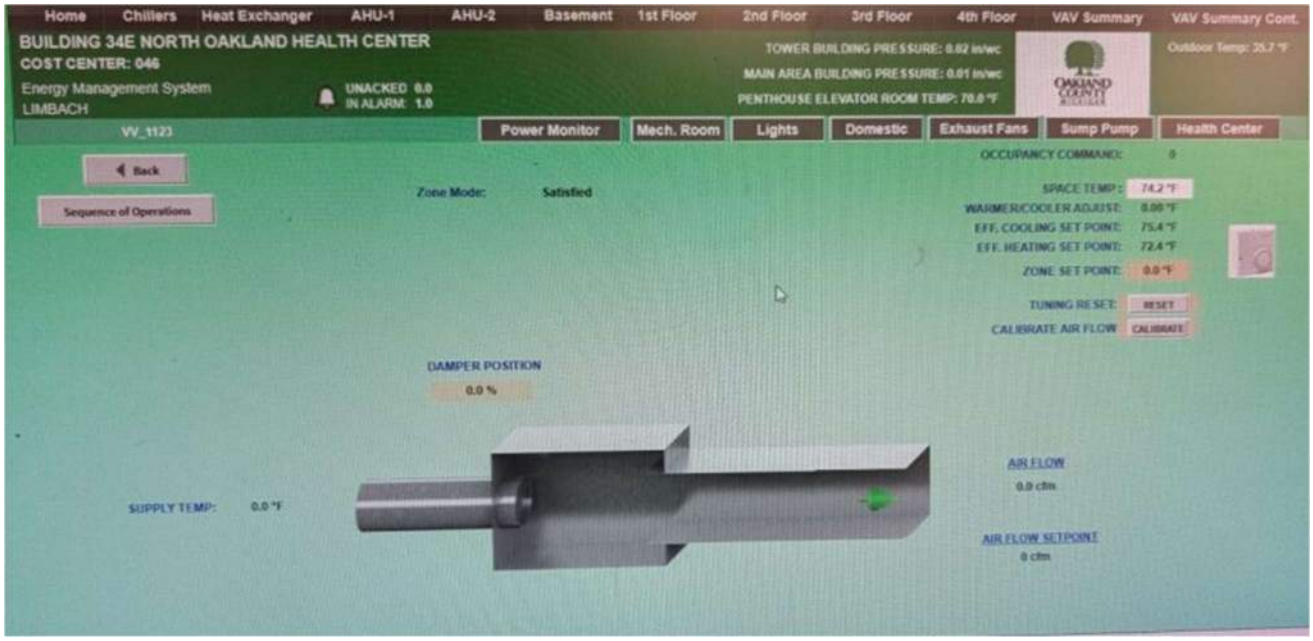


Figure 9: BMS example of potential VAV IAQ issue

While each of these individual examples are minor concerns, these illustrate an opportunity to systematically evaluate all major systems to identify and resolve similar operational discrepancies to optimize system performance and reduce energy usage. The following list represents RCx opportunities that should be evaluated to validate operation, modify and/or repair if discrepancies identified if systems not scheduled for timely replacement. This effort will proactively improve building system operation and optimize energy usage.

- Optimize HVAC scheduling where appropriate
- Optimize HVAC occupied and unoccupied setpoints
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water and chilled water supply reset
- Discharge air setpoint reset
- Outside air temperature lockouts
- Outside air damper control
- Duct static pressure reset
- Repair airside or waterside economizing
- Demand-controlled ventilation
- Repair/seal AHU air leaks

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing RCx will improve equipment operations, extend useful life, and reduce energy costs.

- Energy savings assume 7.5% in estimated heating, and 5% in estimated cooling, and fan energy consumption. Potential scheduling and setback savings are accounted for in ECM 3, and pump savings are accounted for in ECM 4. However, these measures could be combined to maximize project implementation benefits and savings.
- Additional study of equipment capacity requirements could be performed as part of this measure.
- $0.35/SF was used to estimate the cost for the 84,054 SF building.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: This measure proposes engaging a third-party contractor to determine if this building is eligible for the DTE RCx program and systematically evaluate and prioritize major HVAC and control systems and complete retro-commissioning to restore systems to their original design intent.

Table 9: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	Steam Savings (klbs)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
RCx	228	21,215	319.6	36.5	$0	$4,611	$29,419	6.4
Overall % Reduction	**7%**	**2%**	**5%**	**5%**	**--**	**4%**	**--**	**--**

4.2 ECM 2 – LED Lighting and Controls

This measure proposes upgrading all fluorescent lighting to Light-emitting diode (LED) lightbulbs with sensors to reduce energy consumption and electrical demand. LEDs are highly energy efficient as most of the electrical energy supplied to the fixture is converted into light – 80% or more depending upon the LED lamp. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements.

Incorporating lighting controls allows for better management and customization of lighting systems, leading to reduced energy consumption, and increased overall efficiency by limiting the time lighting is on to only when necessary. For indoor lighting, lighting controls consist of occupancy, daylighting, timers, scheduling, and dimming features to optimize light levels based on external lighting availability and usage of a space. For outdoor lighting, the lighting controls consist of motion sensors, photocells, and timers to turn the lighting ON/OFF. The lighting in North Oakland Health Center is primarily fluorescent fixtures rated at 32W. See Section 2.1.3 for the lighting counts used to estimate energy consumption

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture.
- Lights operate an average of 9.5 hours per day for 365 days per year based on office operational hours and BMS lighting schedule. However, this may be an underestimate if the BMS lighting schedule controls all building lighting.
- This measure assumes a 0.50 W/ft² or 60% reduction in interior lighting power.
- LED upgrades cost $150/fixture; motion sensors cost $250 per sensor; sensors placed on 25% of the fixtures. The costs have been split out between the fixtures and controls in the summary table below.
- O&M savings assume an average cost of $3.22/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, subsequent steps include conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. Following this assessment, a controls contractor can be engaged to install the lighting controls and assist building engineers in configuring the schedule to optimize lighting usage.

ECM Savings and ROM Cost:

Table 10: ECM 2 Savings and ROM Cost

Savings Summary								
ECM	**Steam Savings (klbs)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost ($)**	**Simple Payback (Yrs)**
2a: LED Upgrade	0	160,199	547	71	$6,938	$17,622	$150,750	6.1
2b: Motion Sensors	0	34,302	117	15	$0	$3,773	$62,813	16.6
Total	**0**	**194,500**	664	86	$6,938	$21,395	$213,563	10
Overall % Reduction	**0%**	**23%**	**9.8%**	**11.3%**	**--**	**17%**	**--**	**--**

4.3 ECM 3 – HVAC Scheduling and Setback

Implementing standardized setpoints and occupancy schedules for the HVAC system can reduce energy consumption to enhance energy efficiency in areas with regular weekly occupancy. By establishing consistent temperature setpoints and aligning HVAC schedules with actual occupancy patterns, the system avoids unnecessary heating or cooling during unoccupied hours such as evenings, weekends, and holidays. This can be done by enabling seasonal occupied and unoccupied setpoints and schedules on programmable thermostats or enabling these controls in a centralized BAS where only authorized individuals can adjust as needed. This allows the HVAC system to "coast" toward unoccupied setpoints when the spaces are unoccupied and minimizes the need for the HVAC system to run. North Oakland Health Center currently has a building management system, but the HVAC systems operate 24/7, rather than matching the occupancy schedule. Since the health center has typical office hours five days a week, there is an opportunity to reduce the total HVAC operation time with setbacks during unoccupied times to reduce energy consumption.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- The existing HVAC runs 24/7 to maintain occupied setpoints due to the current BAS scheduling, however the building is only occupied Monday to Friday based on the building operational hours.
- Energy savings assume 15% in estimated heating, cooling, fan and pump energy end uses.
- $1500 was used to estimate programming costs required to implement the setbacks.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Conduct a survey of existing control functionalities to determine any necessary upgrades and then establish seasonal setpoints (generally targeting 68-74°F when occupied and 55-60°F/80-85°F when unoccupied) and HVAC schedules that align with building occupancy patterns. Following these steps, the centralized BMS HVAC schedule should be configured accordingly. Verify and monitor to ensure the system is operating as intended and adjust as needed. This measure is recommended for implementation.

Table 11: ECM 3 Savings and ROM Cost

Savings Summary								
ECM	**Steam Savings (klbs)**	**Electric Savings (kWh)**	**Energy Savings (MMBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
HVAC Scheduling and Setback	455	74,028	796.4	87.0	$0	$12,697	$1,500	0.1
Overall % Reduction	**14%**	**9%**	**11.8%**	**11.4%**	**--**	**10%**	**--**	**--**

4.4 ECM 4 – Install VFDs on Pump Motors

Variable Frequency Drives (VFDs) on pumps will provide a dynamic and energy-efficient solution by allowing precise control of pump speed, optimizing performance, and reducing unnecessary energy consumption during periods of lower demand. Currently, the supply and return fan motors on AHU-1 and AHU-2 were observed to have VFDs, but the hot water and chilled water pumps did not and appear to all be constant speed. This ECM proposes evaluating the chilled water and hot water pumps for feasibility to add VFDs to reduce pump energy. These pumps range in size from approximately 3 HP to 15 HP.

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- VFDs will be most effective when paired with a BAS to automatically control speeds.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed. VFDs will likely increase the service life of the equipment if properly selected and installed.
- The savings for this measure assume an average 25% reduction in equipment speed.
- If coupled with routine upgrades to include premium efficiency motors additional energy savings may be achieved.
- Costs assume $300/motor horsepower and assumes redundant lead/lag pumps for each distribution loop.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the chilled water and hot water pumps for compatibility with a VFD and assess the usage pattern and energy consumption. Once this data is collected, select the appropriate type of VFD. Choose VFD based on compatibility with current systems, programmability, and reliability. Evaluate feasibility for VFDs on any systems that remain without VFDs for additional savings.

Table 12. ECM 4 Savings and ROM Cost

Savings Summary								
ECM	**Steam Savings (klbs)**	**Electric Savings (kWh)**	**Energy Savings (MMBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
Install VFDs on Pumps	0	33,560	115	15	$0	$3,692	$18,900	5.1
Overall % Reduction	**0%**	**4%**	**1.7%**	**2%**	**--**	**3%**	**--**	**--**

5 Considered But Not Currently Recommended

No additional ECMs have been considered.

6 Appendix A

Table 13: Monthly Utility Data (2023 to 2024)

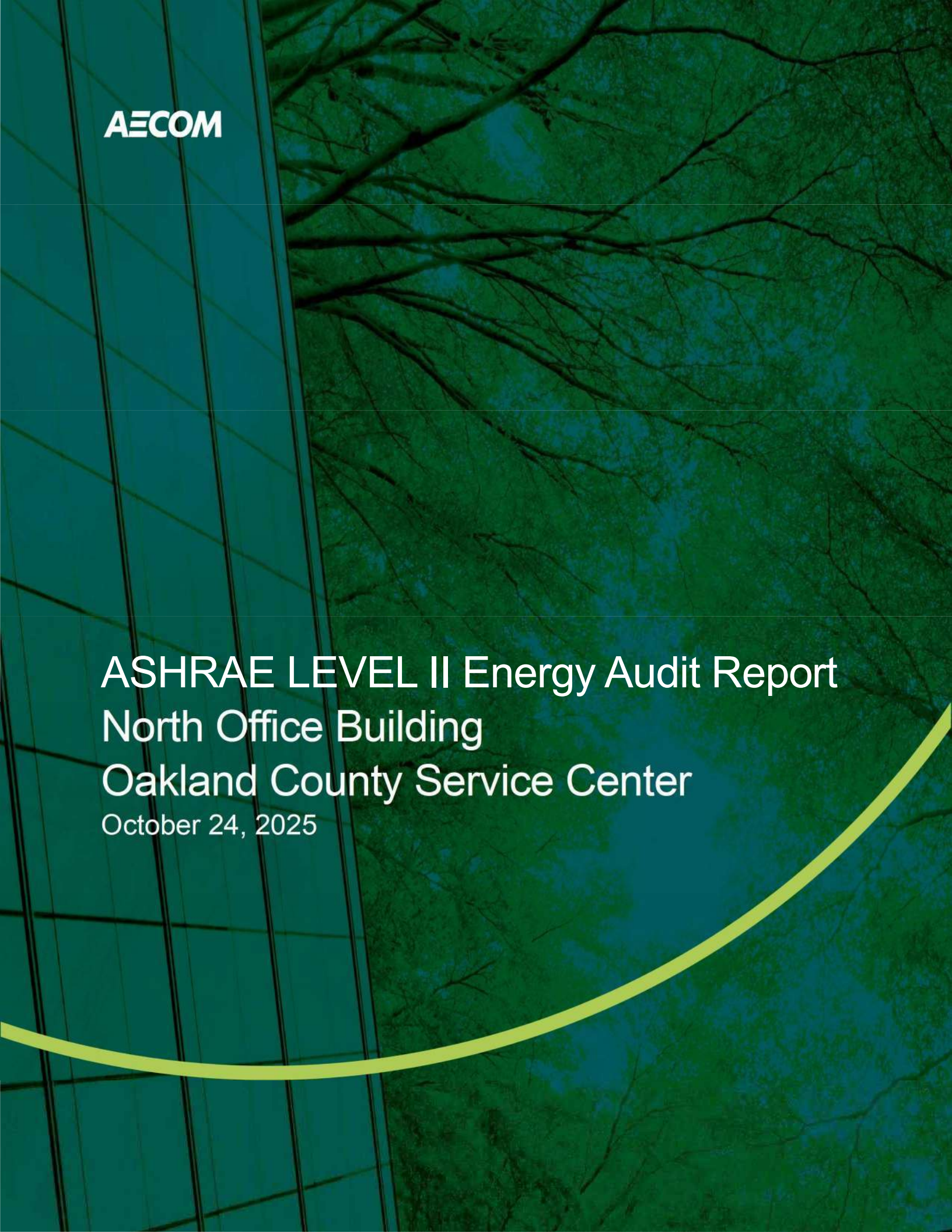
Month	Steam Consumption (klbs)	Steam Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	-	-	32,000	$6,254	76	101	1,051	0
Feb-23	-	-	34,720	$6,254	85	106	955	0
Mar-23	-	-	36,000	$6,297	77	123	918	0
Apr-23	-	-	33,440	$6,681	84	138	525	28
May-23	-	-	38,400	$9,097	111	182	283	76
Jun-23	-	-	31,520	$8,894	112	176	86	139
Jul-23	-	-	37,760	$9,780	120	165	11	227
Aug-23	-	-	35,200	$11,742	143	212	48	141
Sep-23	-	-	33,280	$9,903	125	204	113	85
Oct-23	-	-	38,560	$8,920	109	174	415	31
Nov-23	-	-	40,160	$6,701	85	142	779	0
Dec-23	-	-	35,040	$5,906	72	91	834	0
Jan-24	560	$5,599	43,680	$6,962	85	113	1,194	0
Feb-24	315	$3,149	40,000	$6,699	91	113	874	1
Mar-24	390	$3,895	41,120	$6,713	82	131	771	2
Apr-24	315	$3,154	36,000	$6,845	110	180	437	21
May-24	134	$1,342	38,560	$8,707	106	174	148	98
Jun-24	165	$1,651	34,240	$9,108	115	180	51	207
Jul-24	43	$430	41,120	$10,598	129	179	18	251
Aug-24	59	$591	35,520	$9,373	115	169	37	215
Sep-24	115	$1,150	41,440	$9,507	120	195	84	112
Oct-24	210	$2,103	35,040	$7,944	97	155	356	31
Nov-24	329	$3,289	31,200	$5,591	71	119	607	4
Dec-24	561	$5,607	38,240	$6,371	78	99	1,037	0
2023 Sum	-	-	426,080	$96,428			6,019	727
2024 Sum	3,196	$31,960	456,160	$94,417			5,614	942

7 Appendix B

Table 14: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Efficiency	Approx Year Installed
AHU-1	1	Air handling unit, VAV (HHW, CH)	Basement, 1st floor, 2nd floor	Trane Climate Changer	25B			
AHU-2	1	Air handling unit, VAV (HHW, CH)	1st floor east area, 2nd floor east area, 3rd floor, and 4th floor	Trane Climate Changer	25B			
Chiller 8,9	2	Air cooled chillers	Half building	York	YLAA0120SE46XFBSDTXA XXBLXCXX44SE	120 TON		2016
		Cassette air conditioning units	Temperature controlled rooms					
HX-1	1	Steam to HHW HX	Baseboards, AHUs					
DWH	1	Domestic water heater	Entire building	Lochnivar	RJS080M	80 GAL		
	2	Heating Hot Water Pumps	AHUs	Baldor	EM3710T-G	7.5 HP	91.5%	
HWP-3	2*	SE Baseboard Hot Water	SE Baseboards			3 HP*		
HWP-5	2*	SW Baseboard Hot Water	SW Baseboards			3 HP*		
HWP-7	2*	N Baseboard Hot Water	N Baseboards			3 HP*		
P-10, P-11	2	Chilled Water Pumps	AHUs			15		

AECOM



AECOM

ASHRAE LEVEL II Energy Audit Report
North Office Building
Oakland County Service Center
October 24, 2025

Quality information

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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County North Office Building, 26 East, in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation" or "Not Recommended" measures based on simple payback period or foreseen feasibility issues.

All identified energy reduction opportunities have been characterized in this report as ECMs regardless of scope and scale of capital investment. Additionally, AECOM recognizes that Oakland County wishes to pursue the future electrification of its facilities to the extent practical, as described in AECOM's Service Center-wide assessment report of future electrification options. The ECMs listed in this report address opportunities identified within existing conditions and existing energy infrastructure. The report's proposed ECMs may or may not be relevant to an energy infrastructure environment evolved from fossil fuel-driven energy infrastructure to fully electrically powered energy infrastructure.

The Oakland County North Office Building is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates four ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The three listed measures that are recommended represent a projected 38% annual energy cost savings with an aggregate simple payback of 6.1 years. One measure is recommended for further study.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: North Office Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Annual Electricity Savings**	**Demand Reduction**	**Annual Gas Savings**	**Annual District Steam Savings**	**Total Annual Energy Saved**	**Annual GHG Savings**	**O&M and Water Savings**	**Annual Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	klbs/yr	MMBTU/yr	tCO2e/yr	$/yr	$/yr	$	Years
1	LED Lighting	MED	R	40,378	13	0	0	138	18	$1,548	$4,442	$44,400	7.4
1a	Lighting Controls	LOW	R	6,857	0	0	0	23	3	$0	$754	$18,500	24.5
2	VFDs on AHUs	MED	R	58,805	0	0	0	201	26	$0	$6,469	$16,250	2.5
3	RCx	LOW	R	21,416	0	0	52	135.38	15.69	$0	$2,878	$18,786	6.8
Sum of Recommended Measures				127,457	13	0	52	497	63	$1,548	$14,542	$97,936	6.1
Overall % Reduction				40%	16%	0%	15%	34%	35%	--	38%	--	--
Measures Considered but not Recommended													
4	Pneumatic controls upgrade	N/A	RS	1,485	1	0	0	5.1	0.7		$163	$56,358	345

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The North Office building is approximately 37,000 ft^2 and a three floor building and operates as a standard office building. The building includes veterans services, circuit court probation, and the public defender's office. The building was originally built in 1930 as the Children's Village Juvenile Home and was renovated to become office space in 1975. An assessment of the building management system (BMS) indicated that heating and cooling is provided to the facility 24hrs per day, Monday through Friday, with no heating, ventilation, and air conditioning (HVAC) provided over the weekend. It is assumed that the facility operates on a standard office building schedule, with minimal occupancy outside of these hours.

2.1 Building Systems

2.1.1 Building Envelope

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Masonry construction	In Good appearance from visual inspection, however older construction and may not be adequately insulated
Roof	Roof was not accessible during the site visit	N/a
Glazing	Double-pane with a low to medium window to wall ratio	Moderate

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The North Office Building is a three-story facility. Each floor is served by a separate constant volume (CV) air handling unit (AHU) that are controlled by the BMS. The AHUs are very old and beyond the age of their expected useful life. A 125-ton air-cooled chiller, located outside the building, provides chilled water to the AHUs for cooling. Steam from the central loop, at ~120 pounds per square inch (PSI), enters the building and is reduced to 5 PSI and provided directly to steam coils in the AHUs and baseboards for heating. There are local temperature sensors throughout the building to control the temperature in the occupied spaces. The AHU for the first floor is placed in a small space that constrains access and the unit is noisy. There is a 2-ton air conditioning (AC) unit for the data closet with a condensing unit outside the building.

AHU-LL has a 25-ton capacity. AHU-1L has a 30-ton capacity. AHU-2L has a 50-ton capacity. The heating capacities of the AHUs are unknown.

2.1.2.2 Plumbing

There is a 40-gallon electric domestic water heater serving the entire building. The system has a capacity of either 4,500 W (at 240 V) or 3,380 W (at 208 V). The voltage of the system was not known at the time of the site visit.

2.1.2.3 Building Controls

The building's chiller and AHUs are controlled by a Niagara BMS with a mix of direct digital controls (DDC) and pneumatic controls throughout the facility. The terminal units and baseboard heaters are not on the BMS and are controlled locally. The operation of the HVAC system and chiller through the BMS and local control for the baseboard heat allows for simultaneous heating and cooling, which was acknowledged as a significant issue for this site by facility staff.

The AHUs have operational schedules which operate 24 hours a day Monday to Friday. The AHUs appear to be equipped with airside economizing or free-cooling below 65°F and a discharge air reset schedule from 60°F to 75°F. The chiller has an enable setpoint set to 70°F and the steam enable setpoint is set to 60°F. If functioning properly, these enable setpoints should prevent simultaneous mechanical cooling and heating during the summer months, but the current baseboard local controls cause some overheating and simultaneous heating and free-cooling during the cooler months. It appears this is noticeable when the AHU schedules are off over the weekend and the baseboard heaters overheat some spaces, requiring cooling when the AHU schedules enable. The sequences of operation were not available in the BMS.

2.1.3 Lighting Systems

During the site visit, lighting fixtures were found to be recessed, ceiling-mounted, or suspended, depending on the room layout and use. The building uses a mix of 32W fluorescent and 12W light emitting diode (LED) fixtures. The fixture provided is for the east side of the basement only. The west side is similar, so the quantity can be doubled for the full basement. The first and second floors are also similar, so the total building quantity can be estimated by doubling the basement total.

Table 3: Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
Fluorescent Lights	73	2 lamps
Fluorescent Lights	2	4 lamps
LED Lights	5	1 lamp
Non-LED Exit Lights	8	1 lamp

The total approximate quantity of light fixtures is 88 for the east area and 528 for the whole building. The approximate total wattage is 21,376W. The approximate area per drawing is 37,572 ft^2. The lighting density is calculated as 0.56 W/ft^2.

2.1.4 Electrical Infrastructure

The facility is served by a 500 KVA transformer located outside the building. The main service is rated at 480/277V, 800A, 3-phase, with meter number 700X23G10. A secondary meter is also installed outside, labeled 86 126 010, rated at 240V, 43.2 Kh, and currently indicating a demand

of 3.6 Kh. A single line diagram is not available. The building does not have a backup generator. Additionally, there is a 225 KVA transformer located in the basement, providing 208/120V service. The facility includes a main switchboard rated at 800A, 277/480V, and a main section rated at 800A, 120/208V, supporting power distribution at different voltage levels within the building.

3 Utility Billing Analysis

3.1 Utility Type and Usage

North Office receives electric service, is connected to the steam network, and is not connected to natural gas service. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

Direct steam meter data for North Office came from an unreliable meter, showing large spikes in the middle of the summer and almost no steam consumption in the winter. Therefore, annual steam usage was estimated using a square-foot ratio with the Admin Annex II. A comparison of the utility data can be found below.

Table 4: Metered vs. Estimated Steam Data

Month	Metered North Office Steam Data	Estimated North Office Steam Data
Jan-24	0.44	49
Feb-24	42.78	37
Mar-24	0.46	40
Apr-24	0.00	23
May-24	0.79	6
Jun-24	208.35	19
Jul-24	45.88	7
Aug-24	3.32	3
Sep-24	0.25	4
Oct-24	0.25	12
Nov-24	0.24	16
Dec-24	0.25	43
2024 Sum	303	259

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Steam:** Oakland County Internal Tracking

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 5: Total Energy Usage and GHG Emissions (2024)

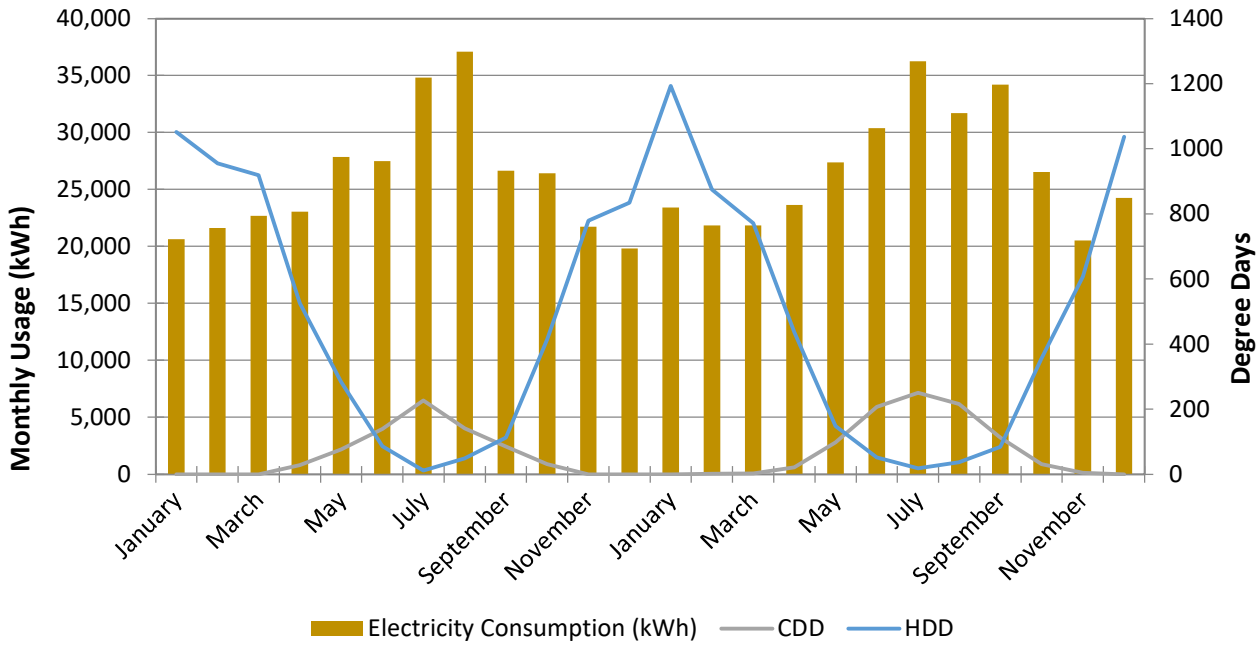
Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	321,840 kWh	1,098	$27,502	$0.11/kWh	0.0004427	142
Steam	348 klbs	415	$3,478.75	$10.00/klb	0.1190000	41
Total	--	1,513	$30,980.75	--	--	184

** Steam (1 klb = 1194 Btu); Electricity (1 kWh = 3413 Btu)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a correlation to weather data, specifically CDD, indicating that there is a significant seasonal summer cooling load. The annual usage for the baseline 12-month period from January to December 2024 is 321,840 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

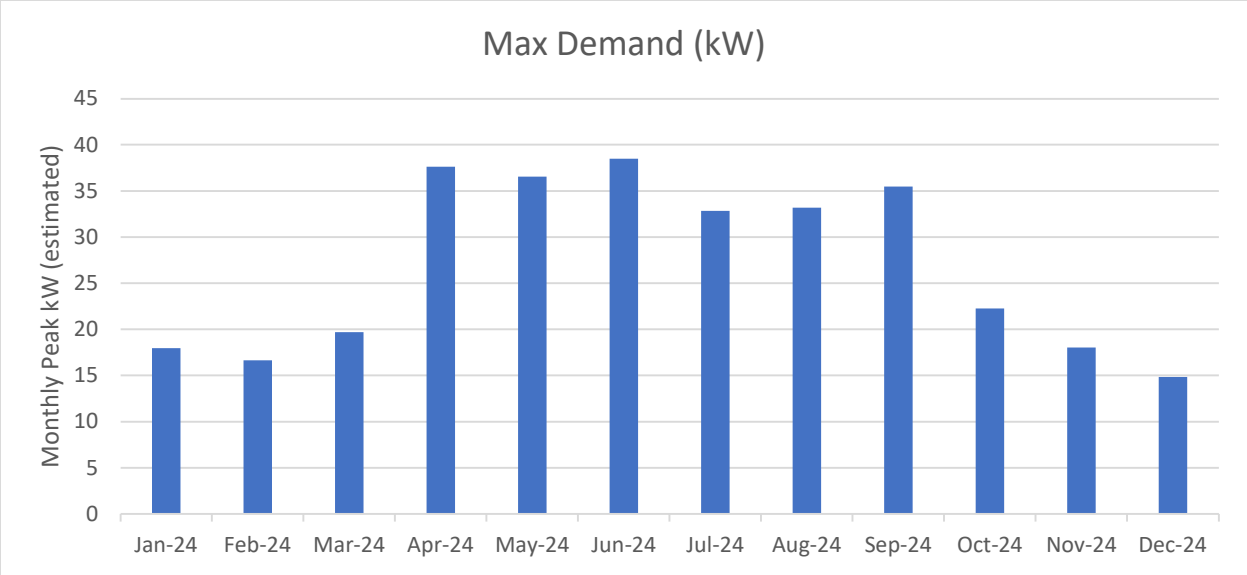
The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 6: Electric Capacity Results

Maximum Building Capacity at Service Transformer	500 kW
Maximum Capacity at Switchgear (A*V*Ph)	665 kW
Estimated Peak Demand	77 kW (estimated)
Remaining Capacity	**423 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable

components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge: **$6.15/kW/Month**

Average Dollar per kWh Used in Calculations: **$0.11/kWh**

Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

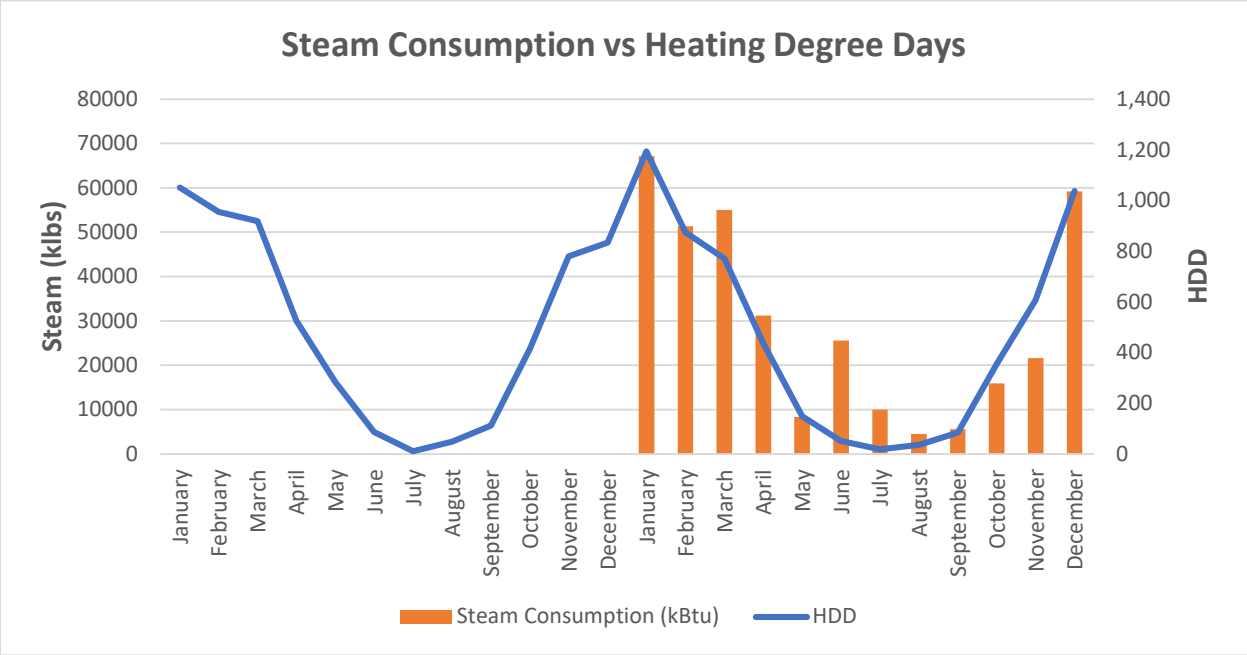
Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Steam Usage Profile

Since direct steam meter data for this building was unreliable, annual steam usage was estimated by extrapolating from another campus building with similar occupancy and system characteristics. A square-foot ratio method was applied, scaling steam consumption from the reference building to match this building's gross floor area.

Figure 3 compares the monthly steam usage profile for 2024 with local monthly weather data for 2023 – 2024 indicated by HDD. Steam data for 2023 is not available. Steam usage shows a direct correlation to weather data, as steam is primarily used for space heating. The annual usage for the baseline 12-month period from January to December 2024 is 259 klbs. Detailed monthly steam usage and costs are in Appendix A.

Figure 3: Steam Usage Profile (January 2023 to December 2024)



3.4.1 Steam Rate Structure

Unlike electricity and natural gas, which are billed directly by external utilities, steam is an internal utility produced on campus. The cost allocation for steam is derived from the total natural gas cost at the central steam plant, as well as costs to operate the plant. Each steam-served building is billed proportionally based on its metered steam usage relative to the campus total. As a result, there are no separate delivery, demand, or third-party charges; the unit cost of steam reflects the cost of natural gas, plant operating cost and efficiency, and distribution system performance.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings.

Average Dollar per klb Used in Calculations: $10.00/thousand lbs

3.5 Energy Cost Index

The energy cost analysis is based on the information provided by an annual purchase request statement for 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 7 below.

Table 7: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$27,502
Steam	$2,976.61
Total	$30,478.61
ECI $/yr/sf	$0.81

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4. Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

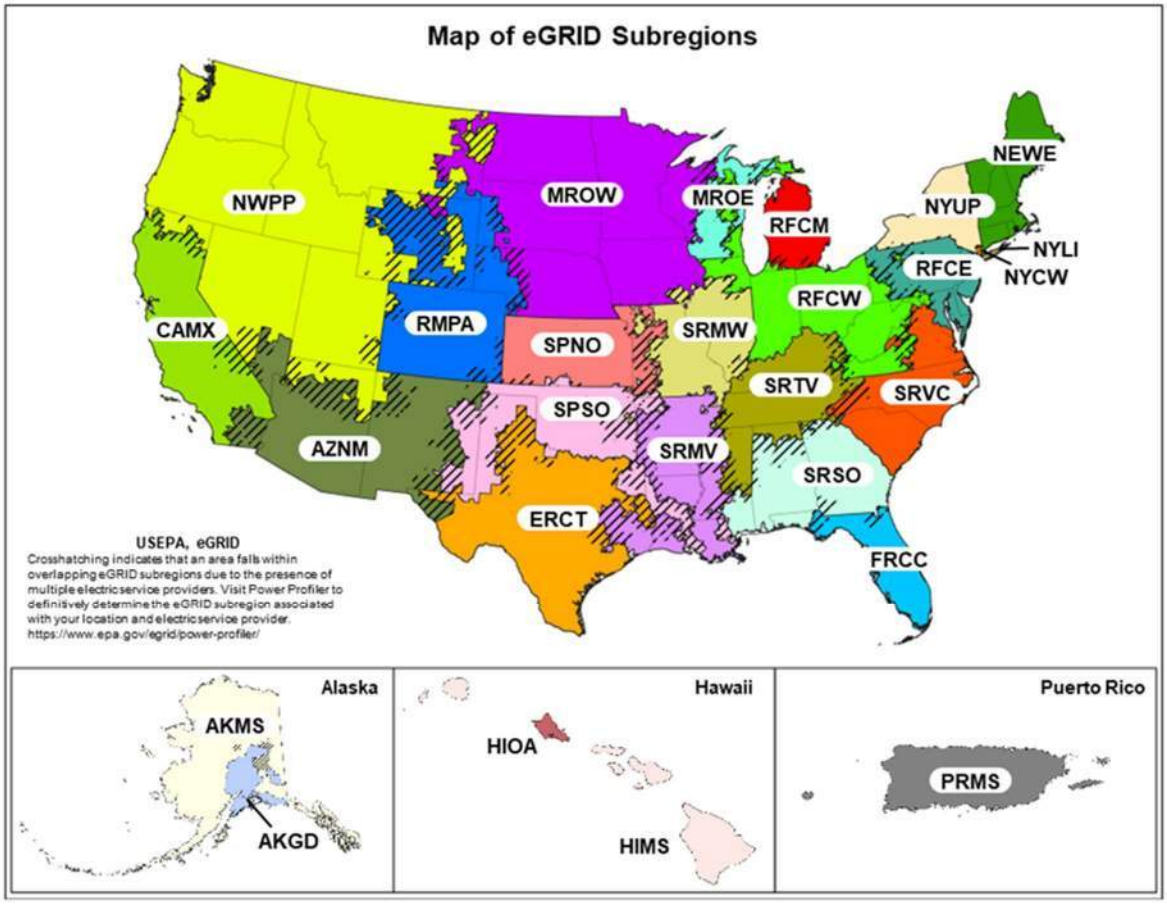
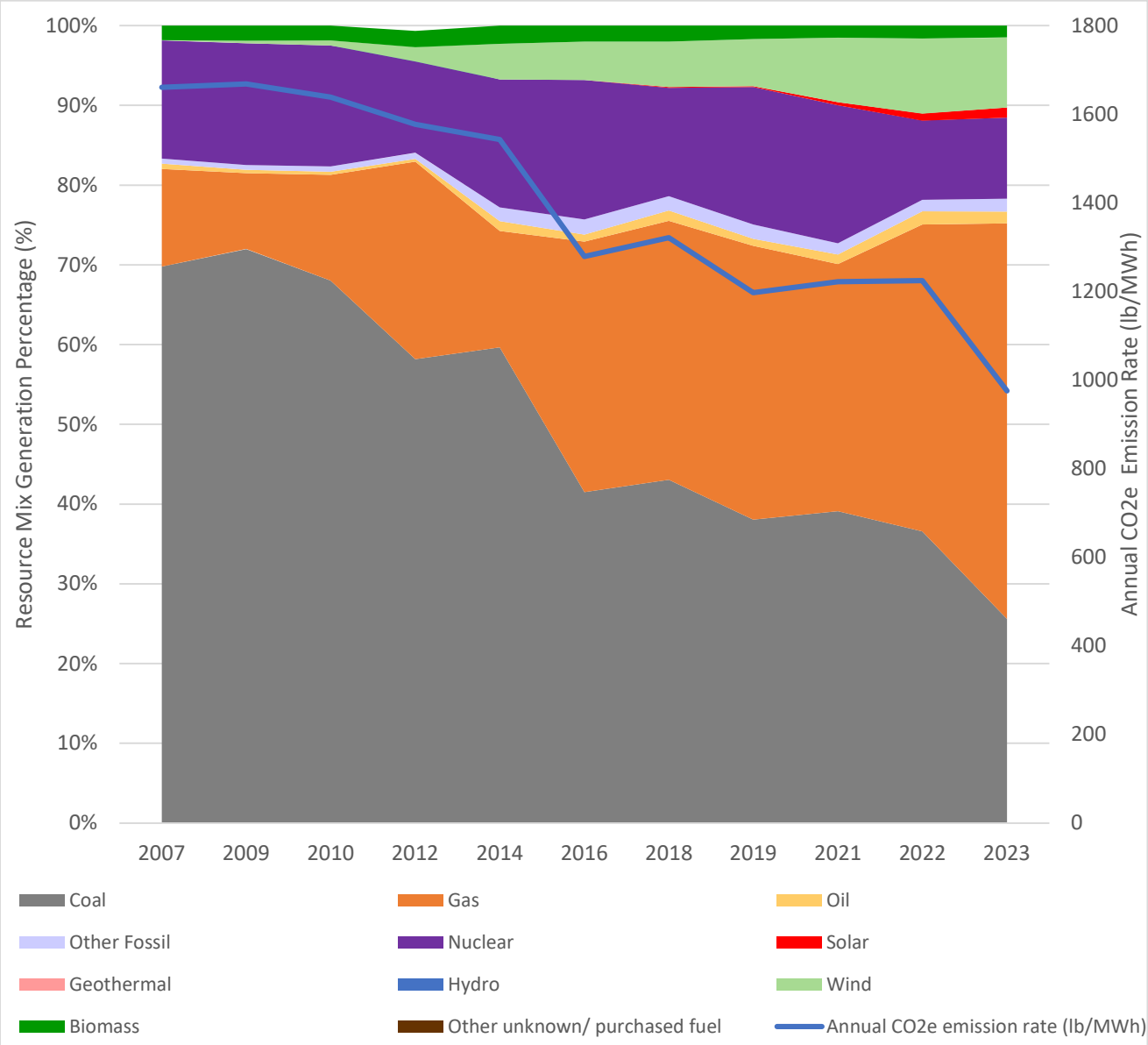


Figure 5 displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 22 percent of carbon emissions are attributed to steam and 78 percent are associated with electricity. Steam combustion and imported electricity resulted in 31 tCO2e (campus-level Scope 1) and 142 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 173 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and steam usage for North Office are converted to kBTUs units, summed, and divided by the total square footage.

Table 8: Annual Utility Summary (2024)

Building:	North Office Building				**Electric EUI:**		29	kBTU/SF/yr
GFA:	37,572	SF			**Steam EUI:**		8	kBTU/SF/yr
eGRID Subregion:	RFCM				**Current EUI**		37	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	321,840	kWh	3.412	1,098	0.0004427	142	$27,502	90%
Natural Gas	0	MCF	1.038	0	0.05492058	0	$ -	0%
Steam	348	klbs	1194	355	0.1190000	35	$2,976.61	10%
		Totals		1,454		**178**	$30,478.61	100%

According to the US EPA, the average site energy use intensity for an office is 52.9 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 37 kBTU/SF, which is slightly lower than the national benchmark. There are still opportunities to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient

3.8 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of occupants.

Table 9 and Figure 8 and Figure 7 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 9: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	0	348	415,363	**11.1**	**41.4**
Space Cooling	65,947	0	0	225,012	**6.0**	**29.2**
Fans	142,771	0	0	487,134	**13.0**	**63.2**
Pumps	5,446	0	0	18,581	**0.5**	**2.4**
DHW	12,042	0	0	41,088	**1.1**	**5.3**
Conveyance	0	0	0	0	**0.0**	**0.0**
Lighting	64,020	0	0	218,438	**5.8**	**28.3**
Plug Loads	30,128	0	0	102,798	**2.7**	**13.3**
Process Loads	1,485	0	0	5,068	**0.1**	**0.7**
Refrigeration	0	0	0	0	**0.0**	**0.0**
Cooking	0	0	0	0	0.0	**0.0**
Information Technology	0	0	0	0	0.0	**0.0**
TOTAL	321,840	0	348	1,513,481	40	184
Historical Billing	321,840	**0**	**348**			
Percent of Actual	100%	0%	100%			
per sqft	8.6	**0.00**	**0.00**			

Figure 7: Existing Electricity End Use Distribution

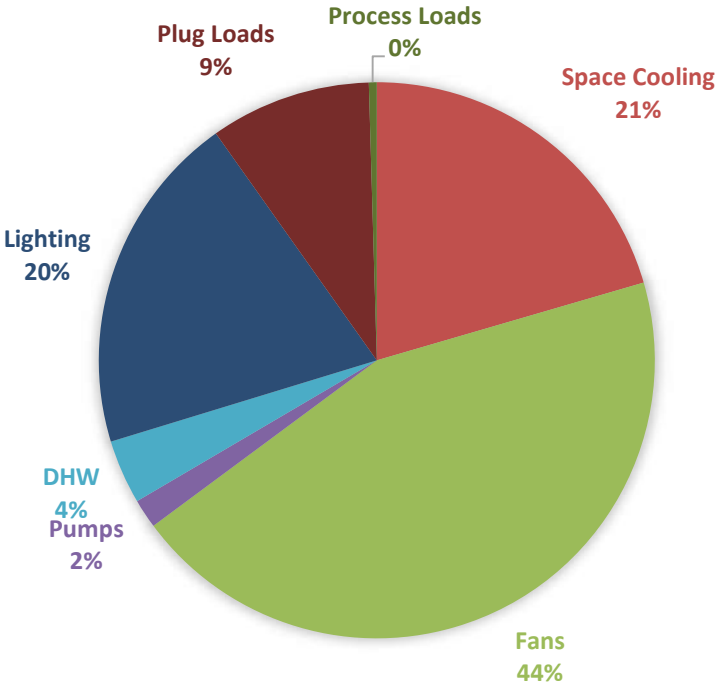
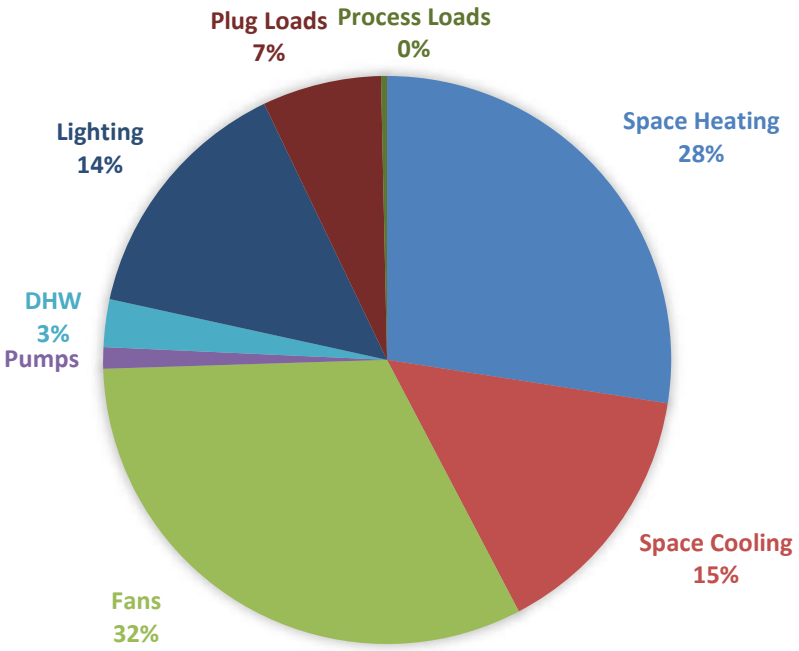


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – LED Upgrade and Controls

This measure proposes upgrading all remaining fluorescent lighting to Light-emitting diode (LED) lightbulbs with motion sensors and dimming functionality where appropriate to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements.

Incorporating lighting controls allows for better management and customization of lighting systems, leading to reduced energy consumption, and increased overall efficiency by limiting the time lighting is on to only when necessary. For indoor lighting, lighting controls consist of occupancy, daylighting, timers, scheduling, and dimming features to optimize light levels based on external lighting availability and usage of a space. For outdoor lighting, the lighting controls consist of motion sensors, photocells, and timers to turn the lighting ON/OFF. The current lighting in the North Office is approximately 6% LED and 94% fluorescent and the estimated wattage is approximately 0.54 W/ft². See Section 2.1.3 for the lighting counts used to estimate energy consumption.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Lights are assumed to be on 12 hours per day for 256 days of the year.
- This measure assumes a 0.33 W/ft² or approximately 60% reduction in interior lighting power and a 30% reduction in hours of operation for adding new controls.

- LED upgrades cost $150/fixture and motion sensors, costing $250 per sensor, would be placed on 25% of the fixtures
- O&M savings assume an average cost of $2.58/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, the subsequent steps would involve conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. Following this assessment, a controls contractor can be engaged to install the lighting controls and assist building engineers in configuring the schedule to optimize lighting usage. This measure is recommended for implementation.

Table 10: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	**District Steam Savings (k lbs)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
LED Upgrade	0	40,378	138	18	$1,548	$4,442	$44,400	7.4
Lighting Controls	0	6,857	23	3	$0	$754	$18,500	24.5
Total	**0**	**47,235**	**161**	**21**	**$1,548**	**5,196**	**62,900**	**9.3**
Overall % Reduction	0.0%	14.7%	11.4%	12.1%		17.3%	--	--

4.2 ECM 2 - Variable Frequency Drives for AHUs

Variable Frequency Drives (VFDs) on fan motors will provide a dynamic and energy-efficient solution by allowing precise control of fan speed, optimizing performance, and reducing unnecessary energy consumption during periods of lower demand. Currently, the three AHUs do not have VFDs. This ECM proposes evaluating the AHUs for feasibility to add a VFD to reduce fan energy as the current three AHUs are constant volume.

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- VFDs will be most effective when paired with a BAS to automatically control speeds.

- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed. VFDs will likely increase the service life of the equipment if properly selected and installed.
- The savings for this measure assume an average 20% reduction in equipment speed and does not account for HVAC scheduling savings, which is included in ECM 3.
- This measure assumes a unit cost of $300 per motor HP.
- If coupled with routine upgrades to include premium efficiency motors additional energy savings may be achieved.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the AHUs for compatibility with a VFD and assess the usage pattern and energy consumption. Once this data is collected, select the appropriate type of VFD. Choose VFD based on compatibility with current systems, programmability, and reliability. This measure is recommended for implementation. This ECM may be best combined with ECM 3 and/or a routine capital upgrade to maximize benefits.

Table 11: ECM 2 Savings and ROM Cost

Savings Summary								
ECM	**District Steam Savings (k lbs)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings**	**Est Project Cost**	**Simple Payback (Yrs)**
VFDs on AHUs	0	58,805	201	26	$0	$6,469	$16,250	2.5
Overall % Reduction	0%	18%	14%	15%	--	22%	--	--

4.3 ECM 3 – Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems such as HVAC, lighting, controls, and other energy-consuming equipment to improve operational efficiency and restore systems to their original design intent.

Observations from the site visit and high-level review of the Niagara BMS system indicate that not all systems are operating optimally or consistently communicating with the BMS. Specific opportunities for this facility include:

- Review HHW distribution to AHU and baseboard heating loops for opportunities to optimize setpoints and minimize simultaneous heating and cooling.
- Calibrate sensors, actuators, and flow meters to ensure accurate control of steam, HHW, and CHW distribution.

- Optimize supply air delivery through VAV boxes and verify or repair perimeter baseboard heating controls.
- Align HVAC schedules to actual building occupancy. The schedules currently operate 24 hours per day 5 days per week while the building is typically only occupied during normal business hours. This should be completed after baseboard heating controls are verified or repaired to prevent overheating when the AHUs are unoccupied.

While each of these individual examples are minor concerns, these illustrate an opportunity to systematically evaluate all major systems to identify and resolve similar operational discrepancies to optimize system performance and reduce energy usage. The following list represents RCx opportunities that should be evaluated to validate operation, modify and/or repair if discrepancies identified if systems not scheduled for timely replacement. This effort will proactively improve building system operation and optimize energy usage.

RCx Opportunities to Evaluate

- Optimize HVAC scheduling and occupied/unoccupied setpoints.
- Eliminate simultaneous heating and cooling through BAS control adjustments.
- Test, adjust, and balance airside systems.
- Restore equipment to automatic control.
- Replace or calibrate faulty sensors, actuators, and/or flow meters.
- Repair or replace malfunctioning steam traps (if any identified in HHW or DHW systems).
- Hot water and chilled water supply temperature reset.
- Discharge air temperature reset.
- Outside air temperature lockouts and damper control.
- Duct static pressure reset and economizer repair.
- Demand-controlled ventilation (if compatible with BMS and occupancy).
- Seal AHU air leaks and repair/replace missing insulation on HHW piping.

Assumptions

- Implementation of this measure will not adversely affect occupant health or safety.
- RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 10% reduction in estimated cooling, fan, and pump end use energy consumption, and 15% reduction in heating end use energy consumption due to large levels of simultaneous heating and cooling noted during the energy audit.
- Project cost is estimated at $0.50 per square foot of building area.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Identify remaining equipment to be connected to the central control system and engage a building controls integration company to plan and cost the system integration. Coordinate with planned capital upgrades and renovations where possible to optimize benefits. This measure is recommended for implementation.

Table 12. ECM 3 Savings and ROM Cost

Savings Summary								
ECM	**District Steam Savings (klbs)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
RCx	52	21,416	135.38	15.69	$0	$2,878	$18,786	6.5
Overall % Reduction	18%	7%	9%	9%	--	7%	--	--

5 Measures Requiring Additional Consideration

This section provides details on measures that were analyzed but are not recommended for immediate implementation at this time. This includes measures that require further study, such as capital-intensive replacements of existing equipment, but are not justified through energy savings alone. This section may also include measures that conflict with building electrification plans, or projects that are simply not recommended due to being financially impractical or not being technically feasible.

5.1 ECM 4 - Upgrade Pneumatic Controls to DDC

Pneumatic controls upgrades refers to the process of upgrading antiquated pneumatic control systems and components to direct digital controls (DDC) and integrating it with a centralized control system. Pneumatic controls use compressed air to operate valves and dampers and are prone to operational and maintenance issues. Upgrading these antiquated controls to DDC will enhance the overall efficiency, functionality, and manageability of HVAC system operation. This measure directly produces electricity savings by eliminating the need for a compressed air system, but also indirectly contributes additional energy savings by enabling better control and functionality such as scheduling and optimization. The building's chiller and AHUs are controlled by Niagara BMS with a mix of DDC and pneumatic controls throughout the facility. The baseboard heaters are not on the BMS and are controlled locally. This measure would entail adding the baseboard heaters and the remaining cooling systems that are still controlled by pneumatic controls to the Niagara system.

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- Upgrading pneumatic controls to DDC will improve existing control functionality.
- There would be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed.
- Costs were estimated using $3/sf for 50% of the building area, given that a portion of the building HVAC system is already connected to the BMS.
- Energy savings assume removal of the compressed air system.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Consider larger capital upgrades that can included DDC control upgrades as part of the retrofit. Identify equipment to be connected to the central control system and engage a building controls integration company to plan and price the system integration. Coordinate with planned capital upgrades and renovations where possible to optimize benefits. This measure is recommended for further consideration.

Table 13: ECM 4 Savings and ROM Cost

Savings Summary

ECM	District Steam Savings (klbs)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Pneumatic Controls Upgrade	0	1,485	5	1	$0	$163	$56,358	345
Overall % Reduction	0%	0.5%	0.4%	0.4%	--	0.5%	--	--

6 Appendix A

Table 14: Monthly Utility Data (2023 to 2024)

Month	Steam Consumption (kBtu)	Steam Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	-	$4,694	20,640	$2,215	28	37	1,051	0
Feb-23	-	$4,765	21,600	$2,035	32	40	955	0
Mar-23	-	$2,369	22,680	$2,034	30	49	918	0
Apr-23	-	$1,811	23,040	$2,027	32	52	525	28
May-23	-	$1,208	27,840	$2,196	37	61	283	76
Jun-23	-	$582	27,480	$2,058	38	60	86	139
Jul-23	-	$870	34,800	$2,817	47	65	11	227
Aug-23	-	$624	37,080	$2,946	50	74	48	141
Sep-23	-	$708	26,640	$2,452	37	60	113	85
Oct-23	-	$1,209	26,400	$2,148	35	57	415	31
Nov-23	-	$2,829	21,720	$1,668	30	51	779	0
Dec-23	-	$2,979	19,800	$1,406	27	34	834	0
Jan-24	605.358	$3,857	23,400	$540	31	42	1,194	0
Feb-24	58,639	$3,706	21,840	$2,234	33	41	874	1
Mar-24	632.82	$3,412	21,840	$1,762	29	47	771	2
Apr-24	0	$784	23,640	$2,074	38	62	437	21
May-24	1088.928	$480	27,360	$2,449	37	60	148	98
Jun-24	285,600	$453	30,360	$2,790	42	66	51	207
Jul-24	62,886	$375	36,240	$3,228	49	67	18	251
Aug-24	4,547	$238	31,680	$2,913	43	63	37	215
Sep-24	342.678	$642	34,200	$2,742	48	77	84	112
Oct-24	348.648	$747	26,520	$2,519	36	57	356	31
Nov-24	335.514	$1,341	20,520	$2,213	29	48	607	4
Dec-24	337.902	$1,889	24,240	$2,038	33	41	1,037	0
2023 Sum	-	$24,648	309,720	26,002			6,019	727
2024 Sum	415,363	$17,924	321,840	27,502			5,614	942

**Steam costs estimated using $10/klb*

***Steam consumption estimated using square footage ratio to the Central Garage*

7 Appendix B

Table 15: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity	Approx Year Installed
AHU-LL	1	Air handling unit (Steam, CHW)	Lower level	TRANE	SWUA-2504-MA	25 TON	1995
AHU-1L	1	Air handling unit (Steam, CHW)	1L level	TRANE	SWUA-3004-MA	30 TON	1995
AHU-2L	1	Air handling unit (Steam, CHW)	2L level			50 TON	1995
N/A	1	Air cooled chiller	Whole building	YORK	YLAA0136SE46XFBB	125 TON	
	1	AC Unit	Data closet			2 TON	2015
N/A	1	Air compressor	HVAC Controls			1.5 HP	
DHW	1	Electric domestic water heater		Rheem	XE40M06ST45U1	40 Gal	2023
CHWP	1	Chilled Water Pump				7.5 HP*	

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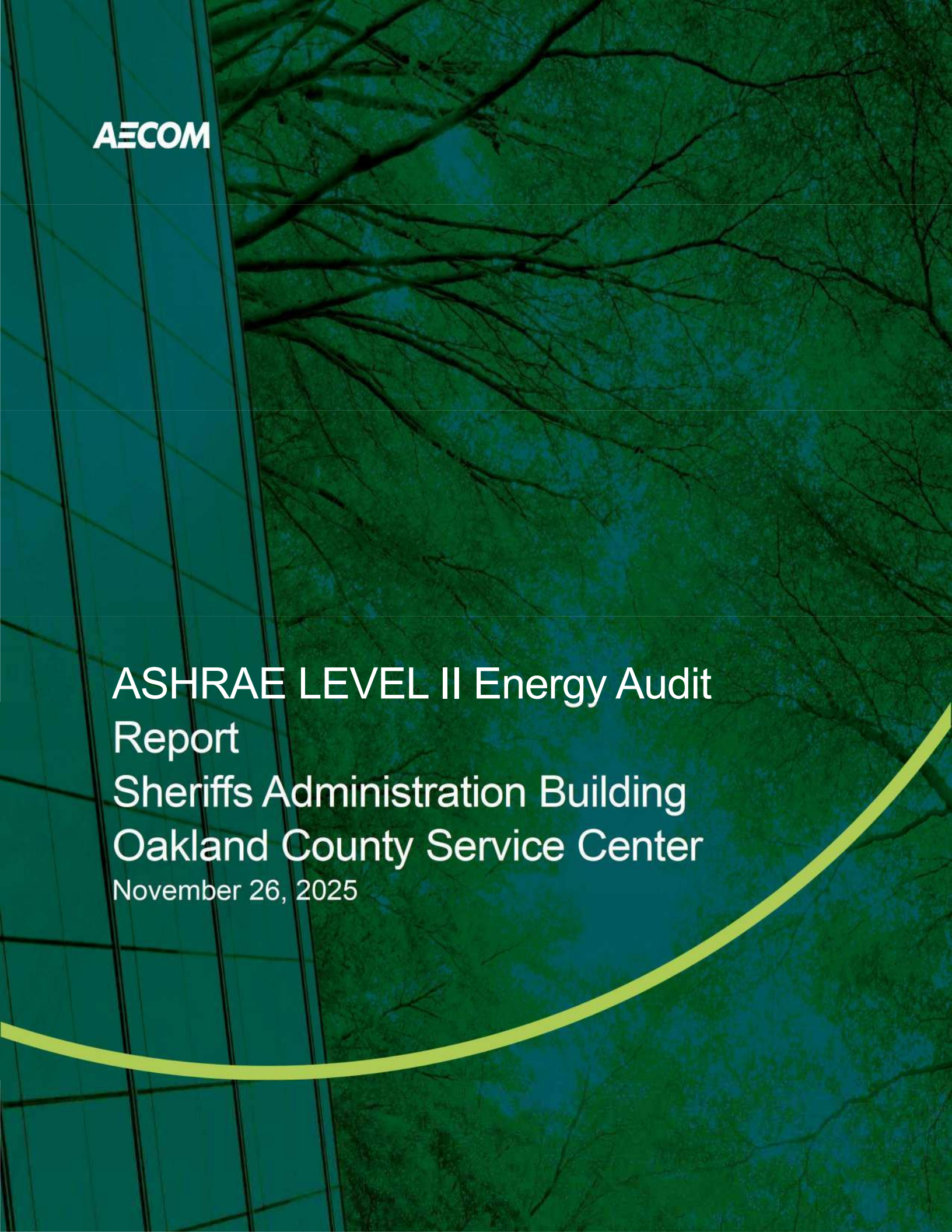

AECOM

ASHRAE LEVEL II Energy Audit Report
Sheriffs Administration Building
Oakland County Service Center

November 26, 2025

Quality information

Prepared by	Checked by	Verified by	Approved by
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Revision History

Revision	Revision date	Details	Authorized	Name	Position

Prepared for:
OAKLAND COUNTY, MI Government

Prepared by:
AECOM

Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Sheriffs Administration Building in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County Sheriffs Administration Building is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates ten ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. Eight of the ten measures are recommended for implementation, with the remaining two measures recommended for further study. The eight recommended measures represent a projected 20% annual energy cost savings with an aggregate simple payback of 14 years.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan Deliverable. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	MTCO2e	$/yr	$/yr	$	Years
ECM 1	Retro-commissioning	HIGH	R	119,184	0	0	1,454	2,142	226	$0	$25,771	$46,418	1.7
ECM 2	Install VFDs on the heating hot water distribution system	HIGH	R	62,780	0	0	0	214	28	$0	$6,906	$44,165	6.4
ECM 3	Optimize the chiller plant and update the control sequences of the chiller plant	MED	R	3,198	0	0	386	472	47	$0	$4,215	$45,375	10.8
ECM 4	Retrofit pneumatic control valves with DDCs. Remove the compressed air system	MED	R	6,870	3	0	545	674	68	$8,000	$6,207	$220,462	15.5
ECM 5	Lighting Fixture Upgrades	MED	R	270,487	29	0	0	923	120	$7,967	29,754	$232,845	6.2
ECM 6	Install lighting occupancy sensors on Existing LED Lighting	MED	R	28,098	0	0	0	96	12	$0	$3,091	$46,625	15.1
ECM 7	Upgrade exhaust fans with VFD-driven fans controlled by zone static pressure	MED	R	24,184	0	0	239	368	39	$0	$5,048	$121,000	24.0
ECM 8	Replace Absorption Chiller with Centrifugal Chiller	High	R	-227,532	-309	0	4,064	4,076	383	$16,000	$15,609	$1,100,000	34.8
Sum of Recommended Measures				**287,268**	**-277**	**0**	**6,688**	**8,965**	**923**	**$31,967**	**$98,476**	**$1,856,890**	**14.4**
Overall % Reduction				24%	-127%	0%	46%	42%	41%	--	20%	--	--

Measures with Additional Consideration Required													
ECM #	Measure Description	Priority	Measure Status	Year -1 Electricity Savings	Demand Reduction	Year -1 Gas Savings	District Steam Savings	Total Energy Saved	Year - 1 GHG Savings	O&M and Water Savings	Year - 1 Cost Savings	Project Cost (Est)	Simple Payback Period
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	K lbs/y	MMBTU	MTCO2e	$/yr	$/yr	$	Years
ECM 9	Install air side heat recovery where possible	MED	RS	6,449	0	0	710	870	87	$0	$7,809	$308,550	39.5
ECM 10	Retrofit the absorption chiller with geothermal heating and cooling. Remove steam heating.	LOW	RS	-591,192	-216	0	14,536	15,339	1,468	$16,000	$80,328	$6,700,859	69.6

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu

*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Oakland County Sheriff's Administration Building, located at 1200 N Telegraph Road, Building #38E, Pontiac, MI 48341, is the largest full-service sheriff's department in Michigan. It serves a jurisdictional population of approximately 1.2 million residents, providing direct law enforcement services to over 343,000 individuals through contracts with 15 communities. Additionally, the office oversees correctional operations for nearly 1,600 inmates and covers a geographic area that includes 450 inland lakes.

The single-story building, constructed in 1971, includes office spaces, a Crime Lab, a DNA Lab, chemical processing, a latent prints lab, an instrumentation lab, a chemistry lab, a blood preparation lab, and storage areas within a 61,891 ft^2 floor area. This 24/7 operating facility underwent significant renovation and was converted from a different type of use to its current state in 2005.

2.1 Building Systems

2.1.1 Building Envelope

The single-story office building features concrete masonry unit (CMU) walls clad in red brick veneer. It is unclear whether the exterior walls have insulation behind the drywall. The double-pane aluminum windows were replaced during the 2005 renovation and are observed to be in fair condition. The window/wall ratio is estimated as 25%. The roof is a flat, poured concrete structure housing exhaust fans. The insulation level above the concrete deck is unknown, assumed to be R20 at minimum as per the construction code requirements valid in 2005.

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	CMU, brick veneer	Good
Roof	Insulation above concrete deck, black tar roof membrane	Good
Glazing	Double-pane	Good

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The mechanical room in the basement connects to the central heating plant via a tunnel where steam and condensate return pipes link the building with the central steam plant. Heating hot water is generated by a steam-to-hot-water shell and tube heat exchanger. The hot water supplies five air handling units (AHUs), baseboards, and unit heaters. Two 15 horsepower (HP) constant-speed pumps distribute the hot water to AHUs, baseboards, and unit heaters. Both pumps are rated NEMA premium with a nominal efficiency of 91.7% and 91%. There is a glycol hot water loop serving the zone exposed to 100% outdoor air (OA).

The cooling is supplied by a two-stage fluid cycle absorption chiller manufactured in 2006. The nominal cooling capacity of the chiller is 440 tons. The coefficient of performance (COP) of the

chiller is 1.21 at 1018 GPM chilled water flow. A steam-fired generator serves as the primary fuel for the chiller. The chiller needs a specific condenser water temperature to start, and it is activated when the outdoor air temperature exceeds 62°F. To initiate the chiller, it requires heat to be injected into the condenser water loop, raising the temperature to 93°F. This introduces additional inefficiency during seasonal changes.

The chilled water is distributed by two 25 HP pumps controlled by variable frequency drives (VFDs) based on pressure differential. The motor efficiencies are rated at 92% and 94%. The condenser water pumps circulate water at a constant speed between the cooling tower, which is located on the ground level. The nominal cooling capacity of the Baltimore Aircoil Series 3000 Cooling Tower, Model 3552A, is approximately 552 tons at 1,656 GPM, within a 95°F to 85°F range with an entering wet bulb temperature of 78°F.

The variable air distribution system is equipped with supply and return fans driven by VFDs. The air is distributed to the building by single-duct configurations to variable air volume (VAV) boxes. The air volumes are determined by duct static pressure, return air temperature. The AHUs feature air-side economizers.

AHU-2 and AHU-3 serve the general office spaces. AHU-1 serves the crime lab. AHU-4 serves the DNA lab, and AHU -5 serves the West End. The system also features carbon dioxide (CO_2) sensors for demand-controlled ventilation on AHUs-2, 3, 4, and 5.

In addition to the chilled water cooling, a 2-ton mini-split air conditioning unit cools the data closet.

The AHUs return air fans are referred to as exhaust fans and primarily serve as such. The roof contains several mushroom-type exhaust fans for common areas and restrooms. Additionally, three fume hood exhaust fans support the lab spaces.

Two identical lab fume hood exhaust fans (EF) powered by 5 HP motors. These fans can exhaust up to 6,300 cubic feet per minute (CFM), depending on the static pressures. EF-2 serving the evidence lab is equipped with a 1.5 HP motor and can exhaust up to 1,520 CFM, depending on the static pressures.

2.1.3 Lighting Systems

The Sheriffs Administration Building consists of a mixture of 32W T8 fluorescent lamps and 12.5W light emitting diode (LED) lamps scattered throughout the building, with the intent to replace all fluorescent lamps with LED. Some fixtures remain powered constantly, as the Sheriff's Admin building is a continuously operational facility. Throughout the building, recessed or surface mount 1'x4' or 2'x4' high bay fixtures are used to light entrances, offices, and corridors, while suspended, parabolic fixtures are used in utility, mechanical, and electrical rooms.

Table 3: Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
Fluorescent & LED Lights	98	1 lamp
Fluorescent & LED Lights	1,358	2 lamp

* Assuming 25% of fluorescent lamps have been replaced by LED equivalent.

The total quantity of light fixtures is 1,456, including fluorescent fixtures and LED fixtures. The approximate total wattage is 76,330 watts, with the total fluorescent lamp wattage being 67,536 watts and total LED lamp wattage being 8,794 watts. The approximate area per drawing is 61,891 ft^2. The lighting density is approximately 1.23 W/ft^2.

2.1.4 Plumbing

The domestic hot water is generated by a Lochinvar indirect water heater. A shell and tube heat exchanger converts steam to hot water, and the hot water circulates through the coil inside the indirect water heater tank to generate domestic hot water. The water is stored at 135°F in the storage tank, which is below the 140°F limit for avoiding Legionella bacteria. Increasing the water storage temperature to 140°F is highly recommended to avoid bacteria growth in the tank for the health and safety of the employees. The hot water has two loops. The first loop is tempered with cold city water before reaching the restrooms, while the second loop is delivered directly to its end use at 135°F. It is recommended to temper the city water with the condensate return to reduce the energy consumption of domestic hot water.

2.1.5 Building Controls

This building is controlled by an InTouch building management system (BMS). The majority of the actuators are converted to electric; however, there are some valve and damper actuator systems that function via pneumatic systems. The BMS features reset schedules for the heating hot water between 180°F and 140°F, depending on the outdoor air temperature readings. The AHUs are capable of air-side economizer utilization, and the BMS can control this feature. The BMS can also control the outdoor lighting schedules.

2.1.6 Electrical Infrastructure

The main service to 38E is supplied by Feeder C and Feeder D to a 750kVA, 4.8kV-480/277V, 1200A, 3-phase, 4 wire transformer located outside of the Sheriff's Admin building. Meter number 72854400, located at the switchgear within the electrical room displayed an instantaneous of 986,640 kWh on April 18th at 8:41AM EST.

The Sheriff's Admin backup power is provided by a 300kW-375kVA,480V 3-phase, 451A, 600-gallon capacity, diesel Caterpillar generator, model 3456300EKW, serial number CCBOO730. The generator has an estimated run time, based on full load operation, of approximately 29 hours.

2.1.7 Additional Information

The facility utilizes a variety of specialized systems to support its operations. The crime and DNA laboratories are equipped with advanced tools not typically found in standard office environments. These include a compressor and vacuum system similar to those used in dental clinics, laboratory fume hoods, specialized refrigeration units for preserving evidence, and various lab processing instruments. Additionally, the facility houses a gas-powered evidence incinerator used to dispose of criminal materials collected during investigations.

3 Utility Billing Analysis

3.1 Utility Type and Usage

The Sheriffs Administration Building receives electric service and is connected to the steam network. Utility billing is managed through separate arrangements for all fuels. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

Steam usage is metered and billed to the building based on the cost to generate the utility. Steam is the primary heating source for the building.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Steam:** Oakland County Internal Tracking

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	1,191,840 kWh	4,067	$131,102	$0.11/kWh	*0.0004427*	528
Steam	14,536 klbs	17,356	$363,397	$10/klbs	*0.119*	1,730
Total	**--**	**21,422**	**$494,500**	**--**	**--**	**2,257**

** Steam (1 klb = 1194 Btu); Electricity (1 kWh = 3413 Btu)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage does not show a strong correlation to weather data, indicating the majority of electricity usage consists of baseload energy, which is expected with steam as the primary heating and cooling energy source. The annual usage for the baseline 12-month period from January to December 2024 is 1,191,840 kWh. Detailed monthly electricity usage and costs are in Appendix A.

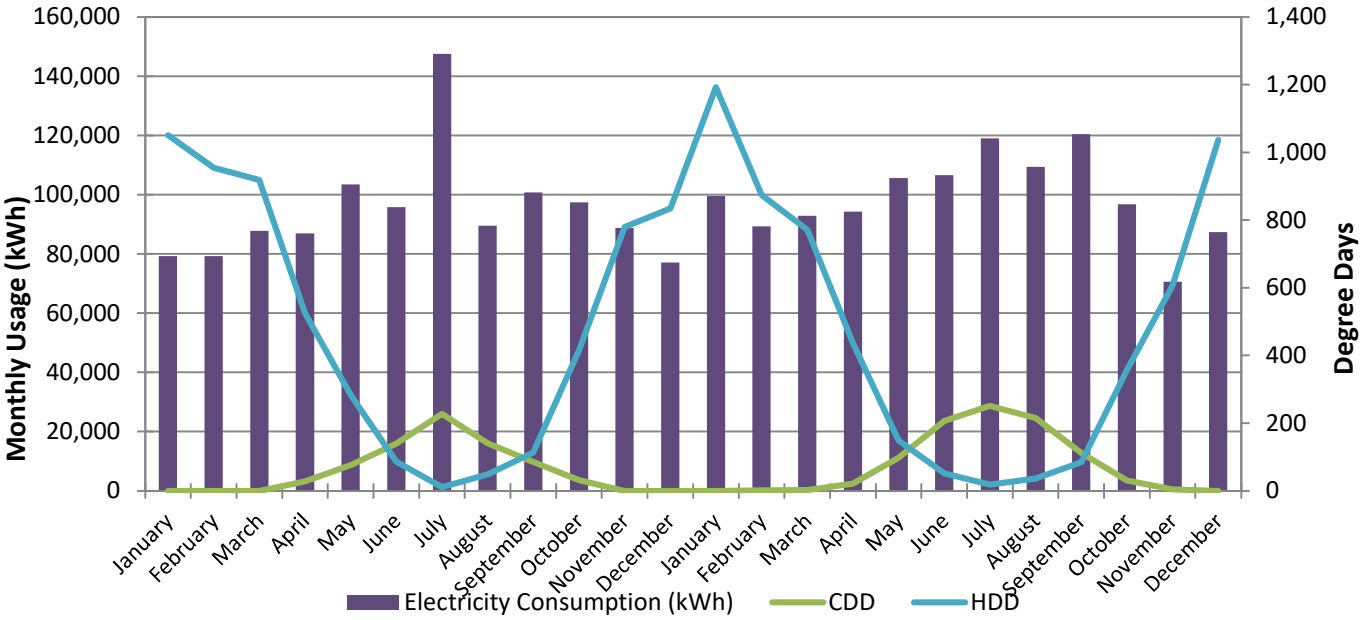


Figure 1: Electricity Usage Profile (January 2023 to December 2024)

3.3 Building Electrical Capacity Analysis

AECOM has developed a methodology to estimate the peak demand of the building which uses the metered consumption of the building, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 5: Electric Capacity Results

Maximum Building Capacity at Service Transformer	750 kW
Maximum Capacity at Switchgear (A*V*Ph)	1000 kW
Estimated Peak Demand	240 kW (estimated)
Remaining Capacity	**510 kW**

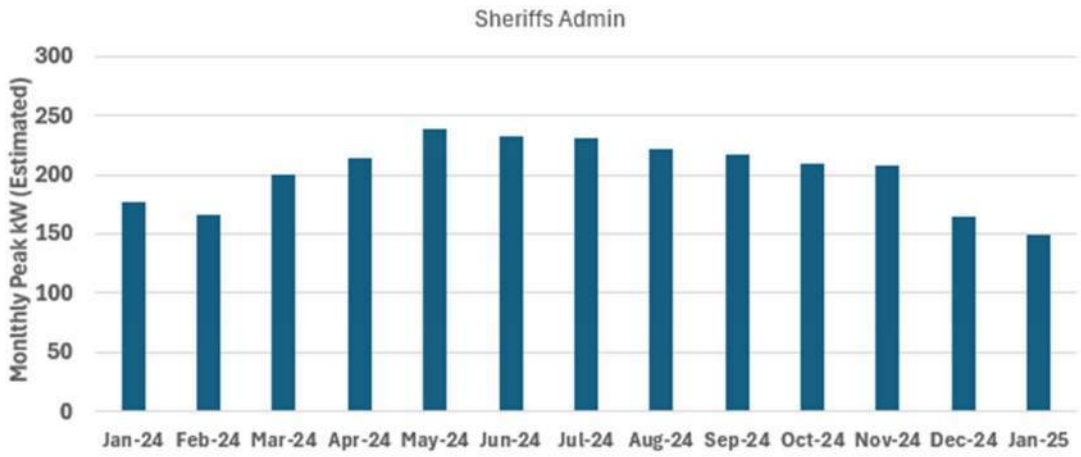


Figure 2: Estimated Electricity Demand Profile

3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge:	**$0.057/kWh**
DTE Electric Demand Charge:	**$6.15/kW/Month**
Average Dollar per kWh Used in Calculations:	**$0.11/kWh**

Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Steam Usage Profile

Figure 3 shows the monthly steam usage profile for 2024 and local monthly weather data indicated by HDD. Steam usage does not show a direct correlation to weather data, as steam is used for both space heating and cooling through the absorption chiller. The annual usage for the baseline 12-month period from January to December 2024 is 14,536 klbs. Detailed monthly steam usage and costs are in Appendix A.

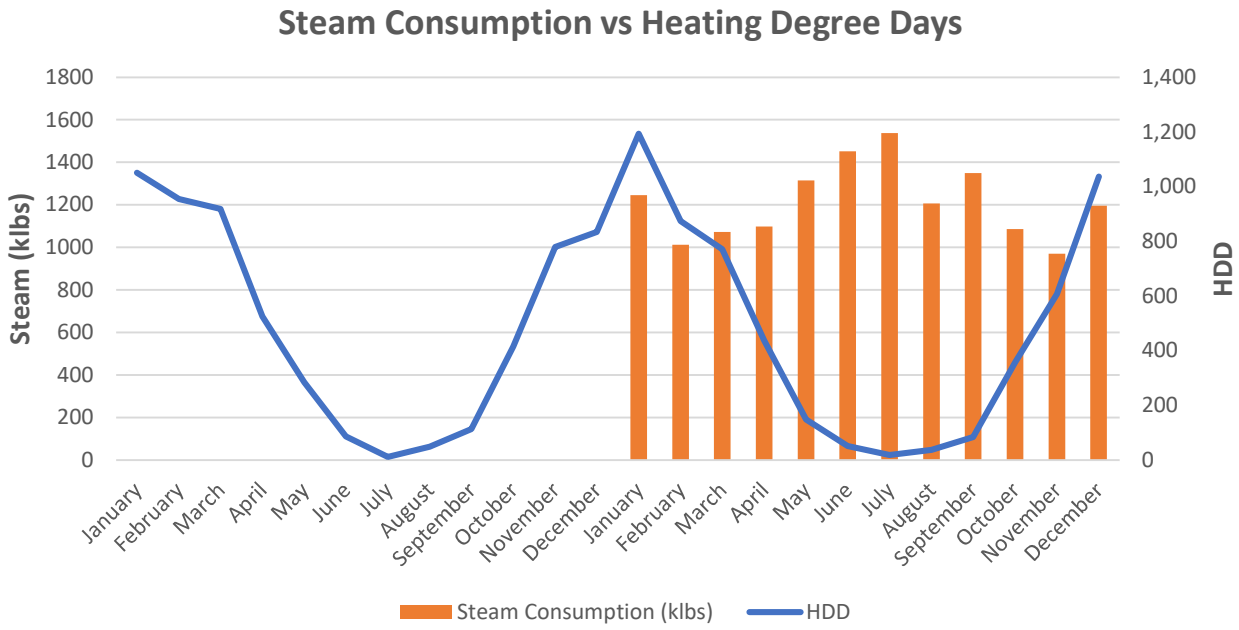


Figure 3: Steam Usage Profile (January 2024 to December 2024)

3.4.1 Steam Rate Structure

Unlike electricity and natural gas, which are billed directly by external utilities, steam is an internal utility produced on campus. The cost allocation for steam is derived from the total natural gas cost at the central steam plant, as well as costs to operate the plant. Each steam-

served building is billed proportionally based on its metered steam usage relative to the campus total. As a result, there are no separate delivery, demand, or third-party charges; the unit cost of steam reflects the cost of natural gas, plant operating cost and efficiency, and distribution system performance.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings.

Average Dollar per klb Used in Calculations: $10.00/thousand lbs

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$131,102
Natural Gas	$0
Steam	$363,397
Total	$494,500
ECI $/yr/sf	$7.99

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4. Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

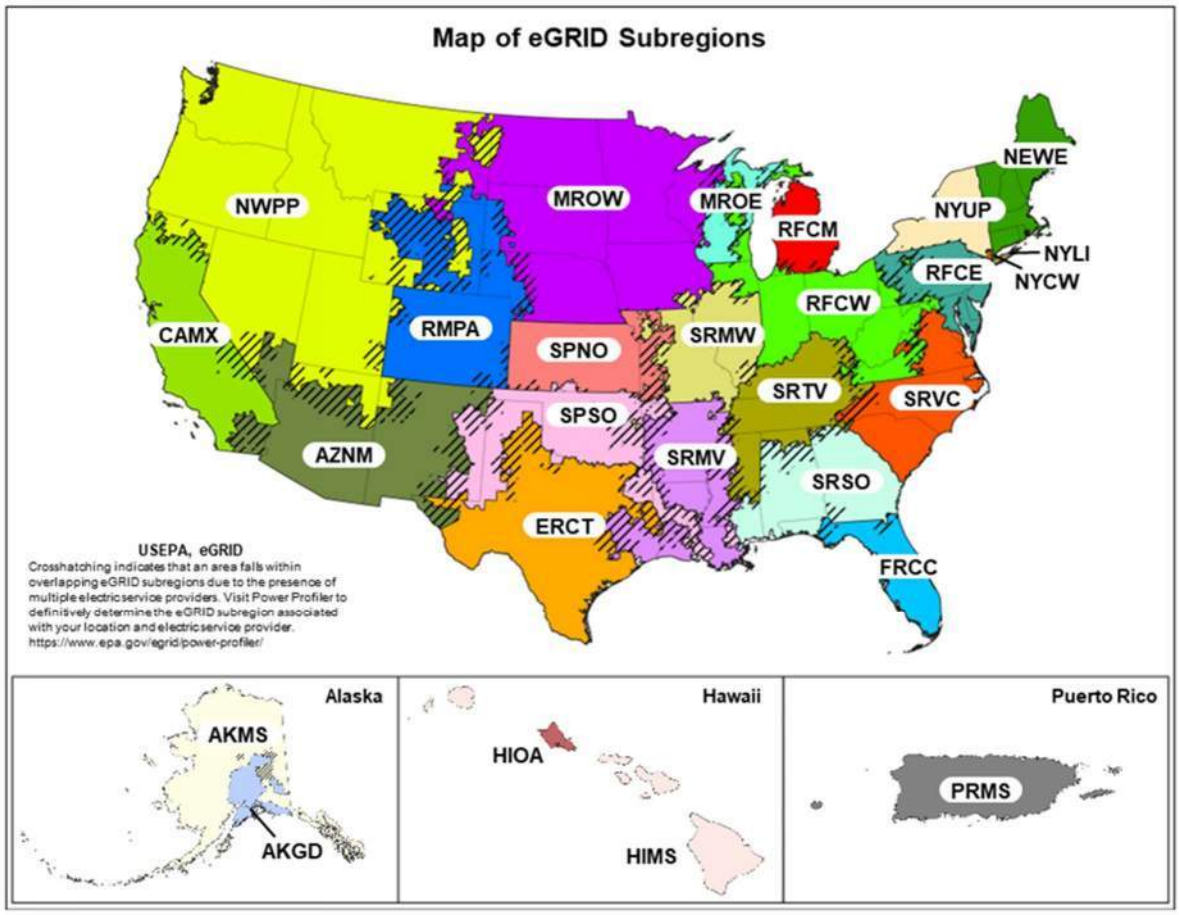


Figure 4: Map of eGRID Subregions

Figure 5 displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

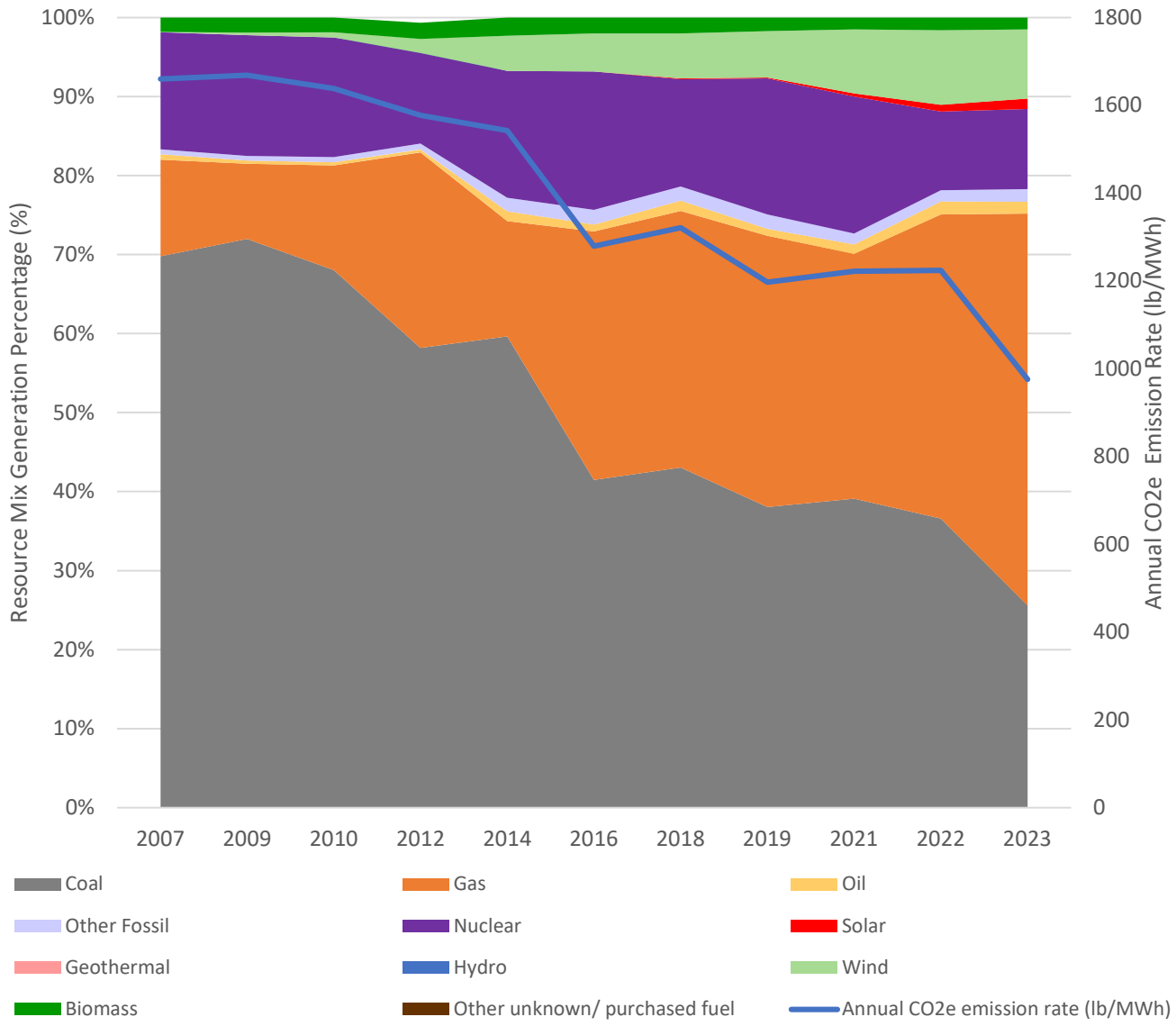


Figure 5: RFCM eGRID Generation Mix and Emissions Factor

Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 74 percent of carbon emissions are attributed to steam and 26 percent are associated with electricity, with trace amounts associated with natural gas. Steam, natural gas combustion and imported electricity resulted in 1,507 tCO2e (campus-level Scope 1) and 528 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 2,034 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for the Sheriffs Administration Building are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Sheriffs Administration Building				**Electric EUI:**		66	kBTU/SF/yr
GFA:	61,891	SF			**Steam EUI:**		280	kBTU/SF/yr
eGRID Subregion:	RFCM				**Current EUI**		346	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	1,191,840	kWh	3.412	4,067	*0.0004427*	528	$131,102	27%
Natural Gas	0	MCF	1.038	0	*0.0549206*	0	$0	0%
Steam	14,536	klbs	1194	17,356	*0.119*	1,730	$363,397	73%
Totals				**21,422**		**2,257**	**$494,500**	**100%**

According to the US EPA, the average site energy use intensity for a police station is 63.5 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 346 kBTU/SF, which is significantly higher than the national benchmark. It's important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison indicates there is a significant opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency, specifically with the cooling energy of the building.

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Parking	Parking		N/A	N/A	None Available
Public Services	Courthouse*		211.4	101.2	CBECS - Courthouse
	Drinking Water Treatment & Distribution (Average EUI presented in Energy per Flow in gallons per day)		5.90	2.27	AWWA - Water Treatment Plant
	Fire Station		124.9	63.5	CBECS - Fire Station/Police Station
	Library		143.6	71.6	CBECS - Library
	Mailing Center/Post Office		96.9	47.9	CBECS - Service
	Police Station		124.9	63.5	CBECS - Fire Station/Police Station
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Social/Meeting Hall		109.6	56.1	CBECS - Social/Meeting
	Transportation Terminal/Station		112.0	56.2	CBECS - Public Assembly
	Wastewater Treatment Plant* (Average EUI presented in Energy per Flow in gallons per day)		7.51	2.89	AWWA - Wastewater Plant
	Other - Public Services		89.3	40.1	CBECS - Other
Religious Worship	Worship Facility*		58.4	30.5	CBECS - Religious Worship
Retail	Convenience Store*	Convenience Store with Gas Station	883.5	350.9	Industry Survey
		Convenience Store without Gas Station			
	Mall	Enclosed Mall	170.7	65.7	CBECS - Enclosed Mall
		Lifestyle Center	228.8	103.5	CBECS - Strip Shopping Mall
		Strip Mall			
		Other - Mall	225.3	101.6	CBECS - Enclosed Mall and Strip Shopping Mall
	Retail Store*		120.0	51.4	CBECS - Retail Store
	Supermarket/Grocery Store*		444.0	196.0	CBECS - Grocery Store/Food Market
	Vehicle Dealership*		138.2	71.9	Industry Survey

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

3.8 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and estimated daily occupancy. Table 8, Figure 7, and Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (klbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	0	10,217	12,199,058	197	1,216
Space Cooling	9,643	0	4,064	4,885,030	79	488
Fans	506,394	0	0	1,727,817	28	224
Pumps	72,417	0	0	247,088	4	32
DHW	0	0	255	304,665	5	30
Conveyance	0	0	0	0	0	0
Lighting	517,006	0	0	1,764,026	29	229
Plug Loads	27,948	0	0	95,357	2	12
Process Loads	9,146	0	0	31,207	1	4
Refrigeration	87,600	0	0	298,891	5	39
Cooking	0	0	0	0	0	0
Information Technology	4,380	0	0	14,945	0	2
TOTAL	**1,234,535**	**0**	**14,536**	**21,568,084**	**348**	**2,276**
Historical Billing	1,191,840	0	14,536			
Percent of Actual	104%	0%	100%			
per sqft	19.26	0	0.23			

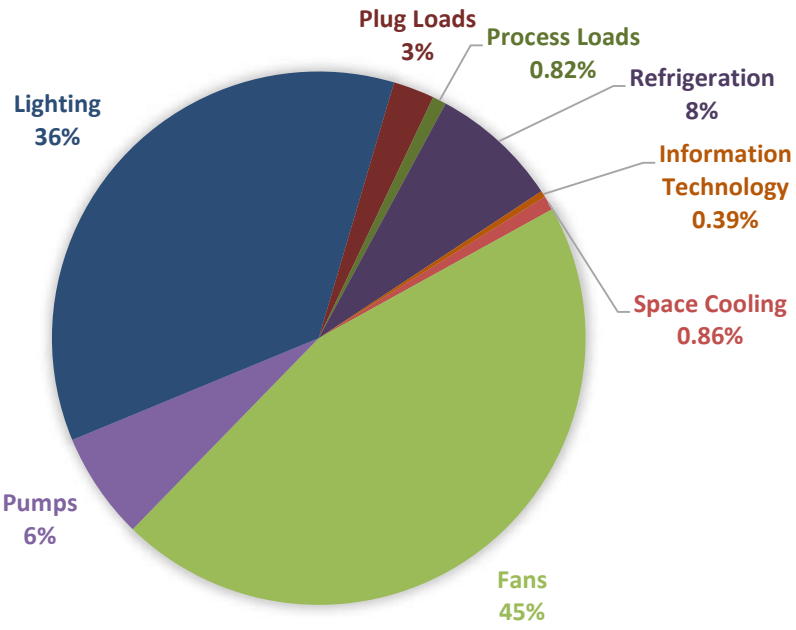


Figure 7: Existing Electricity End Use Distribution

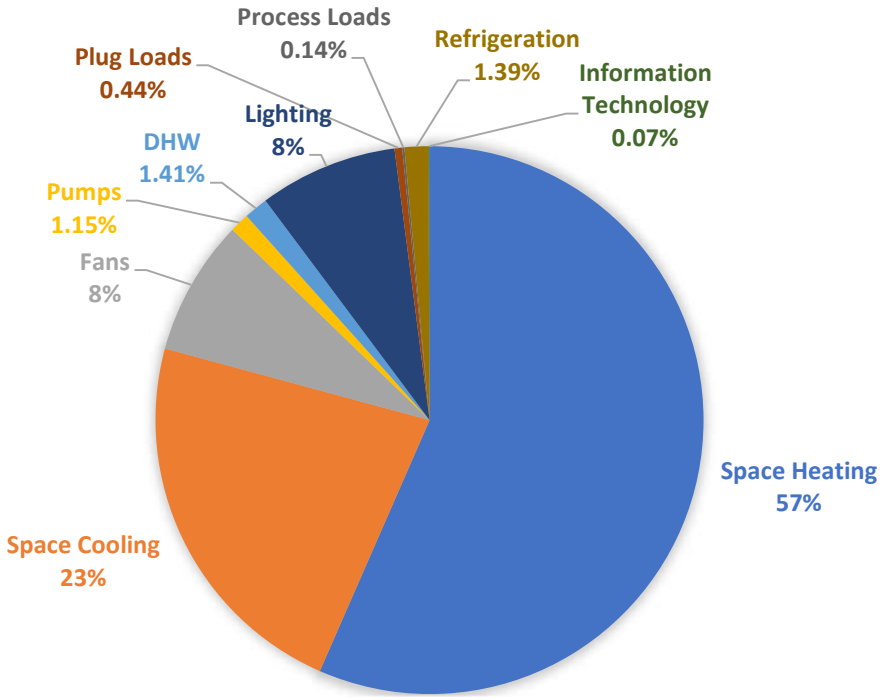


Figure 8: Existing Energy End Use Distribution

4 Energy Conservation Measures (ECM)

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure, but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 –Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent. The Sheriff's Admin building has a robust building automation system that can be leveraged to improve efficiency, however, capital investment into HVAC and replacement of existing pneumatic controls can further improve the impact of building optimization on the overall energy. In the short term, RCx is an extremely valuable measure that should be implemented to its fullest extent to ensure systems are operating effectively and efficiently. This can be completed for existing systems connected to the BAS or delayed until the remaining systems are upgraded and connected to the BAS system.

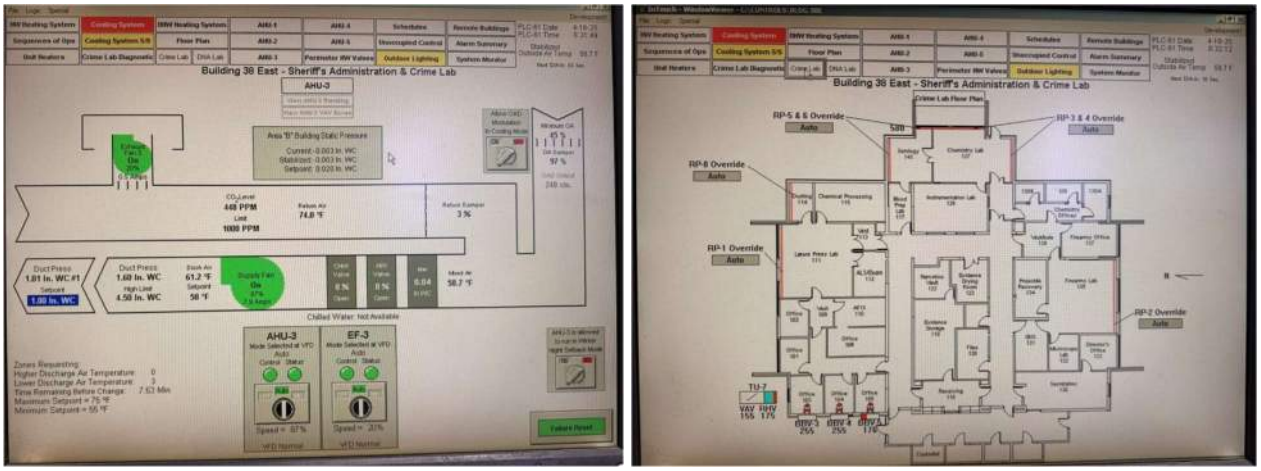


Image 1: Sample Control Graphics

The following list represents RCx opportunities that should be evaluated to validate operation, modify and/or repair if discrepancies identified if systems not scheduled for timely replacement. This effort will proactively improve building system operation and optimize energy usage.

- Test and balance air distribution systems and reduce duct static pressure setpoints
- Reconfigure the condensate return system, avoid the steam trap submerge
- Install DHW preheat system with condensate return
- Test and repair leaky steam traps
- Reduce heating enable setpoint
- Equipment scheduling
- Temperature resets
- Equipment Tuning

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 10% reduction in overall building electricity and 10% in the heating energy. RCx savings can range from 3%-25% of total building energy use.
- Implementation costs assume both investigation to uncover opportunities, and implementation costs to correct deficiencies. Costs can vary significantly depending on findings during investigation, but payback is typically less than 2 years for all projects. Additional funding is typically provided by utility provider to further subsidize cost.
- No additional O&M savings are specified for this measure, as the savings are typically a result of reduced O&M spending at the facility. The cost to implement RCx measures is oftentimes an O&M cost, which should be periodically repeated as measure saving begin to diminish. RCx is typically considered a project with a 5 year life cycle, and should be continually implemented to maintain peak system performance.
- Additional study of equipment capacity requirements could be performed as part of this measure.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: This measure proposes engaging a third-party contractor to determine if this building is eligible for the DTE RCx program and systematically evaluate and prioritize major HVAC and control systems and complete retro-commissioning to restore systems to their original design intent. This measure is recommended for implementation.

This measure also suggests that Oakland County increase their in-house capabilities to identify, correct, and maintain existing equipment to extend service life, maintain optimum cost of operation, and to reduce implementation costs for routine building improvements.

ECM Savings and ROM Cost:

Table 9: ECM 1 Savings and ROM Cost

ECM	Savings Summary							
	Gas Savings (MCF)	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
RCx	0	119,184	1,454	2,142	226	$27,646	$46,418	1.7
Overall % Reduction	**0%**	**10%**	**10%**	**10%**	**10%**	**10%**	-	-

4.2 ECM 2 – Install VFDs on Heating Hot Water Pumps

Variable Frequency Drives (VFDs) on pumps will provide a dynamic and energy-efficient solution by allowing precise control of pump speed, optimizing performance, and reducing unnecessary energy consumption during periods of lower demand. The existing 15 HP hot water pumps do not have VFDs and run at constant speed. This ECM proposes evaluating the heating hot water system pumps for feasibility to add a VFDs to reduce pump energy. This may be coupled with a routine upgrade of pumps as they near end of useful life to new premium efficiency motors and VFDs.



Image 2: Heating Hot Water Pumps

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- VFDs will be most effective when paired with a BAS to automatically control speeds.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed. VFDs will likely increase the service life of the equipment if properly selected and installed.

- The savings for this measure assume an average 30% reduction in equipment speed.
- If coupled with routine upgrades to include new premium efficiency motors additional energy savings may be achieved.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the heating hot water system pumps for compatibility with a VFD and assess the usage pattern and energy consumption. Once this data is collected, select the appropriate type of VFD. Choose VFD based on compatibility with current systems, programmability, and reliability.

ECM Savings and ROM Cost:

Table 10: ECM 2 Savings and ROM Cost

	Savings Summary							
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Install VFDs on the heating hot water distribution system	0	62,780	0	214	28	$6,906	$44,165	6.4
Overall % Reduction	**0%**	**5.3%**	**0%**	**1.0%**	**1.2%**	**1.4%**	**-**	**-**

4.3 ECM 3 – Optimize Chiller Plant

The chiller plant currently utilizes an absorption chiller that is powered by steam from the central plant. The system rejects heat through an evaporative cooling tower located on the roof of the building. The pumps serving the chilled water system have variable speed drives, while the condenser pumps are constant speed with a bypass valve. The system is controlled by the building automation system but has limited control of the chiller integrated control circuits. This measure suggests optimizing the chilled water control system through addition of VFDs, sensors, and visibility in the chiller control board. This will allow the system to be optimized through updates to the sequences of operation. This measure interacts with ECM 7, which suggests replacing the absorption chiller. In the event that ECM 7 is implemented, this measure should be incorporated into the new sequences for the updated chiller unit.

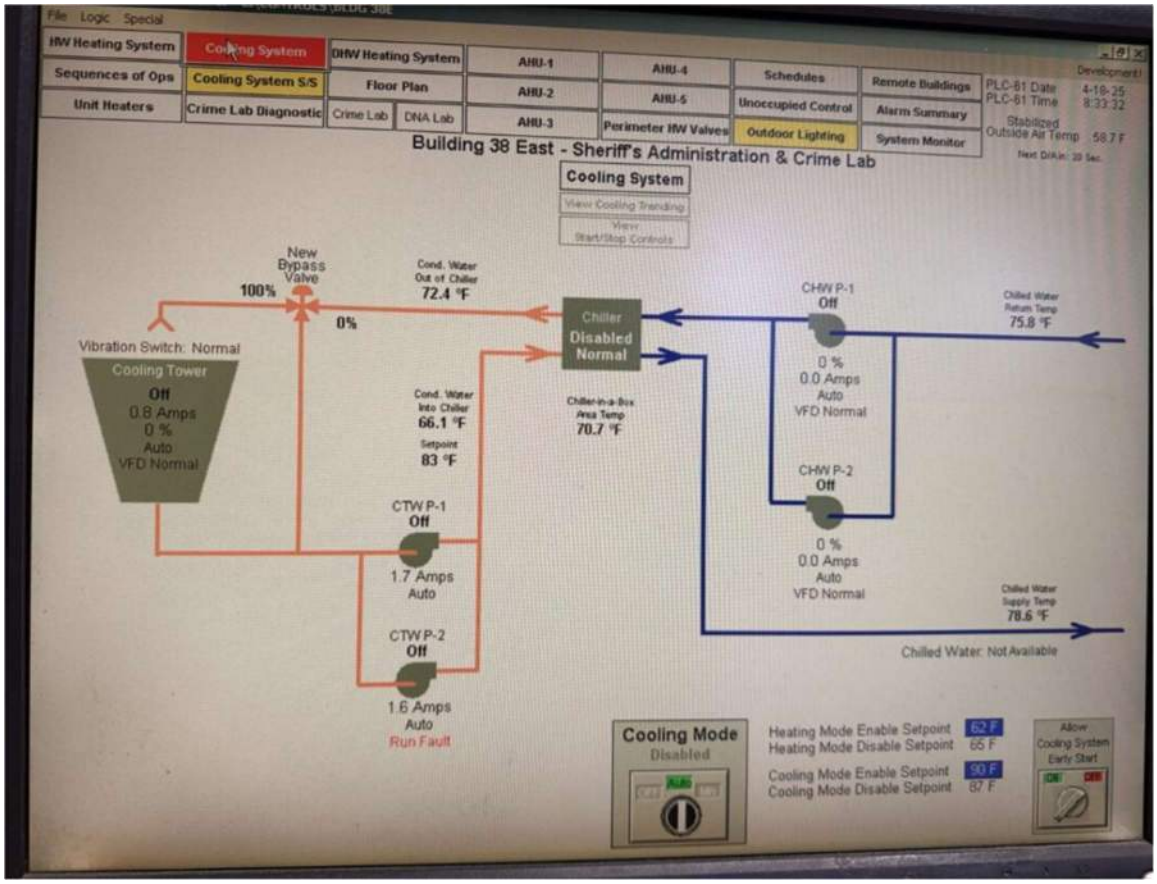


Image 3: Chiller Controls

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- VFDs will be most effective when paired with a BAS to automatically control speeds.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed.
- The savings for this measure assume reductions in pump speeds, reduced chiller loads from set point adjustments, and reduced hours of operation for the system overall through system optimization.
- Implementation costs assume VFD installation, programming labor, and additional sensors to optimize the chilled water system.
- This measure will not impact O&M costs.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the cooling water system pumps for compatibility with a VFD and assess the usage pattern and energy consumption. Once this data is collected, select the appropriate implementation methodology. If variable speed controls are applicable, choose VFD based on compatibility with current systems, and adjust programming and controls to allow for variable flow operation. If system flow can't be reduced, optimize chiller programming to maximum efficiency through temperature and pressure controls on both the chiller and condenser water systems.

ECM Savings and ROM Cost:

Table 11: ECM 3 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Optimize the chiller plant and update the control sequences of the chiller plant	0	3,198	386	472	47	$4,215	$45,375	10.8
Overall % Reduction	**0%**	**0.3%**	**2.7%**	**2.2%**	**2.1%**	**0.9%**	-	-

4.4 ECM 4 - Upgrade Pneumatic Controls to DDC

Pneumatic controls upgrades refer to the process of upgrading antiquated pneumatic control systems and components to direct digital controls (DDC) and integrating it with a centralized control system. Pneumatic controls use compressed air to operate valves and dampers and are prone to operational and maintenance issues. Upgrading these antiquated controls to DDC will enhance the overall efficiency, functionality, and manageability of HVAC system operation. This measure directly produces electricity savings by eliminating the need for a compressed air system, but also indirectly contributes additional energy savings by enabling better control and functionality such as scheduling and optimization. The building has many different vintages of equipment, all with varying levels of deferred maintenance issues. While many of the building systems have already been upgraded to DDC controls, this measure focuses on identifying the remaining pneumatic systems, such as terminal unit zone controls, and upgrading to remove all compressed air requirements for control air. This measure is recommended to be paired with an upgrade to the overall HVAC system to optimize the energy consumption of the existing systems.



Image 4: Pneumatic Controls Compressor

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- Upgrading pneumatic controls to DDC will improve existing control functionality.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed and improved.
- Energy savings assume significant increase in building efficiency through controls optimization measures, as well as the removal of the compressed air system and approximately 4 hours of daily operation to maintain system pressure.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.
- Implementation costs assumes replacement of valves with associated testing and balancing at $2,700/valve. Additionally a lump sum controls material and labor cost of $35,000 is included.

Next Steps: Identify equipment to be connected to the central control system and engage a building controls integration company to plan and price the system integration. Coordinate with planned capital upgrades and renovations where possible to optimize benefits. This measure is recommended for implementation, however, it should be paired and coordinated with additional HVAC retrofit projects to maximize value.

ECM Savings and ROM Cost:

Table 12: ECM 4 Savings and ROM Cost

Savings Summary									
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	O&M Savings ($)	Est Project Cost	Simple Payback (Yrs)
Retrofit pneumatic control valves with DDCs. Remove the compressed air system	0	6,870	545	674	68	$6,207	$8,000	$220,462	15.5
Overall % Reduction	**0%**	**0.6%**	**3.8%**	**3.1%**	**3.0%**	**1.3%**		-	-

4.5 ECM 5 – Upgrade to LED Lighting Fixtures

The building currently uses a mix of LED and linear and fluorescent lighting to illuminate the space. It is estimated that approximately 75% of the fixtures are fluorescent fixtures. Replacement of the existing fixtures can reduce energy consumption by as much as 70%, depending on the fixture selected.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.



Image 5: Example Fixture with Integrated Occupancy Controls

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Interior lights are assumed to be ON at least 18 hours per day for 365 business days per year.
- O&M savings assume an average cost of $3.81/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- This measure assumes a 40% reduction in interior lighting power and a 30% reduction in hours of operation for adding new controls
- LED upgrades cost $215/fixture, which include integrated control sensors and no additional wiring and control circuits. Low-cost fixtures and external controls can be used as an alternative to this implementation method. This measure assumes all fluorescent lamps are converted to LEDs, estimated at 1,083 total fixtures.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Conduct a full lighting count and evaluate fixture options from local lighting vendor. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 13: ECM 5 Savings and ROM Cost

Savings Summary									
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Upgrade to LED Lighting Fixtures	0	270,487	0	923	120	7,967	$29,754	$232,845	6.2
Overall % Reduction	**0.0%**	**22.7%**	**0.0%**	**4.3%**	**5.3%**		**6.0%**		

4.6 ECM 6 – Install Occupancy Sensors on Existing LED Lighting Fixtures

During the site audit, it was observed that lighting was left on in many unoccupied areas. This measure suggests adding lighting control through motion sensors for existing LED fixtures so that lighting is off or dimmed when unoccupied. Motion or occupancy sensors detect activity in spaces and automatically turn lighting on when needed. If no activity is detected, the sensors shut off the lighting to save energy. These controls can be easily integrated into the current lighting control circuits or fixtures. This measure is applied to approximately 25% of the lighting fixtures in the building. The remaining fixtures are addressed in ECM 5.

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety.
- Implementation is assumed to be one sensor per four fixtures, applied to approximately 373 fixtures in the building.
- There will be no impact on the lighting equipment useful life.
- The savings for this measure assume a 30% reduction in lighting in lighting energy
- Implementation costs assume $500/zone for sensor installation.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the lighting system and determine the most cost-effective sensor locations for each zone. Install sensors in place of existing wall switches, or in ceiling panels with wiring connected to the lighting control circuit.

ECM Savings and ROM Cost:

Table 14: ECM 6 Savings and ROM Cost

Savings Summary									
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Install lighting occupancy sensors on Existing LED Lighting	0	28,098	0	96	12	$0	$3,091	$46,625	15.1
Overall % Reduction	**0.0%**	**2.4%**	**0.0%**	**0.4%**	**0.6%**		**0.6%**		

4.7 ECM 7 – Install VFDs and Demand Control on Exhaust Fans

Multiple exhaust fans are present on the roof of the facility that are set to run continuously at constant speed. The demand for exhausting air in the occupied spaces is variable and depends on usage of equipment that requires make-up air to ventilate spaces. For each exhaust system, demand-based controls pair with VFDs can reduce the total air being exhausted from the building, which directly reduces the total air that requires heating and cooling in the building. Energy savings are calculated from an assumed usage schedule of equipment, such as the kitchen exhaust fan, which can be turned OFF is no cooking is being performed below. VFD control provides a dynamic and energy-efficient solution by allowing precise control of fan

speed, optimizing performance, and reducing unnecessary energy consumption during periods of lower demand.



Image 6: Sample of Roof Exhaust Fans

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety, and should improve occupant thermal comfort.
- VFDs will be most effective when paired with a BAS to automatically control speeds.
- There will be no impact on the equipment service capabilities and the current operating and maintenance procedures can still be followed. VFDs will likely increase the service life of the equipment if properly selected and installed.
- The savings for this measure assume an average 10% reduction in equipment speed.
- Implementation costs assume $300/hp to install VFDs, plus additional sensor and programming costs.
- No O&M savings are calculated for this measure, as it assumes similar maintenance requirements to the current system.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Evaluate the building exhaust systems and specify the specific control methodologies required to implement variable speed controls.

ECM Savings and ROM Cost:

Table 15: ECM 7 Savings and ROM Cost

ECM	Savings Summary							
	Gas Savings (MCF)	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Upgrade exhaust fans with VFD-driven fans controlled by zone static pressure	0	24,184	239	368	39	$8,630	$121,000	24
Overall % Reduction	**0%**	**2.0%**	**1.6%**	**1.7%**	**1.7%**	**1.0%**	-	-

4.8 ECM 8 – Replace Absorption Chiller with Centrifugal Chiller

The building is cooled through a steam driven absorption chiller that receives steam from the central plant. Absorption chillers offer some benefits to centrifugal chillers, specifically lower electrical demand and the ability to use waste heat, however those advantages come at the cost of significantly lower coefficient of performance compared to centrifugal chillers. Because steam is the primary source of heating and cooling for the building, the EUI is over six times greater for this building than the national average. Installing a centrifugal chiller is a key measure for reducing operating costs as well as steam plant decommissioning, as the system currently has to provide steam all year to support the cooling of this building.



Image 7: Absorption Chiller

Assumptions:

- Implementation of this ECM will not adversely affect occupant health or safety, and should improve occupant thermal comfort.
- Modern chillers with evaporative cooling towers can achieve a COP of 6, compared to absorption chillers that operate at a COP of less than 1.5. While steam is currently much cheaper than electricity for the county campus, the efficiency of the electric chiller overcomes the difference in fuel cost and still creates a cost savings per year.
- The savings for this measure assume conversion of cooling steam energy to electricity, with current and proposed COPs used to estimate impact.
- Implementation costs assume $2500/ton to replace the 440 ton absorption unit.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Begin design process for chiller replacement, including increasing data collection on existing chiller to fully understand cooling demand. This measure is considered a critical step in campus decarbonization, and should be immediately initiated. ECM 4 should be evaluated against the timeline for implementation of this measure, with any capital improvements being delayed if paybacks are not within the existing chiller remaining useful life.

ECM Savings and ROM Cost:

Table 16: ECM 8 Savings and ROM Cost

Savings Summary									
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Steam Savings (klbs)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
Replace Absorption Chiller with Centrifugal Chiller	0	-227,532	4,064	4,076	383	$16,000	$15,609	$1,100,000	34.8
Overall % Reduction	**0.00%**	**-19.1%**	**28.0%**	**19.0%**	**17.0%**		**3.2%**		

5 Measures Requiring Additional Consideration

This section provides additional information about projects that have been evaluated but are not currently recommended for implementation due to poor economics, feasibility issues, conflicts with other projects already recommended, or requirements for additional study that may impact feasibility. Equipment electrification projects, which have longer paybacks, may be listed here but will be expanded upon in the final Electrification Plan for each building. All electrification projects that are required for campus electrification are not included in the energy audit reports. This report includes two measures that are included in the Not Recommend Category. The measure summaries are given below:

Table 17: Proposed Energy Savings Summary

ECM #	Energy Conservation Measure Description	Year -1 Electricity Savings	Year -1 Gas Savings	District Steam Savings	O&M and Water	Year - 1 Cost Savings	Project Cost (Est)	Simple Payback Period
No	Description	kWh/yr	MCF/yr	klbs/y	$	$/yr	$	Years
ECM 9	Install air-side heat recovery where possible	6,449	0	710	0	$7,809	$308,550	39.5
ECM 10	Retrofit the absorption chiller with geothermal heating and cooling. Remove steam heating.	-591,192	0	14,536	0	$80,328	$6,700,859	69.6

Project Descriptions:

- ECM 9 – Install Air Side Heat Recovery: The savings generated from this project did not justify the implementation costs. Additional investigation could be considered for specific systems but is not recommended at this time.
- ECM 10– Implement Geothermal heating and Cooling: This project may be recommended in the electrification report, but the current cost of steam vs. electricity yielded a negative payback on the implementation of this measure.

6 Appendix A

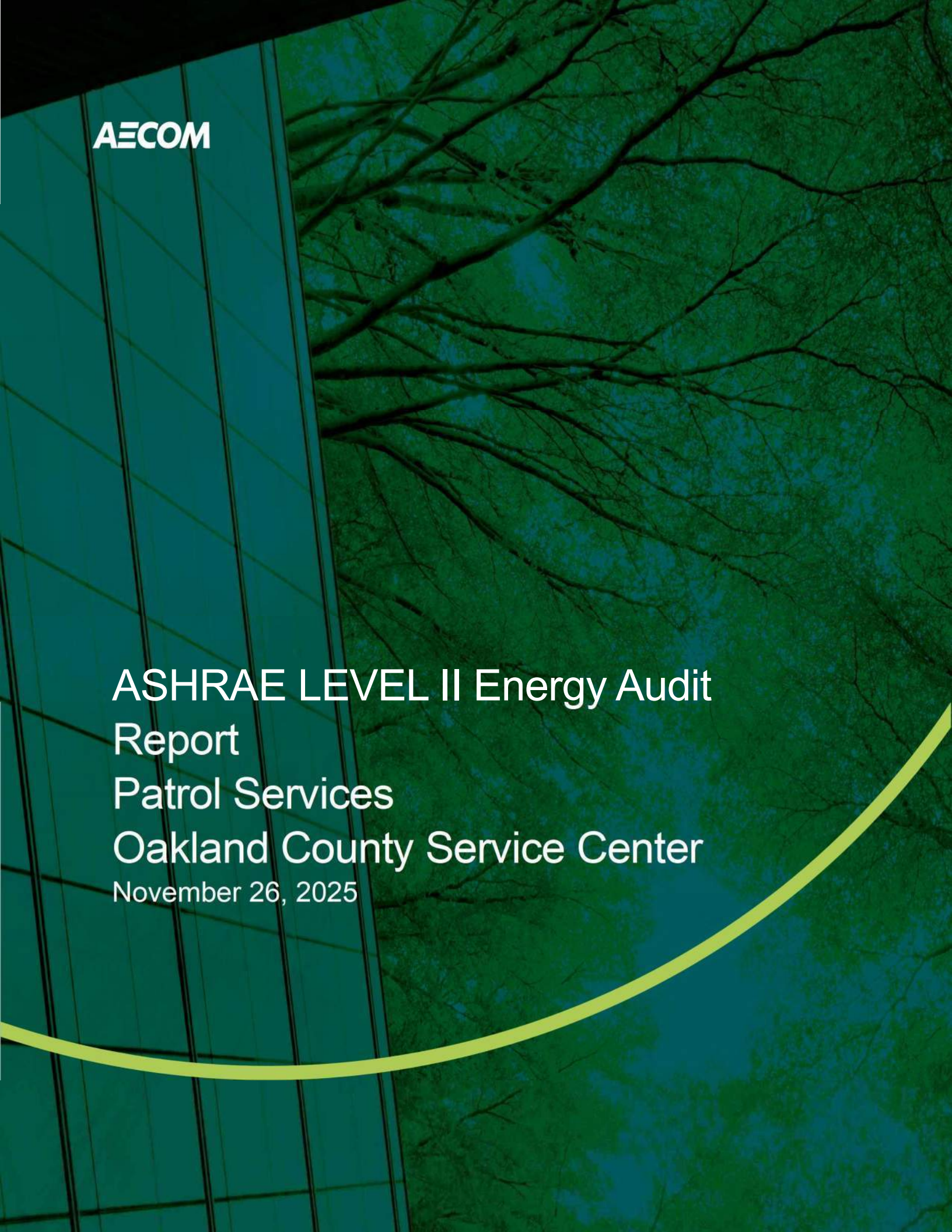
Table 18: Monthly Utility Data (2023 to 2024)

Month	Steam Consumption (kBtu)	Steam Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	-	-	79,200	$8,500	106	141	1,051	0
Feb-23	-	-	79,200	$7,461	118	147	955	0
Mar-23	-	-	87,840	$7,879	118	189	918	0
Apr-23	-	-	86,880	$7,645	121	197	525	28
May-23	-	-	103,440	$8,158	139	228	283	76
Jun-23	-	-	95,760	$7,173	133	208	86	139
Jul-23	-	-	147,600	$11,946	198	275	11	227
Aug-23	-	-	89,520	$7,112	120	178	48	141
Sep-23	-	-	100,800	$9,279	140	228	113	85
Oct-23	-	-	97,440	$7,928	131	209	415	31
Nov-23	-	-	88,800	$6,819	123	207	779	0
Dec-23	-	-	77,040	$5,469	104	131	834	0
Jan-24	1,486,353	$12,449	99,600	$2,298	134	177	1,194	0
Feb-24	1,207,782	$10,115	89,280	$9,132	133	166	874	1
Mar-24	1,279,840	$10,719	92,880	$7,494	125	200	771	2
Apr-24	1,310,130	$10,973	94,320	$8,273	147	239	437	21
May-24	1,570,284	$13,151	105,600	$8,787	142	233	148	98
Jun-24	1,732,664	$14,511	106,560	$9,791	148	232	51	207
Jul-24	1,834,911	$15,368	119,040	$10,604	160	222	18	251
Aug-24	1,439,523	$12,056	109,440	$10,064	147	218	37	215
Sep-24	1,611,367	$13,496	120,480	$9,661	167	272	84	112
Oct-24	1,297,242	$10,865	96,720	$9,187	130	208	356	31
Nov-24	1,157,452	$9,694	70,560	$7,611	98	165	607	4
Dec-24	1,428,303	$11,962	87,360	$7,346	117	149	1,037	0
2023 Sum	-		1,133,520	$95,369			6,019	727
2024 Sum	17,355,851	$145,359	1,191,840	$100,248			5,614	942

7 Appendix B

Table 19: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity	Units
AHU-1	1	Air Handling Unit		TRANE	MCCB030UA0C0UA	480	MBH
AHU-2	1	Air Handling Unit		TRANE	MCCB017UA0C0UA	264	MBH
AHU-3	1	Air Handling Unit		TRANE	MCCB010UAOCOUA	165	MBH
AHU-4	1	Air Handling Unit		TRANE	MCCB030UA0C0UA	462	MBH
AHU-5	1	Central Station Air Handling Unit	Crime lab	MCQUAY	CAH025FDDC		
CH-1	1	Absorption chiller	Entire building	TRANE	ABTF440	440	TON
CT-1	1	Cooling tower		Baltimore Aircoil Series 3000	3552A-MM	552	TON
N/A	1	Steam to HW shell and tube heat exchanger		Bell & Gossett			
ACU	1	Mini split air conditioner, Dx		Carrier		2	TON
N/A	1	Domestic water heater		Lochnivar	RJS120	119	Gal
AC	1	Air compressor		Quincy			
CHWP-1	1	Chilled water pump, VFD				25	HP
CHWP-2	1	Chilled water pump, VFD				25	HP
HHWP-1	1	Heating Hot Water Pump				15	HP
HHWP-2	1	Heating Hot Water Pump				15	HP
CWP-1	1	Condenser Water Pump				30	HP
CWP-2	1	Condenser Water Pump				30	HP
EF-1	1	Exhaust fan	Lab fume hood	GREENHECK	TCBRU-2-18-X-50	5	HP
EF-2	1	Exhaust fan	Lab fume hood	GREENHECK	TCBRU-2-9-X-15	1.5	HP
EF-3	1	Exhaust fan	Lab fume hood	Greenheck	TCBRU-2-18-X-50	5	HP
LEF-1	1	Exhaust fan	Evidence lab	COOK	165 TCNHLM 165TCNHBLE10	3	HP



AECOM

ASHRAE LEVEL II Energy Audit Report
Patrol Services
Oakland County Service Center

November 26, 2025

Quality information

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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Patrol Services Building in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County Patrol Services Building is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Friday April 18, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates four ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The two recommended measures represent a projected 26% annual energy cost savings with an aggregate simple payback of 8 years.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Patrol Services Proposed Energy Savings Summary

ECM #	Measure Description	Priority	Measure Status	Year -1 Electricity Savings	Demand Reduction*	Year -1 Gas Savings	Total Energy Saved	Year - 1 GHG Savings	O&M and Water Savings	Year - 1 Cost Savings	Project Cost (Est)	Simple Payback Period
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	MMBTU	tCO2e	$/yr	$/yr	$	Years
1	Retro-Commissioning & HVAC Scheduling	HIGH	R	12,419	0	153	200.8	13.9	$0	$2,128	$5,656	2.7
2	LED Upgrade & Controls	LOW	R	15,682	5	0	53.5	6.9	$269	$1,725	$27,305	13.7
Sum of Recommended Measures				28,101	5	153	254	21	$269	$3,853	$32,961	8.0
Overall % Reduction				28%	--	**19%**	22%	24%	--	26%	--	--
Measures Requiring Additional Consideration												
N/A	Replace natural gas water heater with ASHP	N/A	NR	-1,156	0	22	19.0	0.7	$0	-$17	$8,000	N/A
N/A	Replace natural gas water heater with instantaneous under sink water heaters	N/A	RS	-5,649	0	22	3.7	-1.3	$0	-$511	$1,200	N/A

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed
**N/A indicates a negative payback period which results from negative cost savings due to the higher cost of electricity relative to the cost of natural gas, common for electrification measures

2 Existing Conditions and Observations

The Oakland County Patrol Services Division is responsible for a wide range of public safety duties. Deputies are assigned to patrol various townships and cities within Oakland County, ensuring public safety and responding to emergencies. They also handle traffic enforcement, which includes monitoring and enforcing traffic laws, investigating motor vehicle accidents, and providing emergency assistance. The division oversees several specialized units such as the Marine, Aviation, and Drone Units, the Search and Rescue Team, and the SWAT Team. In addition to these operational roles, deputies engage with the community by serving as School Resource Officers and participating in outreach programs. The division also provides support services, including technical support and coordination with other divisions like Emergency Communications and Homeland Security.

The single-floor building is approximately 5,656 square feet and operates during normal business hours. Approximately 40 people work in the building.

2.1 Building Systems

2.1.1 Building Envelope

The one-story building with an attic has concrete masonry unit (CMU) walls with brick veneer. It's unknown if there is insulation within the exterior wall structure; however, it is expected that there is insulation in the attic above the ceiling. The entrance has a dual door vestibule, reducing the air infiltration/exfiltration. The building features skylights in the lobby area, harvesting daylight.

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	CMU, red brick veneer	Good
Roof	Attic,	Good
Glazing	20% Window, skylights	Good

* performance criteria has been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

A Trane Voyager packaged unit (RTU-1) installed in 2021, provides heating and cooling to variable volume boxes throughout the building. It has a direct expansion (DX) coil with a cooling capacity of 25 tons and a gas heating input of 350 MBH. The gas furnace provides heating and is designed to supply a 40°F temperature rise. The primary function of the furnace is to temper the air; however, the furnace was not functional during the site visit and reportedly has not functioned properly since install.

A Lochinvar 600 MBH 93% efficiency condensing boiler, installed in approximately 2013, provides heating to the perimeter and reheat coils. It's assumed the boiler and perimeter and reheat coils are currently compensating for the malfunctioning furnace.

2.1.2.2 Plumbing

A gas-fired AO Smith domestic water heater, installed in 2021 with a 42-gallon capacity and 40 MBH heating input supplies domestic hot water to the building. The water is being circulated. The faucets in the restrooms are low-flow fixtures.

2.1.2.3 Building Controls

RTU-1, the hot water system, and terminal units are integrated into the Niagara Building Management System (BMS). These components are accessible via Niagara for monitoring and control, although other equipment remains manually operated. No HVAC operating schedules have been defined for RTU-1 or associated equipment. Systems appear to operate in manual or always-on mode, regardless of occupancy.

2.1.3 Lighting Systems

This building consists of a mixture of T8 fluorescent and light emitting diode (LED) lamps installed in ceiling mounted, recessed, can, and pendant lighting fixtures. Fluorescent bulbs will be replaced by LED as bulbs burn out. All fixtures are manually switched throughout the building. Fixture Ratings: Fluorescent: 32W (typical T8 or T12 lamps) & LED: 12.5W

Table 3: Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
Fluorescent Lights	127	-
LED Lights	43	-

The total approximate quantity of light fixtures is 170, including 127 fluorescent fixtures, and 43 LED fixtures.

The approximate Total wattage is 8,665 watts. The approximate area per drawing is 5,656 ft². The lighting Density is approximately 1.53 W/ft².

2.1.4 Electrical Infrastructure

The main service to 57W is supplied by Feeder A and Feeder B to a 225kVA, 4.5kV-208/120V, 600A, 3-phase, 4 wire transformer located outside of the building.

2.1.5 Additional Information

The building has one electric car charger.

3 Utility Billing Analysis

3.1 Utility Type and Usage

Patrol Services receives electric service, natural gas service, and is not connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per therm.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (MtCO2e)
Electricity	100,804 kWh	344	$11,088	$0.11	0.0004427	45
Natural Gas	799 MCF	830	$3,991	$4.98	0.0549206	44
Total	--	1,174	$15,079	--	--	89

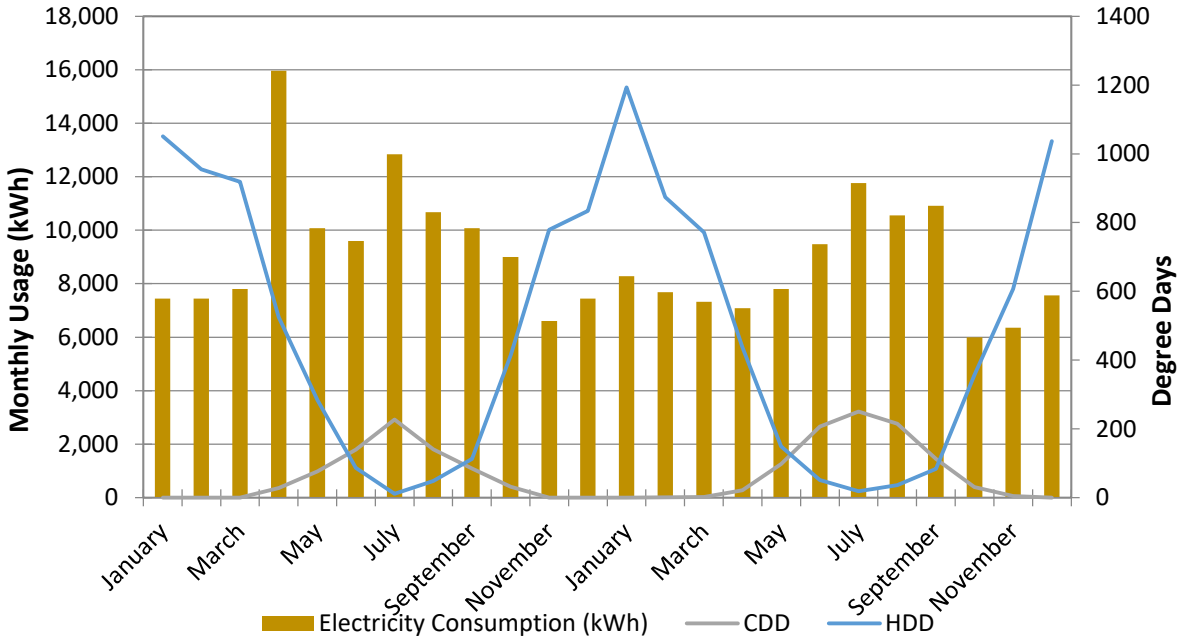
**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*

***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Despite a minor increase in electricity use in the cooling months, electricity usage does not show a strong correlation to weather data, indicating the majority of electricity usage consists of baseload usage. This usage does not vary much from month to month and includes loads such as lighting and fans loads. The slight increase in the summer months The annual usage for the baseline 12-month period from January to December 2024 is 100,804 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

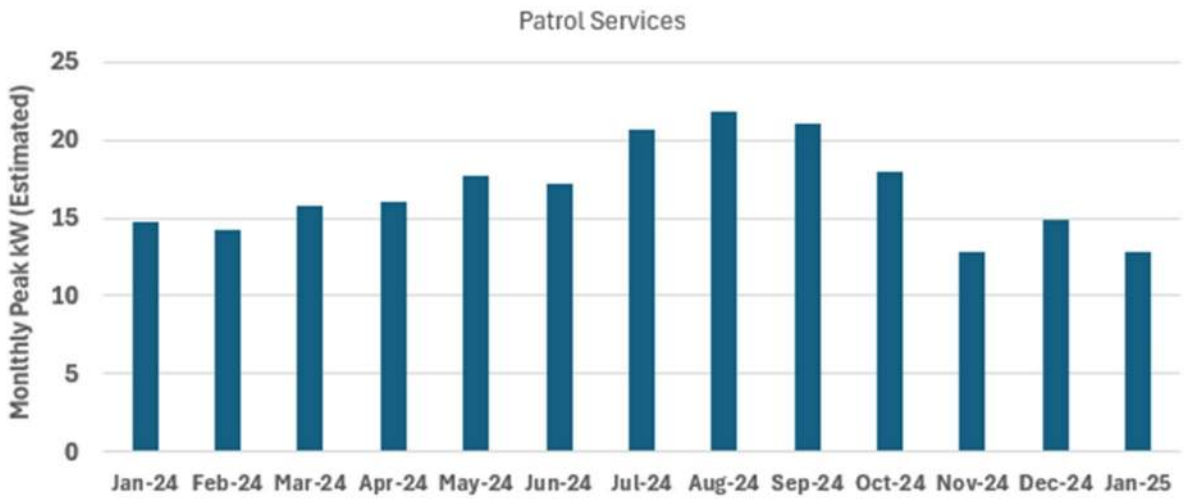
The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 5: Electric Capacity Results

Maximum Building Capacity at Service Transformer	225 kW
Maximum Capacity at Switchgear (A*V*Ph)	216 kW
Estimated Peak Demand	22 kW (estimated)
Remaining Capacity	**198 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge: **$6.15/kW/Month**

Average Dollar per kWh Used in Calculations: $0.11/kWh

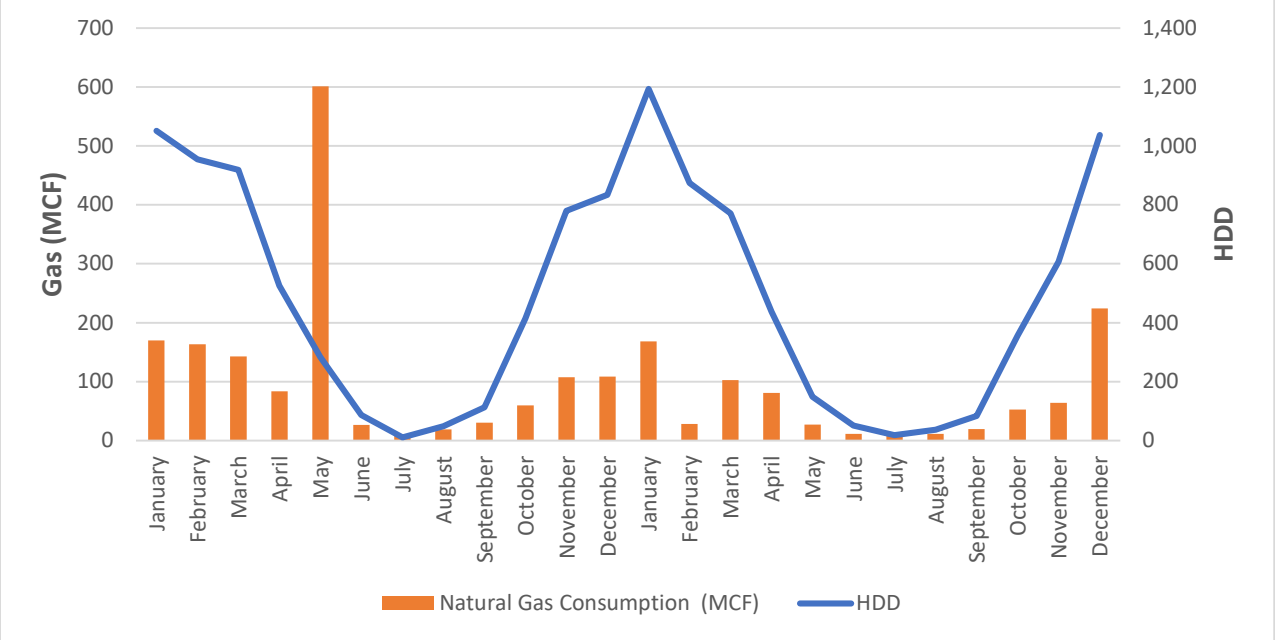
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows a direct correlation to weather data, as natural gas is primarily used for space heating. However, there is baseload summer usage due to domestic hot water usage for bathrooms. There is a billing anomaly in May 2023 which is assumed to be a data entry error. The annual usage for the baseline 12-month period from January to December 2024 is 799 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): $3.48/dTh (decatherm, or 1.038 MCF)

Constellation NG Usage Charge (Day Gas): $5.29/dTh (decatherm, or 1.038 MCF)

Average Dollar per MCF Used in Calculations: $4.98/MCF

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$11,088
Natural Gas	$3,991
Total	$15,079
ECI $/yr/sf	$2.67

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American

Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

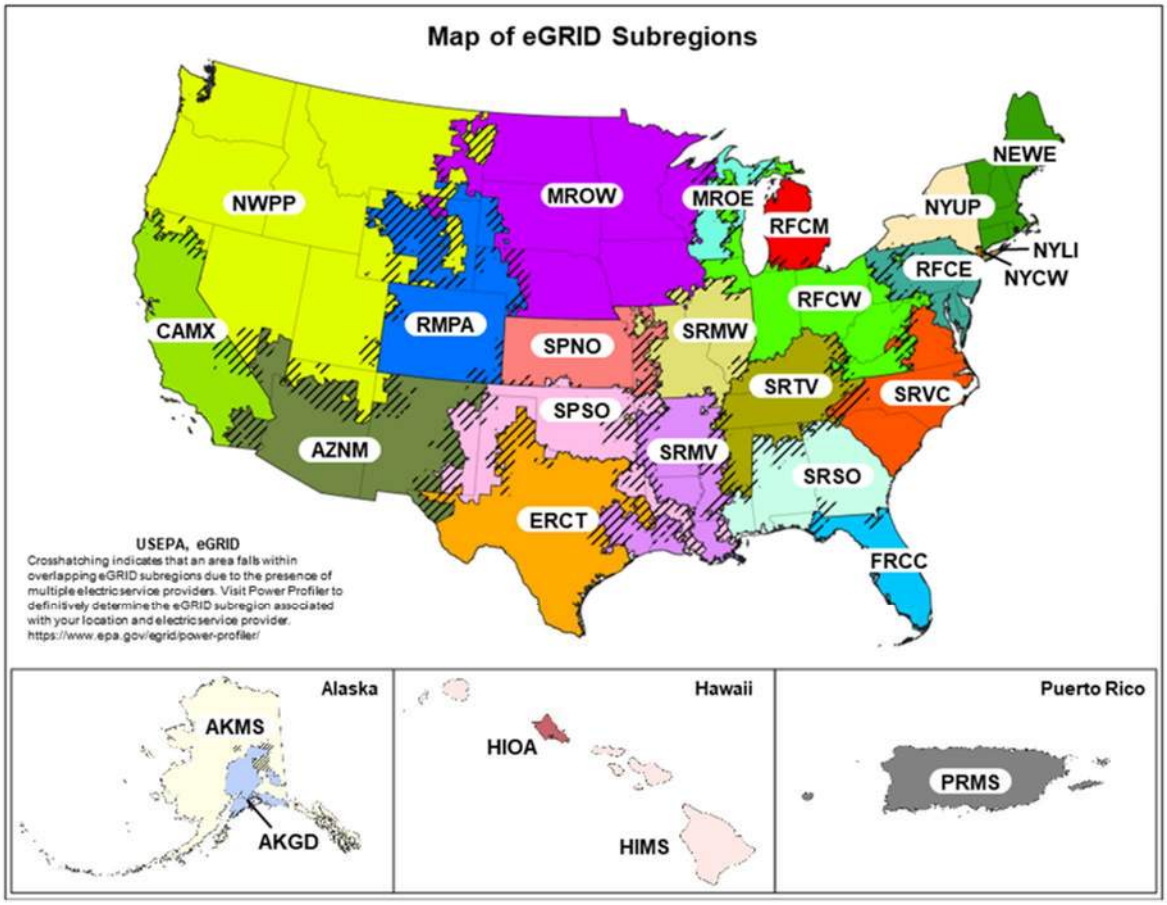
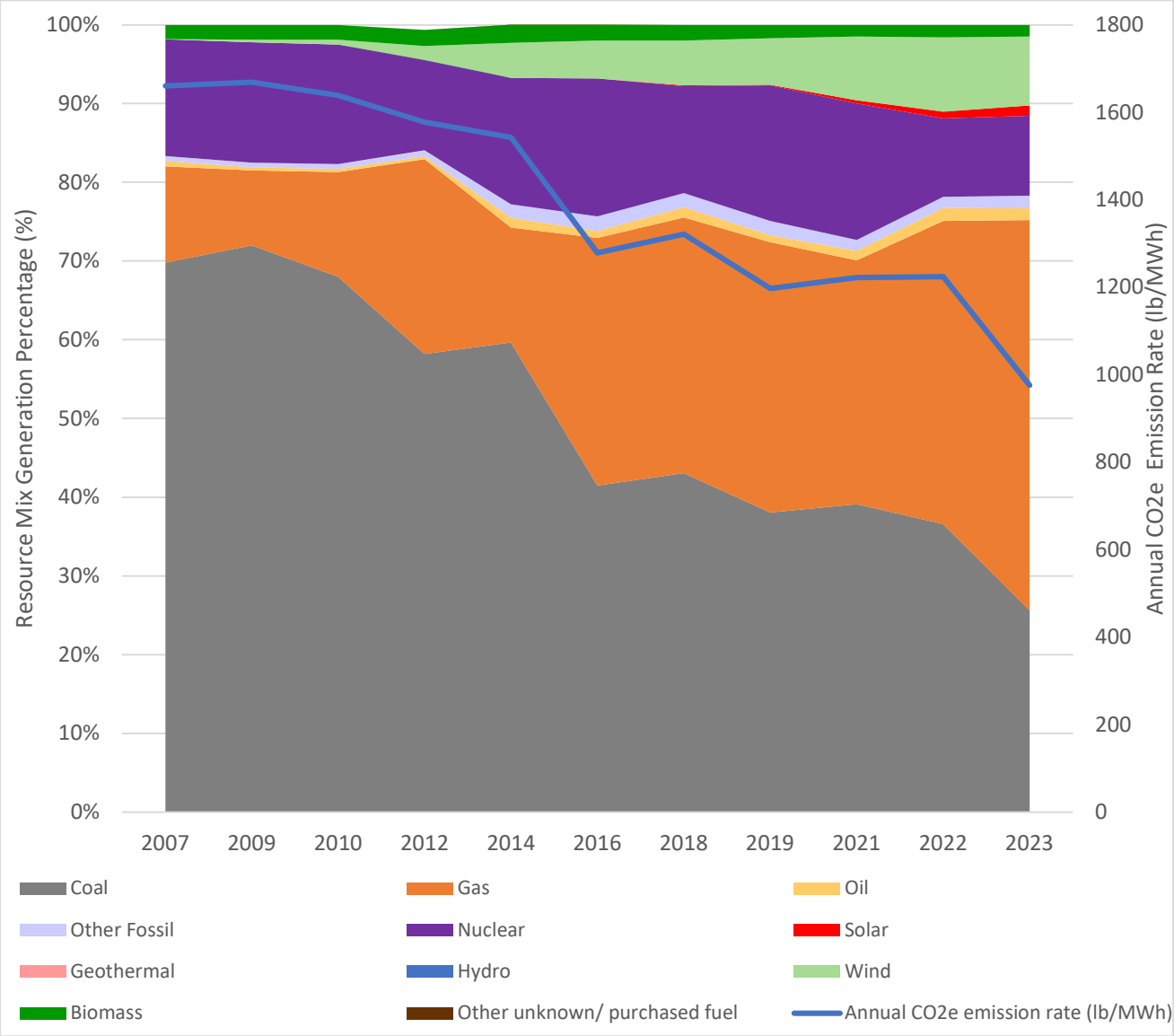


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 50 percent of carbon emissions are attributed to natural gas and 50 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 44 tCO2e (campus-level Scope 1) and 45 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 89 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for Patrol Services are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Patrol Services				**Electric EUI:**		61	kBTU/SF/yr
GFA:	5,656	SF			**Gas EUI:**		147	kBTU/SF/yr
eGRID Subregion:	RFCM				**Current EUI**		208	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	100,800	kWh	3.412	344	0.0004427	45	$11,088	74%
Natural Gas	799	MCF	1.038	830	0.0549206	44	$3,991	26%
		Totals		**1,174**		**89**	**$15,079**	**100%**

According to the US EPA, the average site energy use intensity for a public service facility Is 40.1 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 208 kBTU/SF, which is significantly higher than the national benchmark. It’s important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison indicates there is a significant opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency. The high gas EUI indicates there may also be a metering issue so the metered data should be validated.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Parking	Parking		N/A	N/A	None Available
Public Services	Courthouse*		211.4	101.2	CBECS - Courthouse
	Drinking Water Treatment & Distribution (*Average EUI presented in Energy per Flow in gallons per day*)		5.90	2.27	AWWA - Water Treatment Plant
	Fire Station		124.9	63.5	CBECS - Fire Station/Police Station
	Library		143.6	71.6	CBECS - Library
	Mailing Center/Post Office		96.9	47.9	CBECS - Service
	Police Station		124.9	63.5	CBECS - Fire Station/Police Station
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Social/Meeting Hall		109.6	56.1	CBECS - Social/Meeting
	Transportation Terminal/Station		112.0	56.2	CBECS - Public Assembly
	Wastewater Treatment Plant* (*Average EUI presented in Energy per Flow in gallons per day*)		7.51	2.89	AWWA - Wastewater Plant
	Other - Public Services		89.3	40.1	CBECS - Other
Religious Worship	Worship Facility*		58.4	30.5	CBECS - Religious Worship
Retail	Convenience Store*	Convenience Store with Gas Station	883.5	350.9	Industry Survey
		Convenience Store without Gas Station			
	Mall	Enclosed Mall	170.7	65.7	CBECS - Enclosed Mall
		Lifestyle Center	228.8	103.5	CBECS - Strip Shopping Mall
		Strip Mall			
		Other - Mall	225.3	101.6	CBECS - Enclosed Mall and Strip Shopping Mall
	Retail Store*		120.0	51.4	CBECS - Retail Store
	Supermarket/Grocery Store*		444.0	196.0	CBECS - Grocery Store/Food Market
	Vehicle Dealership*		138.2	71.9	Industry Survey

3.8 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees and visitors. Table 8 and Figure 7 and Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	763	0	792,357	140	42
Space Cooling	23,375	0	0	79,756	14	10
Fans	38,722	0	0	132,119	23	17
Pumps	2,238	0	0	7,636	1	1
DHW	0	22	0	22,923	4	1
Conveyance	0	0	0	0	0	0
Lighting	19,653	0	0	67,057	12	9
Plug Loads	9,642	0	0	32,899	6	4
Process Loads/EV Charging	7,170	0	0	24,463	4	3
Refrigeration	0	0	0	0	0	0
Cooking	0	0	0	0	0	0
Information Technology	0	0	0	0	0	0
TOTAL	**100,800**	**785**	**0**	**1,159,210**	**205**	**88**
Historical Billing	100,800	799	0			
Percent of Actual	100%	98%	0%			
per sqft	17.8	0.1	0			

Figure 7: Existing Electricity End Use Distribution

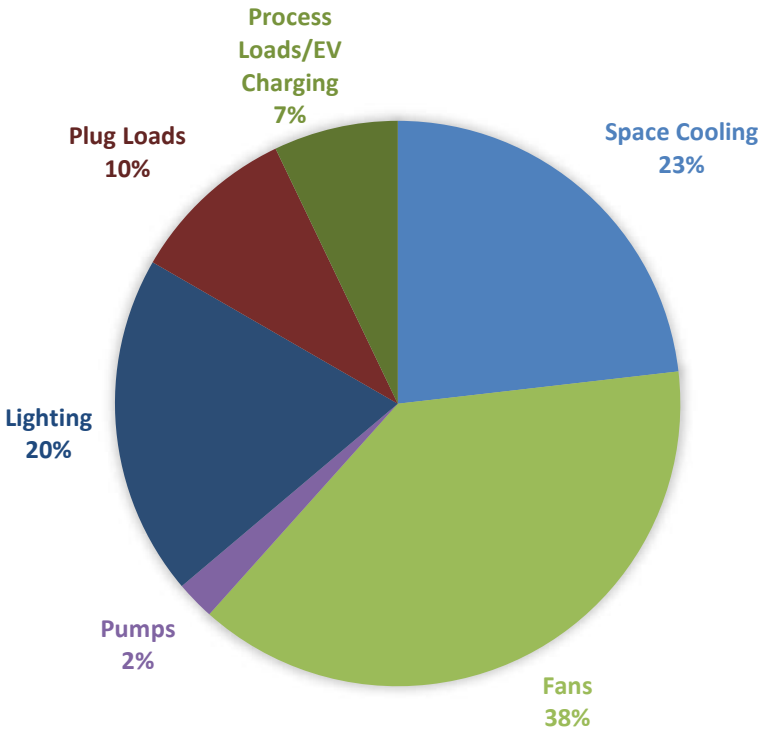
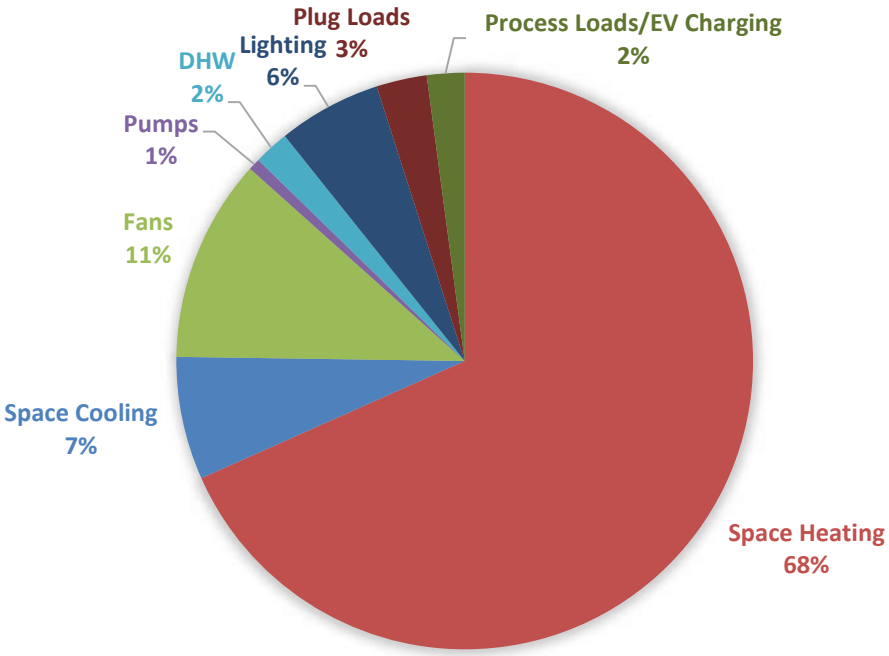


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable when bundled together but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – Retro-Commissioning and HVAC Scheduling

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent.

Implementing standardized setpoints and occupancy schedules for the HVAC system can reduce energy consumption to enhance energy efficiency in areas with regular weekly occupancy. By establishing consistent temperature setpoints and aligning HVAC schedules with actual occupancy patterns, the system avoids unnecessary heating or cooling during unoccupied hours such as evenings, weekends, and holidays. This can be done by enabling seasonal occupied and unoccupied setpoints and schedules on programmable thermostats or enabling these controls in a centralized BAS where only authorized individuals can adjust as needed. This allows the HVAC system to “coast” toward unoccupied setpoints when the spaces are unoccupied and minimizes the need for the HVAC system to run.

Patrol Services currently utilizes a building controls system which allows for advanced control of HVAC systems and scheduling. However, it was noted that during the site assessment there were issues with the BMS computer which may result in other issues and inefficiencies within the system. It was also noted that the main RTU that serves the building does not have a schedule established in the BMS and runs 24/7 while the building is only occupied during typical business hours. This measure combines RCx and HVAC scheduling, as the BMS system issues and furnace issues should be resolved prior to implementing HVAC schedules to align operations with building occupancy.

The following list represents RCx opportunities that should be evaluated to validate operation, repair if discrepancies identified or implement if not active and feasible for major HVAC

systems.. This effort will proactively improve building system operation and optimize energy usage.

- Repair gas heating element in Trane RTU
- Repair BMS computer
- Establish HVAC schedules aligned to occupancy
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Discharge air setpoint reset
- Outside air temperature lockouts
- Outside air damper control
- Duct static pressure reset
- Repair airside or waterside economizing

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing RCx will improve equipment operations, extend useful life, and reduce energy costs.
- The existing RTU runs 24/7 to maintain occupied setpoints due to the current BAS scheduling.
- Assumes the condensing boiler serving perimeter and reheat systems is compensating for the RTU furnace and overall heating load remains similar.
- Energy savings assume a 20% reduction in estimated heating, cooling, and fan end use energy consumption.
- Additional study of equipment capacity requirements could be performed as part of this measure.
- $1/SF was used to estimate the cost for the 5,656 SF building. This price assumes that the RCx process will be completed with other buildings of similar size, which improves the efficiency and lowers the overall cost of the process.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: This measure proposes engaging a third-party contractor to determine if this building is eligible for the DTE RCx program and systematically evaluate and prioritize major HVAC and control systems and complete retro-commissioning to restore systems to their original design intent. Once BMS and other identified HVAC issues are resolved, establish seasonal setpoints (generally targeting 68-74°F when occupied and 55-60°F/80-85°F when unoccupied) and HVAC schedules that align with building occupancy patterns. Following these steps, the centralized BMS HVAC schedule should be configured accordingly. Verify and monitor to ensure the system is operating as intended and adjust as needed. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 9: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
RCx and HVAC Scheduling	153	12,419	201	14	$0	$2,128	$5,656	2.7
Overall % Reduction	**19%**	**12%**	**17%**	**16%**	**--**	**14%**	**--**	**--**

4.2 ECM 2 – LED Lighting and Controls

This measure proposes upgrading all remaining fluorescent lighting (estimated 127 fixtures) to light-emitting diode (LED) lightbulbs with sensors to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements.

Incorporating lighting controls allows for better management and customization of lighting systems, leading to reduced energy consumption, and increased overall efficiency by limiting the time lighting is on to only when necessary. For indoor lighting, lighting controls consist of occupancy, daylighting, timers, scheduling, and dimming features to optimize light levels based on external lighting availability and usage of a space. For outdoor lighting, the lighting controls consist of motion sensors, photocells, and timers to turn the lighting ON/OFF. The current lighting in Patrol Services is described in Section 2.1.3. There are 127 32 W fluorescent fixtures and 43 12.5 W LED fixtures for an estimated wattage of 8,665.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.



Figure 9: Example Fixture with Integrated Occupancy Controls

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture.
- Lights operate 10 hours per day for 252 business days per year, based on office occupancy.
- O&M savings assume an average cost of $3.81/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- This measure assumes a 0.88 W/ft² or 60% reduction in lighting power and 30% reduction in hours through implementation of controls.
- LED upgrades cost $215/fixture, which include integrated control sensors and no additional wiring and control circuits. Low-cost fixtures and external controls can be used as an alternative to this implementation method.
- This measure does not recommend adding new controls to the existing LED fixtures.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps:

Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, if integrated controls are not included in each fixture, subsequent steps are required that may consist of conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. Following this assessment, a controls contractor can be engaged to install the lighting controls and assist building engineers in configuring the schedule to optimize lighting usage.

ECM Savings and ROM Cost:

Table 10: ECM 2 Savings and ROM Cost

Savings Summary								
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost ($)**	**Simple Payback (Yrs)**
LED Upgrade & Controls	0	15,682	53.5	6.9	$267	$1,725	$27,305	13.7
Overall % Reduction	**0%**	**16%**	**4.6%**	**8%**	**--**	**11%**	**--**	**--**

5 Measures Requiring Additional Consideration

This section provides details on measures that were analyzed but are not recommended for immediate implementation at this time. This includes measures that require further study, such as capital-intensive replacements of existing equipment, but are not justified through energy savings alone. This section may also include measures that conflict with building electrification plans, or projects that are simply not recommended due to being financially impractical or not being technically feasible.

5.1 ECM – Domestic Hot Water Upgrades

Domestic hot water systems provide heated water for uses such as handwashing, cleaning, showering, cooking, and laundry. This can represent a significant portion of a building's overall energy usage. Maintaining proper water temperature and control is not only critical for energy efficiency but also for health and safety – temperatures must be 140F to prevent bacteria growth such as Legionella, yet low enough to prevent scalding and prevent excessive energy use. This measure proposes two options for replacing the existing 40 MBH AO Smith natural gas domestic hot water heater.

Option A recommends installing an air source heat pump (ASHP) water heater. Switching from a conventional electric water heater to an air-source heat pump (ASHP) water heater can significantly reduce energy use, as ASHP units operate at roughly 40% of the energy consumption of standard electric models, making them a far more efficient option, this measure also supports goals to electrify fossil-fuel use to reduce carbon emissions.

Option B recommends installing instantaneous electric under-sink water heaters for each bathroom or break room sink in place of the central tank-type water heater. Unlike traditional hot water heaters with storage, under-sink electric heaters provide hot water on-demand and eliminate the need to continuously maintain a storage tank of hot water. As the sink tap turns on, cold water flows through an electric resistance heating element and is quickly heated before flowing through the faucet. This method of water heating for bathroom and break room use during regular business hours reduces energy consumption by eliminating standby heat losses associated with hot water storage tanks and heat loss associated with piping between water heaters and their end use. Additionally, switching from a gas-fired water heater to electric under-sink heaters improves operational comfort and supports goals to electrify fossil-fuel use to reduce carbon emissions.

ECM Savings and ROM Cost:

Table 11: ECM 3 Savings and ROM Cost

Savings Summary – Domestic Hot Water Upgrades								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost ($)	Simple Payback (Yrs)
Option A: ASHP Water Heater	22	-1,156	19.0	0.7	$0	-$17	$8,000	-473.6
Option B: Under Sink Heaters	22	-5,649	54.8	1.4	$0	-$265	$1,200	-4.5

6 Appendix A

Table 12: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	170	$1,419	7,440	$798	10	13	1,051	0
Feb-23	163	$1,512	7,440	$701	11	14	955	0
Mar-23	142	$756	7,800	$700	10	17	918	0
Apr-23	83	$643	15,960	$1,404	22	36	525	28
May-23	601	$6,253	10,080	$795	14	22	283	76
Jun-23	27	$274	9,600	$719	13	21	86	139
Jul-23	8	$185	12,840	$1,039	17	24	11	227
Aug-23	19	$249	10,680	$848	14	21	48	141
Sep-23	30	$452	10,080	$928	14	23	113	85
Oct-23	60	$690	9,000	$732	12	19	415	31
Nov-23	107	$999	6,600	$507	9	15	779	0
Dec-23	108	$1,314	7,440	$528	10	13	834	0
Jan-24	168	$1,837	8,280	$191	11	15	1,194	0
Feb-24	28	$1,713	7,680	$786	11	14	874	1
Mar-24	103	$1,565	7,320	$591	10	16	771	2
Apr-24	81	$479	7,080	$621	11	18	437	21
May-24	27	$300	7,800	$750	10	17	148	98
Jun-24	11	$517	9,480	$871	13	21	51	207
Jul-24	10	$399	11,760	$1,048	16	22	18	251
Aug-24	12	$271	10,560	$971	14	21	37	215
Sep-24	19	$394	10,920	$876	15	25	84	112
Oct-24	53	$602	6,000	$570	8	13	356	31
Nov-24	64	$938	6,360	$686	9	15	607	4
Dec-24	224	$1,001	7,560	$636	10	13	1,037	0
2023 Sum	1,520	$14,746	114,960	$9,699			6,019	727
2024 Sum	799	$10,016	100,800	$8,597			5,614	942

7 Appendix B

Table 13: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Efficiency	Capacity 2	Approx Year Installed
RTU-1	1	Packaged Air Handling Unit (NG, Dx)	Whole building	Trane	YCH330BEJ17D2EJB 00C0000HJB0MK0R0 000000000	350 MBH input 280 MBH out (heat)		25 TON (cool)	2021
N/A	1	Heating hot water condensing boiler	Perimeter and reheat coils	Lochnivar		600 MBH input 560 MBH out	93%		2013
DWH	1	Domestic hot water		AO Smith	GCR-40 40A0	40 MBH	62% UEF	42 GAL	2021
HWP	1	Heating HW Pump	Perimeter and reheat coils			0.75	HP		

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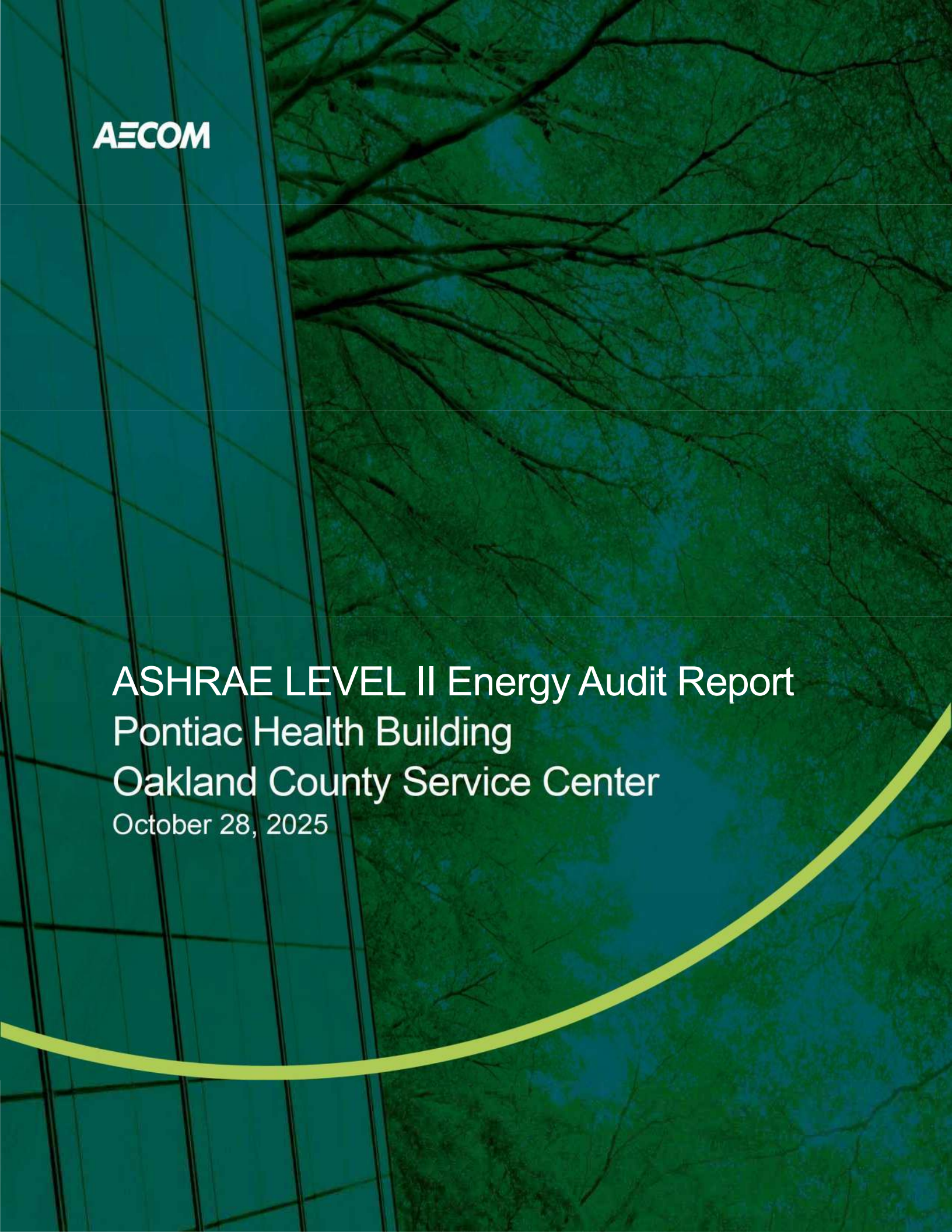

AECOM

ASHRAE LEVEL II Energy Audit Report
Pontiac Health Building
Oakland County Service Center
October 28, 2025

Quality information

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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Pontiac Health Building, 36 East, in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation" or "Not Recommended" measures based on simple payback period or foreseen feasibility issues.

All identified energy reduction opportunities have been characterized in this report as ECMs regardless of scope and scale of capital investment. Additionally, AECOM recognizes that Oakland County wishes to pursue the future electrification of its facilities to the extent practical, as described in AECOM's Service Center-wide assessment report of future electrification options. The ECMs listed in this report address opportunities identified within existing conditions and existing energy infrastructure. The report's proposed ECMs may or may not be relevant to an energy infrastructure environment evolved from fossil fuel-driven energy infrastructure to fully electrically powered energy infrastructure.

The Oakland County Pontiac Health Building is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted in April 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates two ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The two listed measures represent a projected 24% annual energy cost savings with an aggregate simple payback of 12.9 years. Both measures are prioritized as "Recommended" for implementation.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Report However, if immediate HVAC upgrades are necessary, the recommended upgrades should be "electrification-ready" to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE's prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Pontiac Health Building Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	KW	MCF/yr	k lbs/y	MMBTU	tCO2e	$/yr	$/yr	$	Years
1a	LED Lighting Upgrade	LOW	R	30,720	12	0	0	105	14	$645	$3,379	$45,000	11.2
1b	Lighting Controls	LOW	R	5,530	0	0	0	19	2	$0	$608	$18,750	30.8
2	BAS Installation & RCx	LOW	R	18,428	0	0	149	241	26	$0	$3,519	$41,250	11.7
			Sum	54,678	12	0	149	365	42	645	7,506	$105,000	**12.9**
			Overall % Reduction	28%	25%	0%	15%	20%	20%	--	24%	--	

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Pontiac Health Building was originally designed and built in 1955 and was 30,000 ft^2. The building was used as a medical facility and operates at all hours. In 2022, a 3,000 ft^2 evidence area was added as part of building renovation.

2.1 Building Systems

2.1.1 Building Envelope

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Masonry construction	In good appearance from visual inspection, however older construction and may not be adequately insulated
Roof	Flat roof with black membrane and solar panels partially covering the roof.	Assumed R-20 or less (age-dependent)
Glazing	Double pane with a low window to wall ratio. Non-renovated section had some single pane windows.	Poor (non-renovated section) to Good (renovated section)

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

This building was originally built in the 1950s and had a 2,000-3,000 ft^2 renovation in 2022 to allow for Evidence storage. The 1955 section of the building is supplied by an air handling unit (AHU-1) which has a heating capacity of 260 MBH and direct expansion (DX) cooling capacity of 26.6 tons and an outdoor condensing unit.

There is an existing steam to heating hot water (HHW) heat exchanger to provide HHW to the heating coil for AHU-1 and to the baseboards. The heat exchanger was built in 1973.

For the building renovation, a hybrid heat pump system was installed with a fluid cooler (FC-1), hot water heating from the steam to hot water heat exchanger, variable speed pump (P-4), and four hybrid heat pumps (HHP). The fluid cooler has a capacity of 30.5 tons of cooling. The loop temperature ranges from 85°F to 120°F. Unlike traditional water source heat pumps, the hybrid heat pumps do not have reversing valves and operate as variable speed fan coil units with hydronic heating mode.

Supplemental space conditioning at the facility includes a mini-split heat pump with 1.5 tons of heating capacity and 1.5 tons of cooling capacity. Additionally, the “Virtua” (360° computer training room for police officers) is served by 2 mini-split air conditioning (AC) units, the condensing units for which are on the roof. The Virtua room is used by the police force three to four times per year. This room was reported to have a local thermostat connected to the AHU

and has baseboard heating in addition to the dedicated AC units; however, the room was not accessible during the site visit.

Pumps P-3 and P-4 are operated by variable frequency drives and are connected to the HHPs. P-1 and P-2 are existing pumps for AHU-1 and baseboard heaters..

The total cooling capacity of the systems serving this building is 85 tons and the heating capacity is 55 tons.

2.1.2.2 Plumbing

One 30-gallon electric domestic water heater, rated at 4,500 W (240 V) or 3,500 W (208 V). The voltage of the system was not known at the time of the site visit.

2.1.2.3 Building Controls

While much of the Pontiac Health Building continues to operate with local controls, select equipment has been integrated into the Niagara Building Management System (BMS) platform. This includes FC-01 (fluid cooler), the associated hybrid heat pump system, and AHU-02 serving the renovated 2022 addition.

2.1.3 Lighting Systems

The old areas of the building use T-8 fluorescent fixtures in most spaces and fixtures are estimated at one fixture per 100 square feet. The renovation completed in 2023 specified all LED type fixtures. The renovation design drawings show approximately 90 2x2 troffer LED fixtures.

Table 3: Lighting Summary

Lighting	Total Fixtures	Lamps per Fixture
Fluorescent Lights	300	2 lamp
2x2 LED Troffer	90	1 lamp

The approximate total wattage of all interior lighting is 21,900 watts. The approximate area per drawing is 33,000 ft^2. The lighting density is calculated as 0.66 W/ft^2.

2.1.4 Electrical Infrastructure

The building electrical system is served by a 1200A 120/208V 3-phase service. The transformer serving the building is estimated at 500kVA. The building has a rooftop solar photovoltaic (PV) array that supplements the building's electrical load. While the PV system reduces reliance on grid electricity, it does not fully offset total energy use. The system is monitored through the Enphase energy management platform, which provides visibility into solar generation and system performance. The exact installation date is unclear, but based on the electricity data available, it appears the installation may have come online between the Fall 2023 and Spring of 2024.

3 Utility Billing Analysis

3.1 Utility Type and Usage

Pontiac Health receives electric service, is connected to the steam network, and is not connected to natural gas service. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

Steam usage is metered and billed to the building based on the cost to generate the utility. Steam is the primary heating source for the building.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Steam:** Oakland County Internal Tracking

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	195,168 kWh	666	$21,468	$0.11/kWh	0.0004427	86
Steam	996 klbs	1,189	$9,960	$10.00/klb	0.1190000	119
Total	--	1,855	$31,429	--	--	205

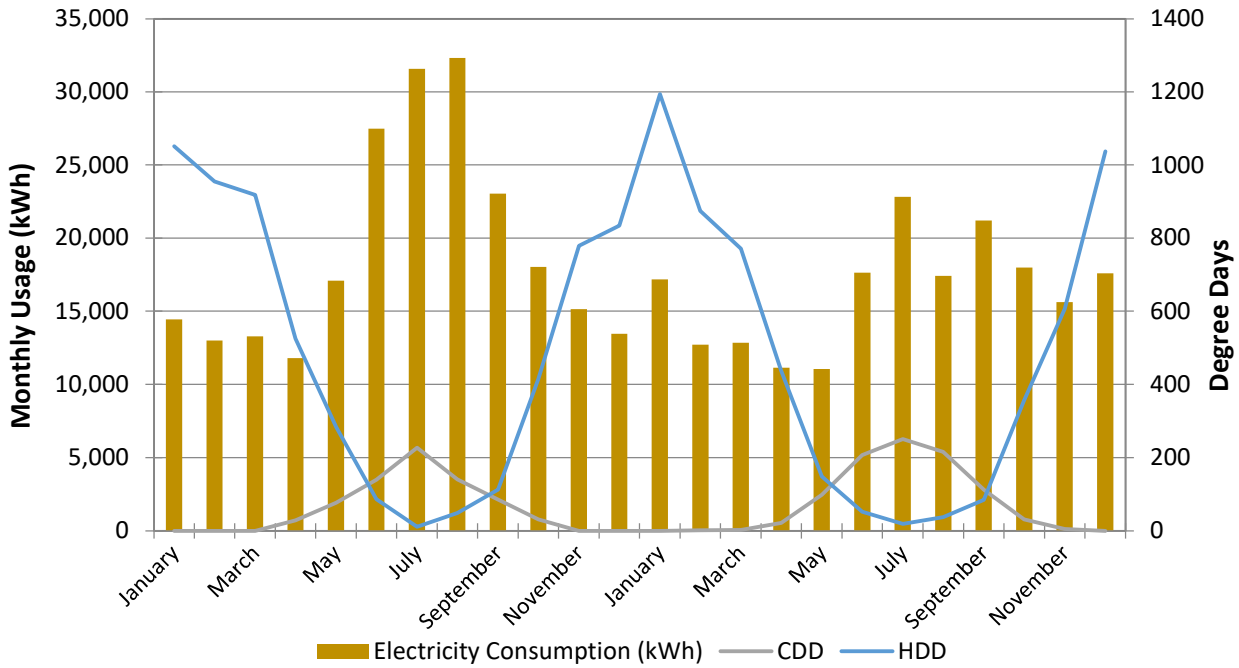
** Steam (1 klb = 1194 Btu); Electricity (1 kWh = 3413 Btu)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a direct correlation to weather data, specifically CDD, indicating that electricity is primarily used for space cooling. The annual usage for the baseline 12-month period from January to December 2024 is 195,168 kWh. The date the rooftop solar array came online is unclear, but based on the electricity data provided, it appears the array may have come online between Fall 2023 and Spring 2024. This is indicated by the decreased electricity usage through summer 2024, when solar generation is at its peak. Weather data indicates the CDD were greater in summer 2024 than summer 2023, so the actual usage is expected to be higher.

The actual metering of the solar array should be verified. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

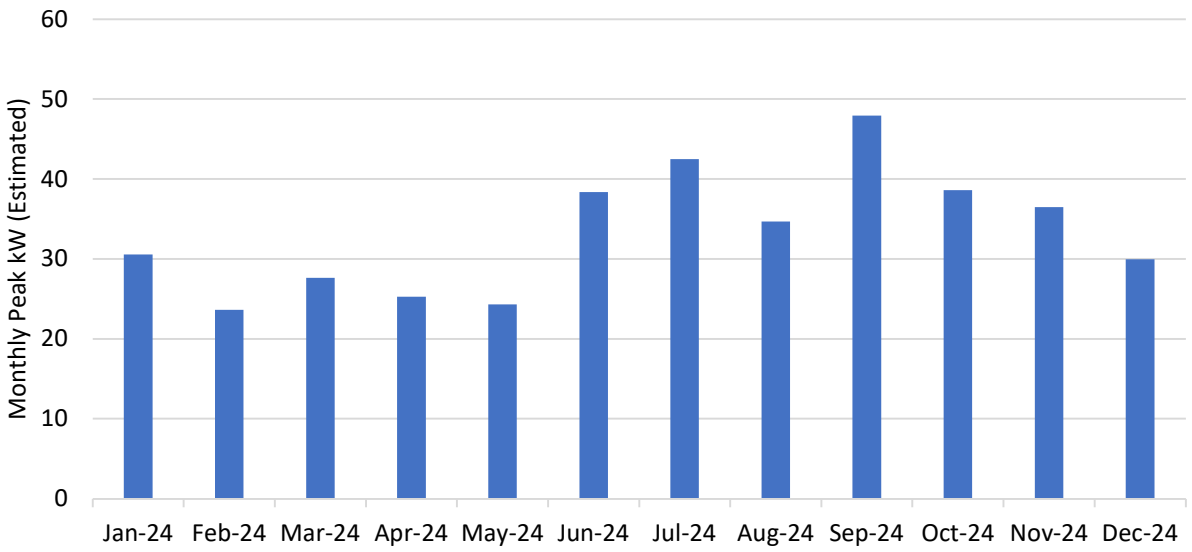
AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

The peak demand estimated may be lower than the actual building demand, as it appears the rooftop solar array generation may directly supplement the building and offset the metered consumption, which was used to estimate the demand.

Table 5: Electric Capacity Results

Maximum Building Capacity at Service Transformer	750 kW
Maximum Capacity at Switchgear (A*V*Ph)	900 kW
Estimated Peak Demand	88 kW (estimated)
Remaining Capacity	**667 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge:	**$0.057/kWh**
DTE Electric Demand Charge:	**$6.15/kW/Month**
Average Dollar per kWh Used in Calculations:	**$0.11/kWh**

Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

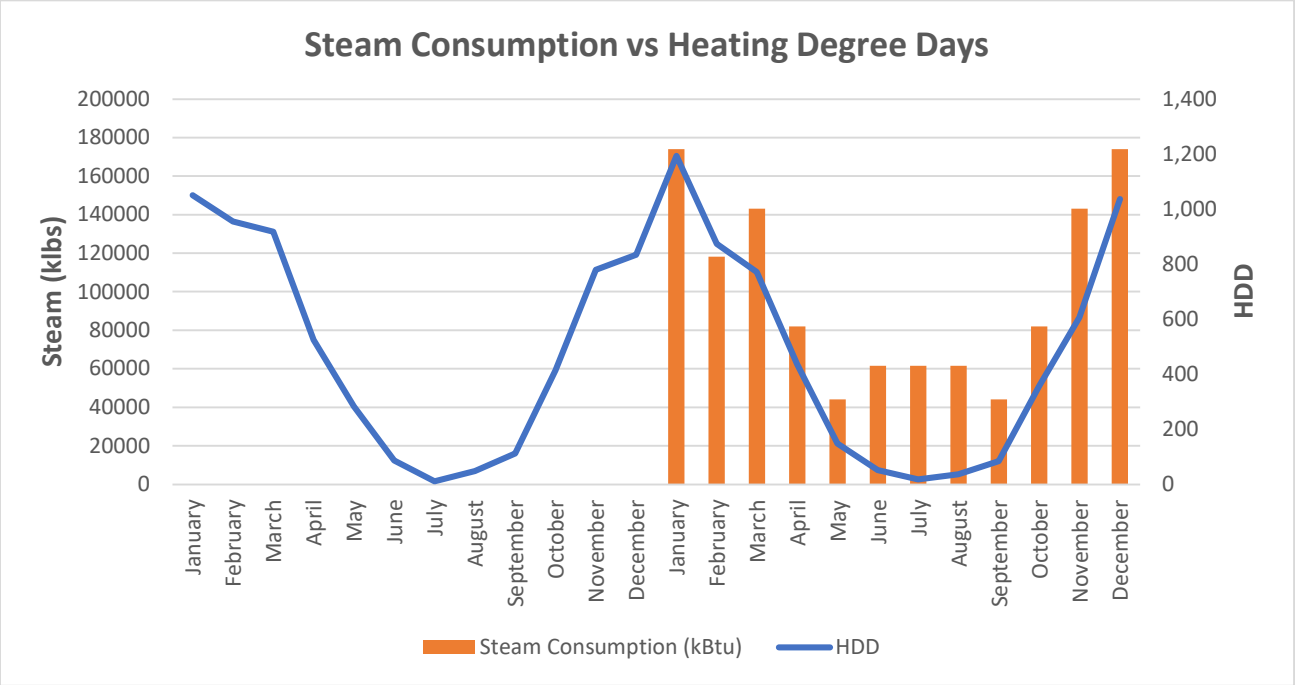
Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

The metering agreement for the new rooftop solar array is unclear. However, the size of the array is only able to offset some usage so net-metering is unlikely a concern.

3.4 Steam Usage Profile

Figure 3 compares the monthly steam usage profile for 2024 with local monthly weather data for 2023 – 2024 indicated by HDD. Steam data for 2023 is not available. Steam usage shows a direct correlation to weather data, as steam is primarily used for space heating. The annual usage for the baseline 12-month period from January to December 2024 is 996 klbs. Detailed monthly steam usage and costs are in Appendix A. Steam usage from July through December 2024 was extrapolated from January through June data due to errors in the recorded steam meter readings.

Figure 3: Steam Usage Profile (January 2023 to December 2024)



3.4.1 Steam Rate Structure

Unlike electricity and natural gas, which are billed directly by external utilities, steam is an internal utility produced on campus. The cost allocation for steam is derived from the total natural gas cost at the central steam plant, as well as costs to operate the plant. Each steam-served building is billed proportionally based on its metered steam usage relative to the campus total. As a result, there are no separate delivery, demand, or third-party charges; the unit cost of steam reflects the cost of natural gas, plant operating cost and efficiency, and distribution system performance.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings.

Average Dollar per klb Used in Calculations: $10.00/thousand lbs

3.5 Energy Cost Index

The energy cost analysis is based on the information provided by an annual purchase request statement for 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$21,468
Steam	$9,960
Total	$31,429
ECI $/yr/sf	$0.95

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4. Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

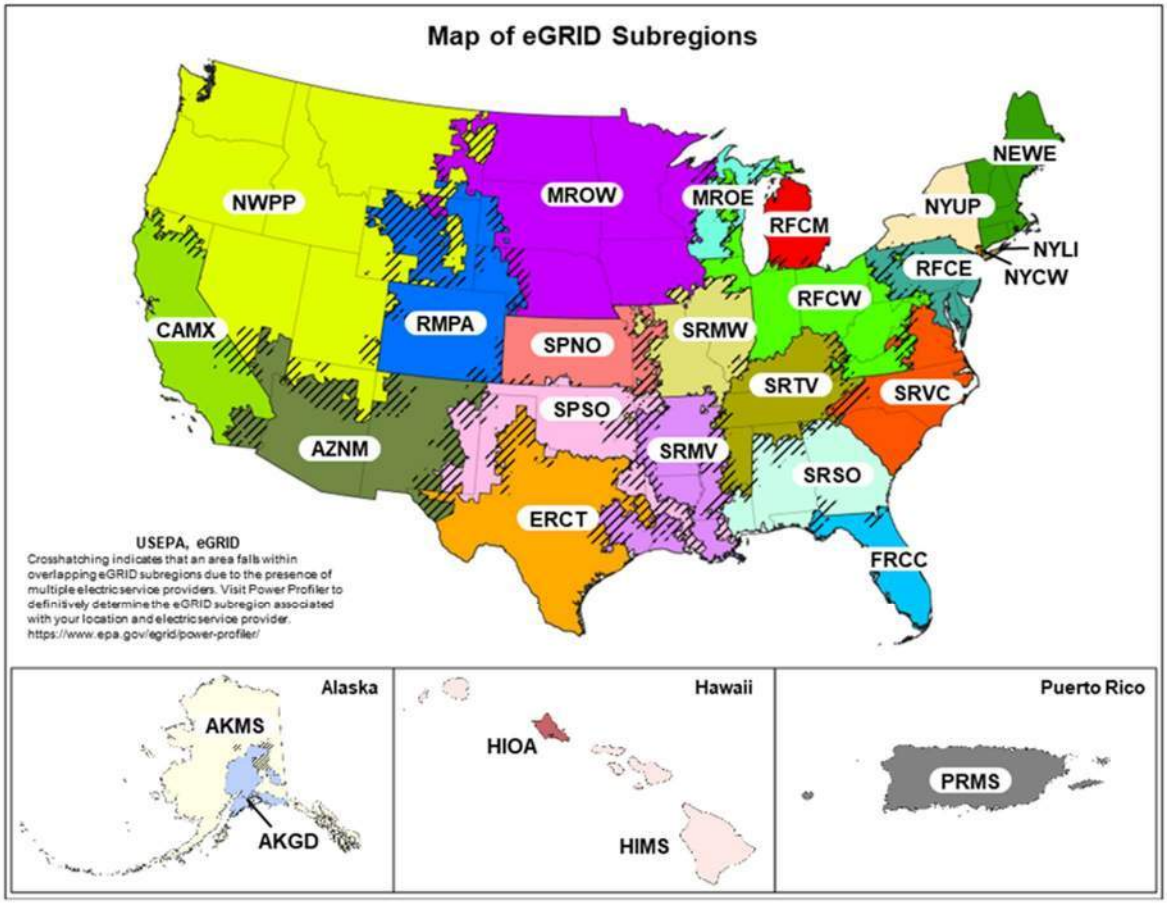
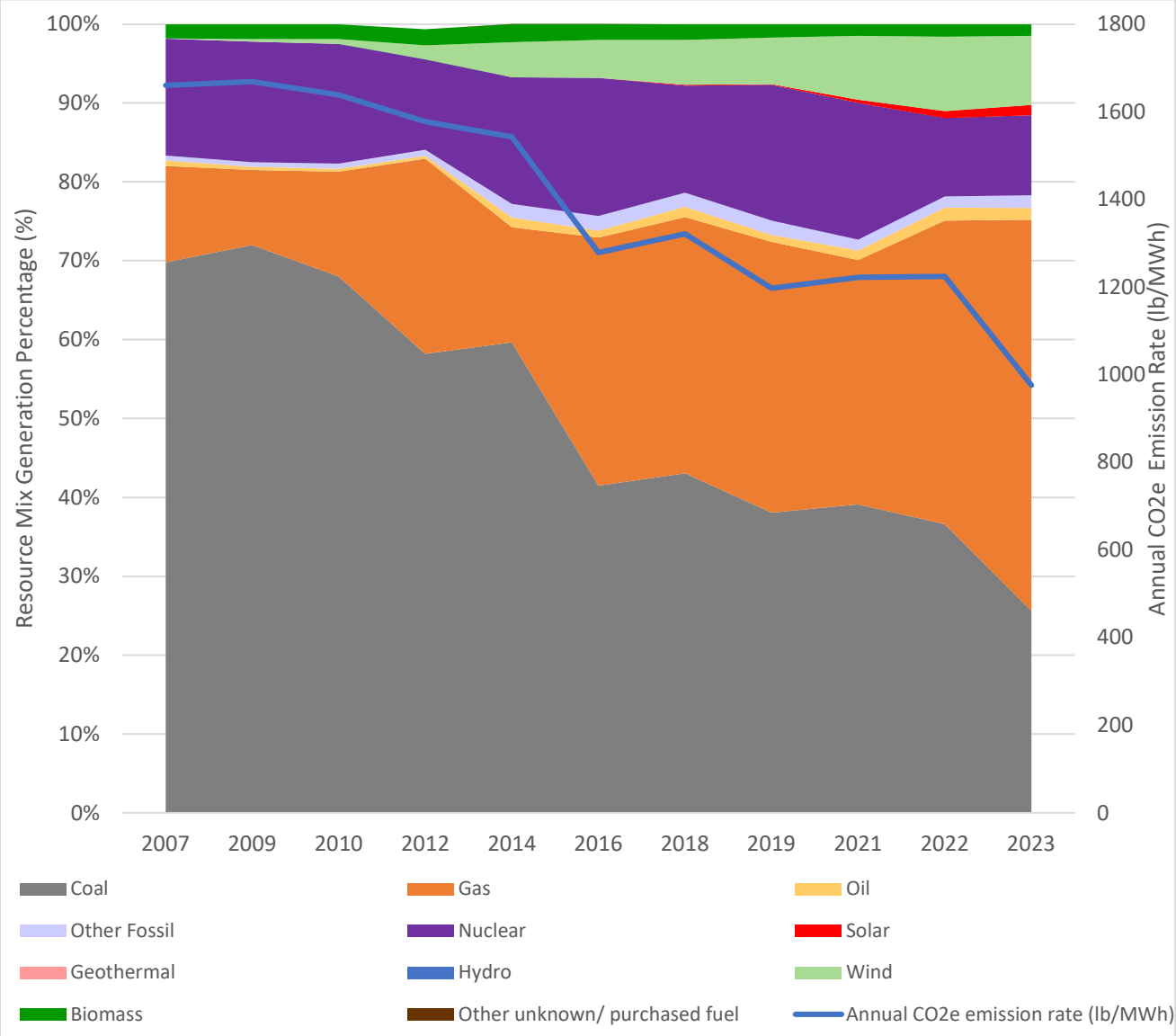


Figure 5 displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 58 percent of carbon emissions are attributed to steam and 42 percent are associated with electricity. Steam combustion and imported electricity resulted in 119 tCO2e (campus-level Scope 1) and 86 tCO2e (campus-level Scope 2) emissions,

respectively, for a total of 205 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and steam usage for Pontiac Health are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Pontiac Health Building				**Electric EUI:**		20	kBTU/SF/yr
GFA:	33,000	SF			**Steam EUI:**		36	kBTU/SF/yr
eGRID Subregion:	RFCM				**Current EUI**		56	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	195,168	kWh	3.412	666	0.0004427	86	$21,468	63%
Natural Gas	0	MCF	1.038	0	0.0549206	0	$0	0%
Steam	996	klbs	1194	1,189	0.1190000	119	$9,960	37%
Totals				1,855		**205**	$31,429	100%

According to the US EPA, the average site energy use intensity for a medical office is 97.7 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 56 kBTU/SF, which is lower than the national benchmark. As mentioned previously, the new solar array may be directly offsetting some of the building electricity consumption so they electricity EUI may be higher than the current reported 2024 utility data. Using 2023 electricity data (assumed to be prior to solar installation coming online), the building EUI would be closer to 60 kBTU/SF. However, observations from the site visit indicate there are still opportunities to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient

3.8 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees. Table 8 and Figure 7 and Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	0	994	1,187,229	36	118
Space Cooling	48,951	0	0	167,020	5	22
Fans	55,108	0	0	188,030	6	24
Pumps	13,744	0	0	46,894	1	6
SHW/DHW	7,063	0	0	24,099	1	3
Conveyance	0	0	0	0	0	0
Lighting	56,064	0	0	191,290	6	25
Plug Loads	9,188	0	0	31,349	1	4
Process Loads	5,050	0	0	17,231	1	2
Refrigeration	0	0	0	0	0	0
Cooking	0	0	0	0	0	0
Information Technology	0	0	0	0	0	0
TOTAL	195,168	0	994	1,853,142	56	205
Historical Billing	195,168	**0**	**996**			
Percent of Actual	100%	0%	100%			
per sqft	5.9	**0.00**	**0.03**			

Figure 7: Existing Electricity End Use Distribution

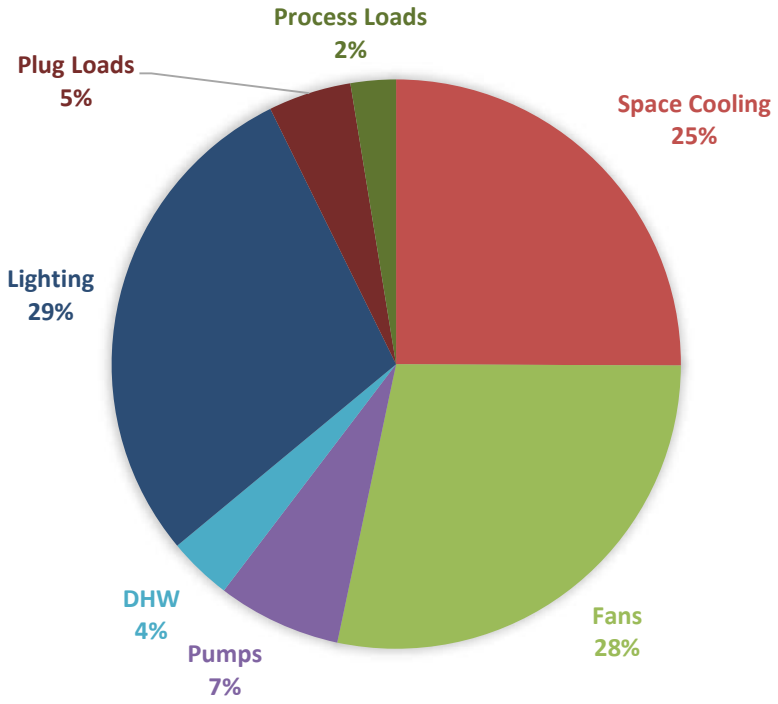
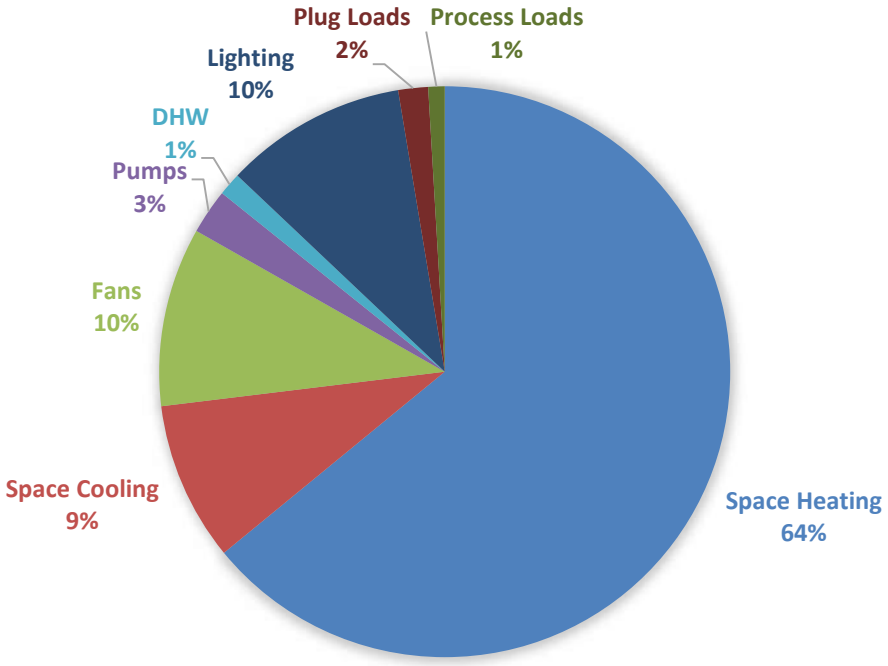


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – LED Upgrade and Lighting Controls

This measure proposes upgrading all remaining fluorescent lighting (approximately 300 fixtures) to Light-emitting diode (LED) lightbulbs with motion sensors and dimming functionality where appropriate to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements.

Incorporating lighting controls allows for better management and customization of lighting systems, leading to reduced energy consumption, and increased overall efficiency by limiting the time lighting is on to only when necessary. For indoor lighting, lighting controls consist of occupancy, daylighting, timers, scheduling, and dimming features to optimize light levels based on external lighting availability and usage of a space. For outdoor lighting, the lighting controls consist of motion sensors, photocells, and timers to turn the lighting ON/OFF. The current lighting in Pontiac Health is approximately 23% LED and 77% fluorescent and the estimated wattage is approximately 0.66 W/ft². See Section 2.1.3 for the lighting counts used to estimate energy consumption.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture. Lighting controls that include dimming will likely require full fixture replacement, which drive up the total cost of implementation for the measure.

- Lighting fixture counts were only provided for the newly renovated section of the building. The old section assumed 1 fixture per 100 square feet.
- Lights are assumed to be turned on 10 hours per day for 256 days of the year.
- This measure assumes a 0.36 W/ft² or approximately 55% reduction in interior lighting power and a 30% reduction in hours of operation for adding new controls.
- LED upgrades cost $150/fixture and motion sensors, costing $250 per sensor, would be placed on 25% of the fixtures. This measure does not assume integrated lighting controls for each new fixture.
- O&M savings assume an average cost of $2.15/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, the subsequent steps would involve conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. Following this assessment, a controls contractor can be engaged to install the lighting controls and assist building engineers in configuring the schedule to optimize lighting usage. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 9: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	**District Steam Savings (k lbs)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
LED Upgrade	0	30,720	105	14	$645	3,379	$45,000	11
Lighting Controls	0	5,530	19	2	$0	608	$18,750	31
Total	0	36,250	124	16	$645	3,987	$63,750	14
Overall % Reduction	0%	18.6%	6.7%	7.8%	--	12.7%	--	--

4.2 ECM 2 – BAS Controls Integration and Retro-Commissioning

This combined measure involves installing a building automation system (BAS) and completing retro-commissioning (RCx) once the BAS is operational. Together, these steps enable centralized control, improve system coordination, and ensure building operations are optimized for efficiency and reliability.

BAS Integration

Pontiac Health currently operates with a mix of local controls and partial integration to the Niagara BAS (FC-01 fluid cooler, the hybrid heat pump loop, and AHU-02 for the 2022 addition). This ECM expands BAS integration to the legacy 1955 wing and other key equipment (e.g., AHU-1 heating/cooling coils and fans, baseboard heating control valves, legacy pumps P-1/P-2, remaining thermostats, and applicable mini-split controls). Full integration will enable consistent scheduling, setpoint management, alarming, trend logging, and coordinated operation across systems that today run largely stand-alone.

Retro-Commissioning

With the expanded BAS in place, commissioning will verify sequences of operation, tune control loops, and correct long-standing operational issues.

The following list represents commissioning opportunities that should be evaluated to validate operation, repair if discrepancies identified or implement if not active and feasible for major HVAC systems. This effort will proactively improve building system operation and optimize energy usage.

- Optimize HVAC scheduling in non 24/7 occupied spaces
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water supply reset
- Discharge air setpoint reset
- Outside air temperature lockouts

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 15% reduction in estimated heating, cooling, fan, and pump end use energy consumption.
- Project cost is estimated at $1.2 per square foot of building area.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Identify remaining equipment to be connected to the central control system and engage a building controls integration company to plan and cost the system integration. Coordinate with planned capital upgrades and renovations where possible to optimize benefits. This measure is recommended for implementation.

ECM Savings and ROM Cost

Table 10: ECM 2 Savings and ROM Cost

Savings Summary								
ECM	District Steam Savings (k lbs)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est Project Cost	Simple Payback (Yrs)
BAS Installation & RCx	149	18,428	241	26	$0	3,519	$41,250	12
Overall % Reduction	15.0%	9.4%	13.0%	12.6%	--	11.2%	--	--

5 Considered But Not Currently Recommended

No additional ECMs have been considered.

6 Appendix A

Table 11: Monthly Utility Data (2023 to 2024)

Month	Steam Consumption (kBtu)	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23		14,447	$1,550	19	26	1,050.9	0
Feb-23		12,992	$1,224	19	24	954.6	0
Mar-23		13,281	$1,191	18	29	918.4	0
Apr-23		11,786	$1,037	16	27	525.3	28.1
May-23		17,091	$1,348	23	38	283.4	76.3
Jun-23		27,487	$2,059	38	60	86.3	139.1
Jul-23		31,564	$2,555	42	59	11.3	226.9
Aug-23		32,307	$2,567	43	64	48.3	140.6
Sep-23		23,034	$2,120	32	52	112.5	84.9
Oct-23		18,037	$1,468	24	39	414.5	31.1
Nov-23		15,140	$1,163	21	35	779.2	0
Dec-23		13,466	$956	18	23	834.1	0
Jan-24	173,886	17,172	$396	23	31	1,193.6	0
Feb-24	118,224	12,706	$1,300	19	24	873.9	1
Mar-24	143,032	12,842	$1,036	17	28	771.2	2.1
Apr-24	82,040	11,133	$977	15	25	437.1	20.9
May-24	44,189	11,044	$1,327	15	24	148.4	98
Jun-24	61,572	17,642	$1,621	25	38	51.4	206.7
Jul-24	61,572	22,826	$2,033	31	42	18.4	250.9
Aug-24	61,572	17,426	$1,603	23	35	36.6	215.4
Sep-24	44,189	21,204	$1,700	29	48	84	112.3
Oct-24	82,040	17,978	$1,708	24	39	356	30.7
Nov-24	143,032	15,612	$1,684	22	36	606.9	4.2
Dec-24	173,886	17,583	$1,479	24	30	1,036.80	0
2023 Sum	62,123	230,632	$19,238			6,019	727
2024 Sum	51,067	195,168	$16,864			5,614	942

*Red steam consumption values are assumptions based on existing data

7 Appendix B

Table 12: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Capacity 2	Capacity 3	Approx Year Installed
AHU-1	1	Air handling unit (Dx)	1956 section of building			260 MBH	26.6 TON	12000 CFM	
	1	Outdoor condensing unit		Carrier	38AKS028---500--	2.33 TON			
FC-1	1	Fluid cooler	HHP-1 to 4	Krack	FEVF-13410KA NCC46IN	30.5 TON			2023
HHP-1 to 4	4	Hybrid heat pumps	Renovated section		SKV070C4-1H0X & SKV070C4-2H0X	23.3.33 TON			2023
EVAP-1	1	Mini split heat pump	Supplement space conditioning	Mitsubishi Electric	NTXSST18A112AA	1.5 TON	1.5 TON		
	2	Mini split air conditioning units	Virtua room (used 3-4 times per year)	Mitsubishi Electric	PUY-A30NHA7	2.5 TON			
	1	Steam to HW Heat Exchanger	AHU-1, baseboards						1973
	1	Domestic water heater (electric)		Lochinvar	LTA030KD200	4.5 kW @ 240 V, 3.5 @ 208 V	30 Gal		
P-3,4	2	Pumps, VFD	HHP-1 to 4			2 HP			2023
P-1, 2	2	Existing pumps				2 HP			
AH-2	1	N/a	N/a	N/a	N/a				

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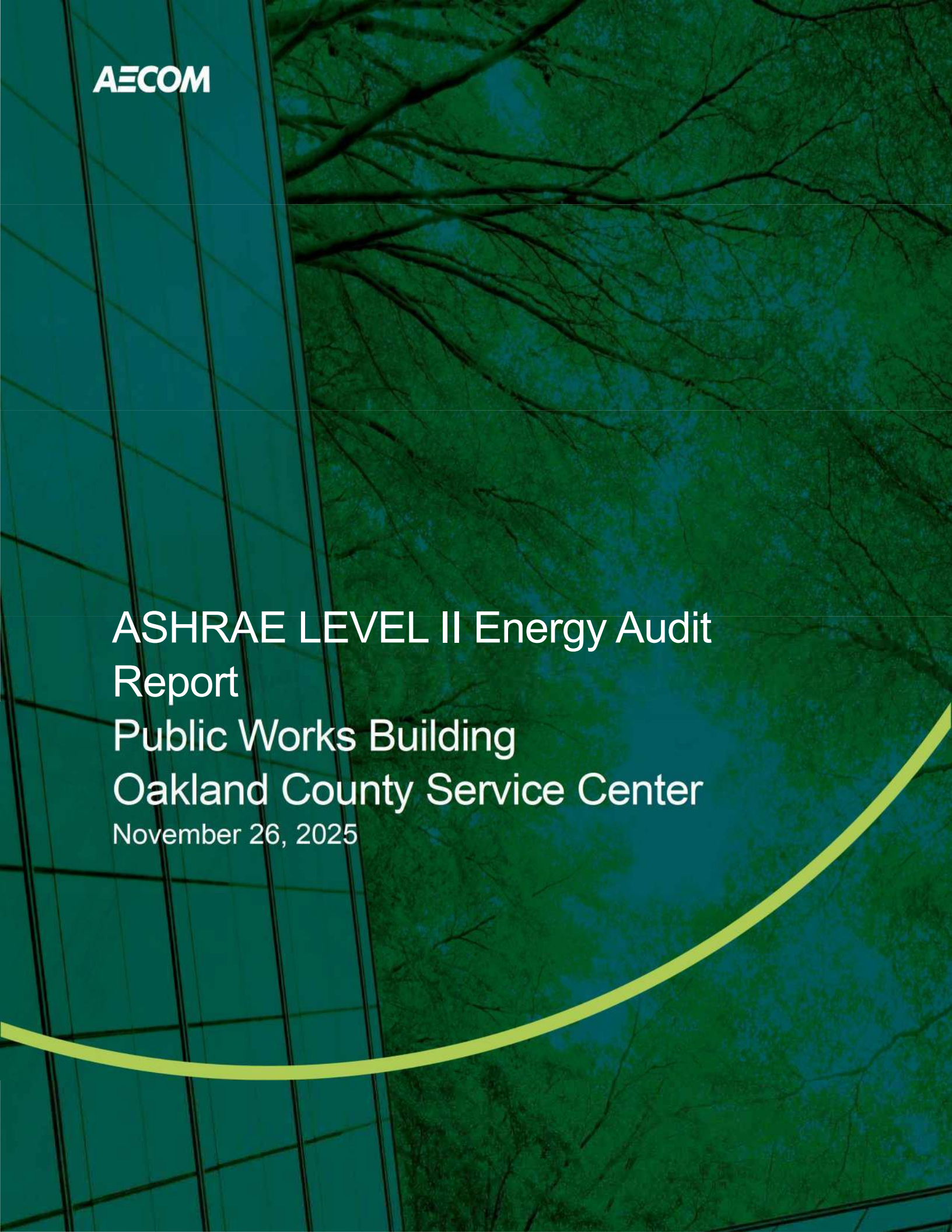

AECOM

ASHRAE LEVEL II Energy Audit Report
Public Works Building
Oakland County Service Center

November 26, 2025

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

Prepared for:
OAKLAND COUNTY, MI Government

Prepared by:
AECOM

Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Public Works Building in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce operating cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Public Works Building is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Wednesday April 16, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates three Energy Conservation Measures (ECMs) for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The 2 listed measures represent a projected 18% annual energy cost savings with an aggregate simple payback of 7.5 years. Two measures are prioritized as “Recommended” for implementation, while one is considered but not recommended.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures.[2]

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Public Works Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year – 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	KW	MCF/yr	klbs/y	MMBTU	MTCO2e	$	$/yr	$	Years
1	Lighting Upgrades	HIGH	R	126,785	41	0	0	432.59	56.13	$8,199	$13,946	$223,170	10.1
2	Building RCx	HIGH	R	81,857	0	5,279	0	807.21	64.17	$0	$11,538	$30,140	2.6
			Sum	**208,641**	**41**	**5,279**	**0**	**1,240**	**120**	**8,199**	**25,485**	**253,310**	**7.5**
Overall % Reduction				**19%**	**17%**	**10%**	**0%**	**14%**	**16%**		**18%**		

Notes
Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

Measures Requiring Additional Study													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year – 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	KW	MCF/yr	klbs/y	MMBTU	MTCO2e	$	$/yr	$	Years
1	Replace dual duct HVAC w/ VAV	LOW	R	102,894	0	10,558	0	1,406.90	101.41	6760.00	$16,386	$1,202,000	51.9

Notes
Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Public Works building is approximately 68,000 ft^2 consisting of a main building and garage. The main building operates as an office building, with the garage containing a Shop area to park and maintain the County Public Works vehicles. As-built drawings located during the site visit indicated the facility was constructed in 1969. An assessment of the Building Management System (BMS) indicated that heating and cooling is provided to the facility 24hrs per day, seven days per week.

2.1 Building Systems

2.1.1 Building Envelope

The building has one above-grade floor, comprised of a mix of office space and warehouse space. The window/wall ratio is estimated to be about 10%. The windows appear to be in poor condition; however, they are single-pane windows and are assumed to be original to the building.

The CMU and poured concrete building is clad brick veneer and wood paneling in some parts. The roofing system comprises insulation installed above a concrete deck, overlaid with EPDM. The roof insulation levels are unknown at this stage; however, it is assumed to be a minimum of R20 providing a moderate level of thermal resistance.

Table 2. Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Masonry construction with panel exteriors in some areas	Moderate
Roof	Flat roof with EPDM	Assumed R-20 or less (age-dependent)
Glazing	Single pane	Poor

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

This two floor building is served by six air handling units (AHU) and two rooftop units (RTU). The AHUs are very old and are approaching the end of their expected useful life. ASU-1 and ASU-2 serve the upper level and the lower level respectively have a dual duct arrangement. ASU-2 serves the lower level. ASU-3, ASU-4 and ASU-5 serves the ground level, drain offices, locker rooms, and the garage area. ASU-1 and ASU-2 serve the upper level. RTU-1 also serves a little portion of upper level. ASU-6 serves the drain shop offices.

The facility is cooled by a water-cooled chiller that is in good condition. The cooling tower is outside the building, on the ground, to reject the heat from the chiller. The building is heated by two (2) hot water boilers which generate 180°F heating hot water which is supplied to the AHU's and the baseboard heaters.

The garage has existing infrared heaters and unit heaters that are used to heat the garage spaces. Some office spaces have local thermostats which are not controlled through the BMS.

The total cooling capacity of the systems serving this building is 400 Tons. The total heating capacity is 240 Tons.

2.1.2.2 Plumbing

A 100-Gal capacity natural gas domestic heating hot water is used to provide hot water to the building having a input capacity of 200000 BTUH.

2.1.2.3 Building Controls

The building is primarily controlled by a Niagara BMS, however there is some local controls for some heating units in the garage space.

2.1.3 Lighting Systems

During the site visit, lighting fixtures were found to be recessed, ceiling-mounted, or suspended, depending on the room layout and use. The building uses a mix of 32W fluorescent and 28W fluorescent in the mechanical room and 12W light emitting diode (LED) fixtures. The fixtures provided are for the first floor.

Table 3. Lighting Summary – Main Building

Lighting	Main Building	
	Total Fixtures	Lamps per Fixture
Fluorescent Lights	2	1 lamp
Fluorescent Lights	251	2 lamp
Fluorescent Lights	20	4 lamp
LED Lights	28	1 lamp
LED Lights	6	1 lamp
Incandescent Lights	3	1 lamp
Non-LED Exit Sign	3	-

The total approximate quantity of light fixtures is 317 for the first floor and 317 for the second floor. The approximate total wattage is 22,192 watts. The approximate area per drawing is 39,196 ft^2. (19,598 ft^2 per floor). The calculated lighting density is 0.57 W/ft^2.

The fixtures for the garage area of this building are provided below.

Table 4. Lighting Summary – Garage

Lighting	Garage	
	Total Fixtures	Lamps per Fixture
Fluorescent Lights	262	2 lamps
Fluorescent Lights	32	4 lamps
Incandescent Lights	79	-
Fluorescent Lights	103	3 lamps

The total approximate quantity of the light fixtures in the garage per drawing is 262 fluorescent of 2 lamps (92W), 32 fluorescent of 4 lamps (144W), 79 incandescent (150W), and 103 fluorescent of 3 lamps (144W).

There are 1,110 total fixtures in the entire building. The approximate total wattage is 112,986 watts. The approximate area per drawing is 33,283 ft^2. The calculated lighting density is 0.294 W/ft^2.

2.1.4 Electrical Infrastructure

The facility is powered by a 750 KVA transformer located in the electrical room. The main electrical service is rated at 480/277V, 600A, 3-phase, and is tracked by meter number 55082439. A single line diagram is not available, and demand data is currently missing. The facility is equipped with backup power, supplied by a 360 kW generator. Additionally, the electrical room includes a 112.5 KVA transformer with a 480V delta configuration.

3 Utility Billing Analysis

3.1 Utility Type and Usage

Public Works receives electric service, natural gas service, and is not connected to the steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

Steam usage is still tracked but appears under electricity, which reflects the energy needed to power steam boilers, and natural gas at the central heating plant.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

Table 5 summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 5: Total Energy Usage and GHG Emissions (2024)

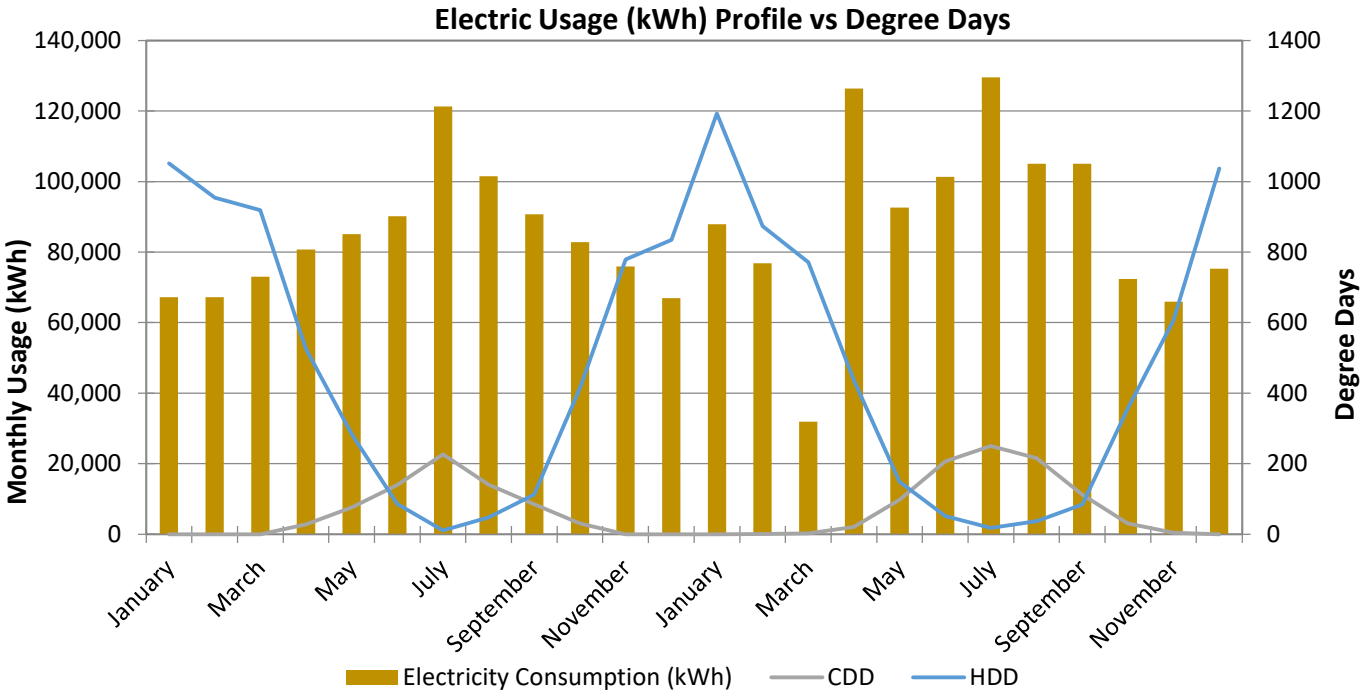
Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	1,070,150 kWh	3,651	$117,717	$0.11	0.0004427	474
Natural Gas	5,153 MCF	5,349	$25,674	$4.98	0.05294	28,301
Total	**--**	**9,000**	**$143,391**	**--**	**--**	**28,774**

**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a strong correlation to weather data, with air conditioning being used in summer months and winter heating provided by natural gas. The annual usage for the baseline 12-month period from January to December 2024 is 1,070,150 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

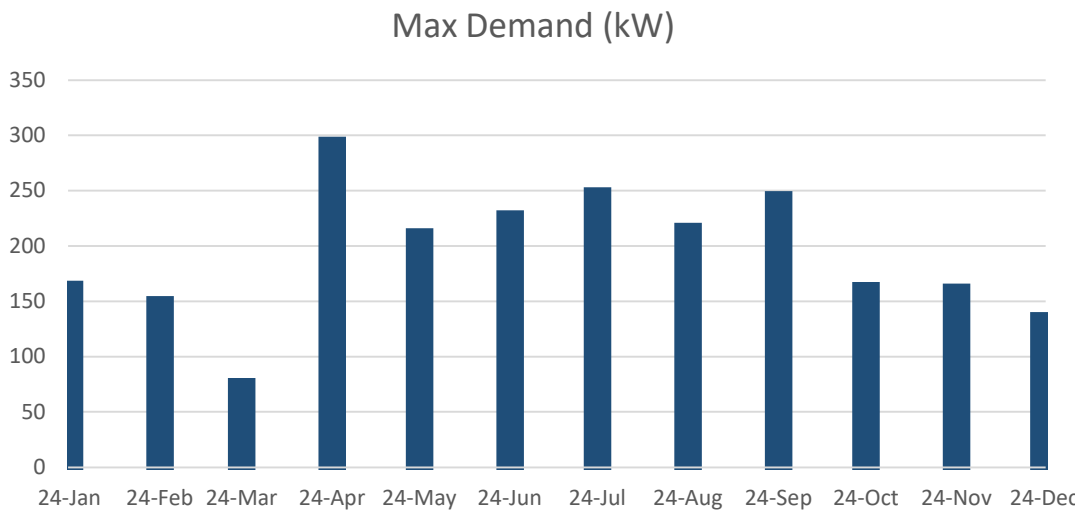
The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 6. Electric Capacity Results

Maximum Building Capacity at Service Transformer	750 kW
Maximum Capacity at Switchgear (A*V*Ph)	498 kW
Estimated Peak Demand	289 kW (estimated)
Remaining Capacity	**212 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge:	**$0.057/kWh**
DTE Electric Demand Charge:	**$6.15/kW/Month**
Average Dollar per kWh Used in Calculations:	**$0.11/kWh**

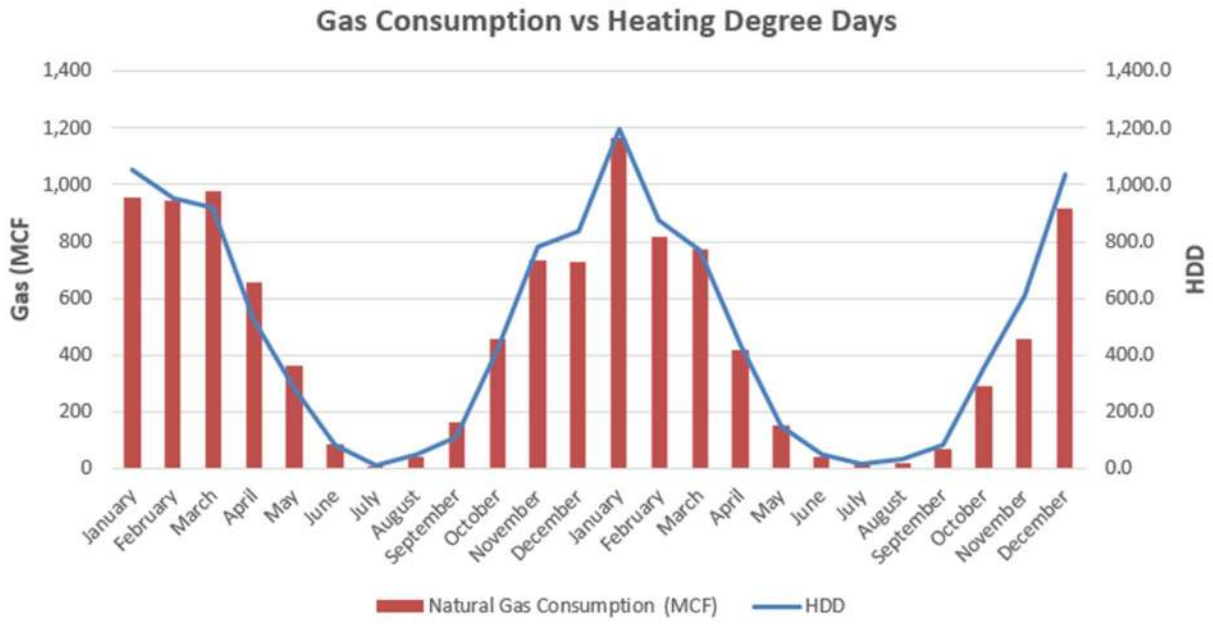
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows a direct correlation to weather data, as natural gas is primarily used for space heating. The annual usage for the baseline 12-month period from January to December 2024 is 5,152 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: **$1.33/MCF (1,038,000 BTU**

Constellation NG Usage Charge (fixed Fee): **$3.48/dTh (decatherm, or 1M BTU)**

Constellation NG Usage Charge (Day Gas): **$5.29/dTh (decatherm, or 1M BTU)**

Average Dollar per Therm Used in Calculations: **$4.98/MCF**

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 7 below.

Table 7: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$117,717
Natural Gas	$25,674
Total	$143,391
ECI $/yr/sf	$1.90

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

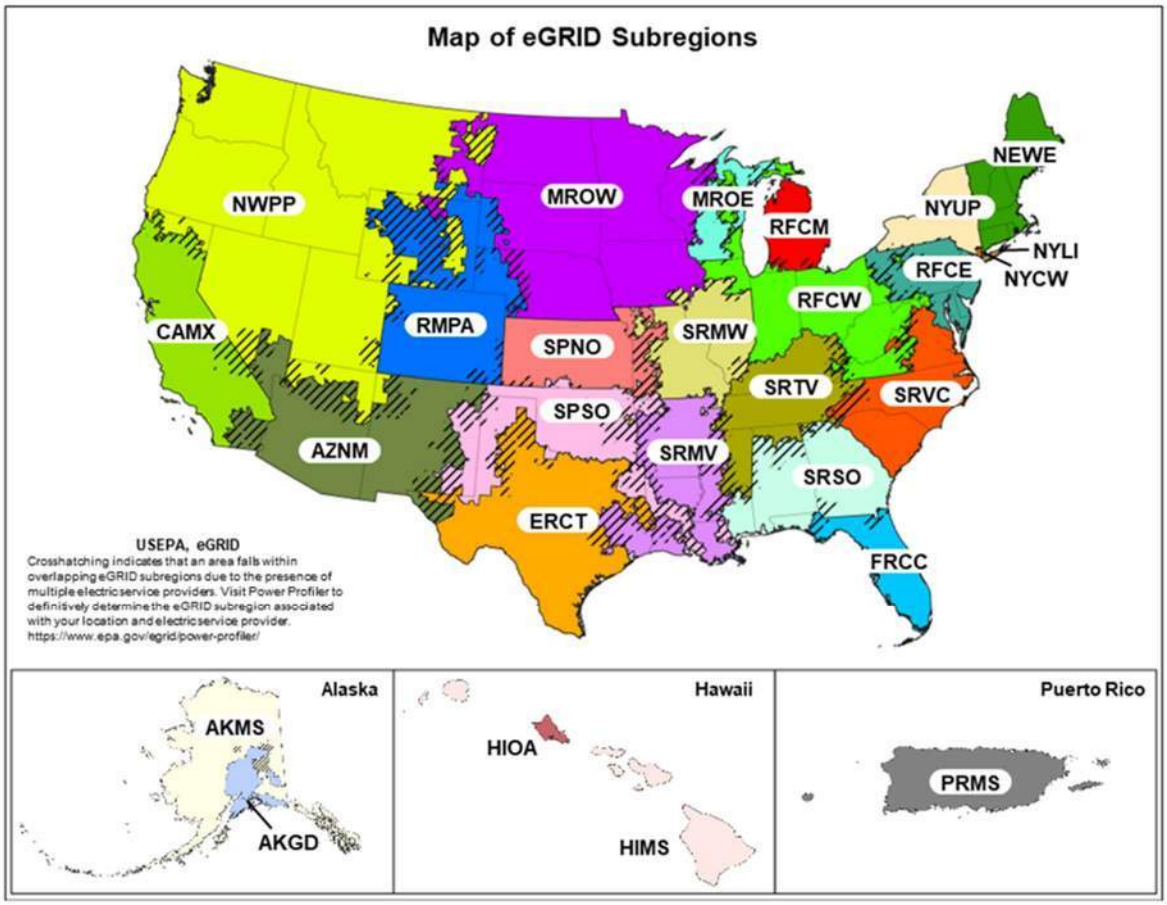
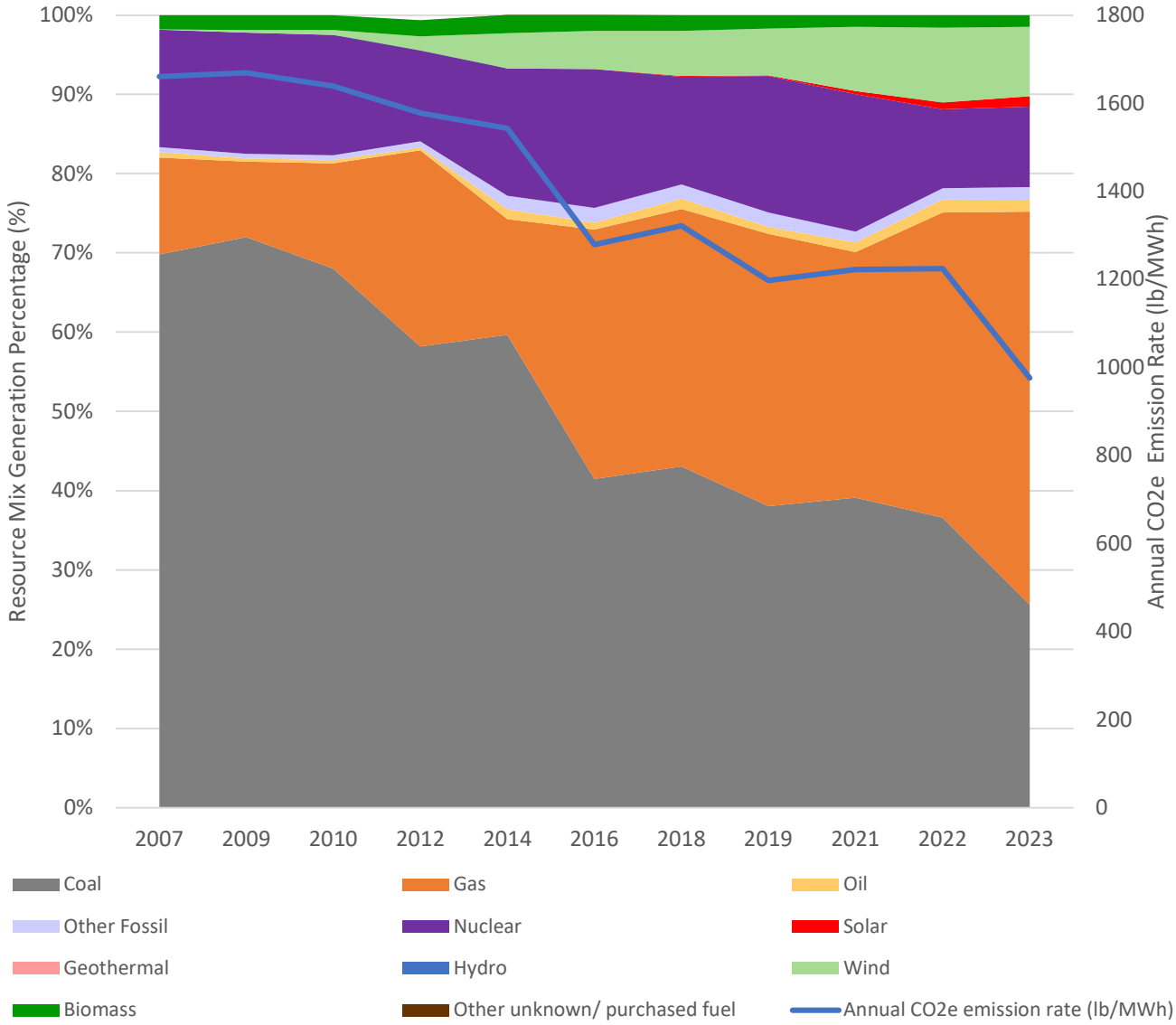


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 98.3 percent of carbon emissions are attributed to natural gas and 1.7 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 28,301 tCO2e (campus-level Scope 1) and 474 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 28,301 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for Public Works are converted to kBTUs units, summed, and divided by the total square footage.

Table 8: Annual Utility Summary (2024)

Building:	Public Works					**Electric EUI:**	48	kBTU/SF/yr
GFA:	75,351	SF				**Gas EUI:**	71	kBTU/SF/yr
eGRID Subregion:	RFCM					**Current EUI**	119	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	1,070,150	kWh	*3.412*	3,651	*0.0004427*	474	$117,716.50	82%
Natural Gas	5,152	MCF	*1.038*	5,349	*0.05294*	273	$25,674.24	18%
Steam	0	klbs	*1194*	0	*0.1190000*	0	$ -	0%
		Totals		**9,000**		**747**	**$143,391**	**100%**

According to the US EPA, the average site energy use intensity for a non-specific Public Services building is 40.1 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 119 kBTU/SF, which is significantly higher than the national benchmark. It's important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison indicates there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Parking	Parking		N/A	N/A	None Available
Public Services	Courthouse*		211.4	101.2	CBECS - Courthouse
	Drinking Water Treatment & Distribution (Average EUI presented in Energy per Flow in gallons per day)		5.90	2.27	AWWA - Water Treatment Plant
	Fire Station		124.9	63.5	CBECS - Fire Station/Police Station
	Library		143.6	71.6	CBECS - Library
	Mailing Center/Post Office		96.9	47.9	CBECS - Service
	Police Station		124.9	63.5	CBECS - Fire Station/Police Station
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Social/Meeting Hall		109.6	56.1	CBECS - Social/Meeting
	Transportation Terminal/Station		112.0	56.2	CBECS - Public Assembly
	Wastewater Treatment Plant* (Average EUI presented in Energy per Flow in gallons per day)		7.51	2.89	AWWA - Wastewater Plant
	Other - Public Services		89.3	40.1	CBECS - Other
Religious Worship	Worship Facility*		58.4	30.5	CBECS - Religious Worship
Retail	Convenience Store*	Convenience Store with Gas Station	883.5	350.9	Industry Survey
		Convenience Store without Gas Station			
	Mall	Enclosed Mall	170.7	65.7	CBECS - Enclosed Mall
		Lifestyle Center	228.8	103.5	CBECS - Strip Shopping Mall
		Strip Mall			
		Other - Mall	225.3	101.6	CBECS - Enclosed Mall and Strip Shopping Mall
	Retail Store*		120.0	51.4	CBECS - Retail Store
	Supermarket/Grocery Store*		444.0	196.0	CBECS - Grocery Store/Food Market
	Vehicle Dealership*		138.2	71.9	Industry Survey

3.8 End Use Distribution

Table 9 shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees. Table 9 and Figure 7 and

Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 9: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	5,086	0	5,279,125	70.1	279.3
Space Cooling	456,411	0	0	1,557,276	20.7	202.1
Fans	298,264	0	0	1,017,678	13.5	132.0
Pumps	63,890	0	0	217,993	2.9	28.3
SHW/DHW	0	53	0	55,102	0.7	2.9
Conveyance	0	0	0	0	0.0	0.0
Lighting	177,055	0	0	604,111	8.0	78.4
Plug Loads	66,849	0	0	228,090	3.0	29.6
Process Loads	7,680	0	0	26,204	0.3	3.4
Refrigeration	0	0	0	0	0.0	0.0
Cooking	0	0	0	0	0.0	0.0
Information Technology	0	0	0	0	0	0
TOTAL	**1,070,150**	**5,138**	**0**	**8,985,578**	**119**	**756**
Historical Billing	1,070,150	5,152	0			
Percent of Actual	100%	100%	0%			
per sqft	14.20	0.71	0			

Figure 7: Existing Electricity End Use Distribution

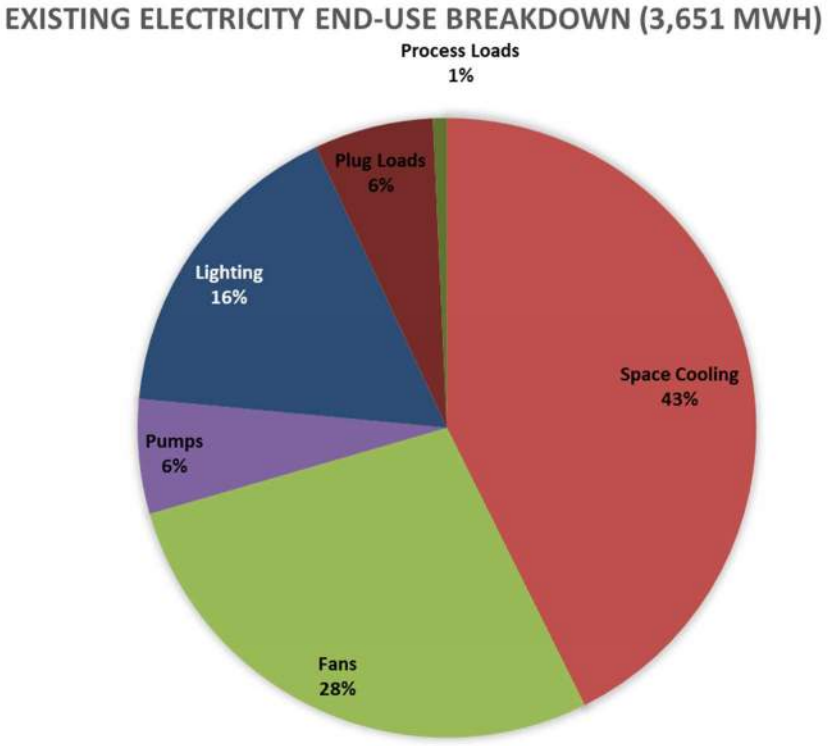
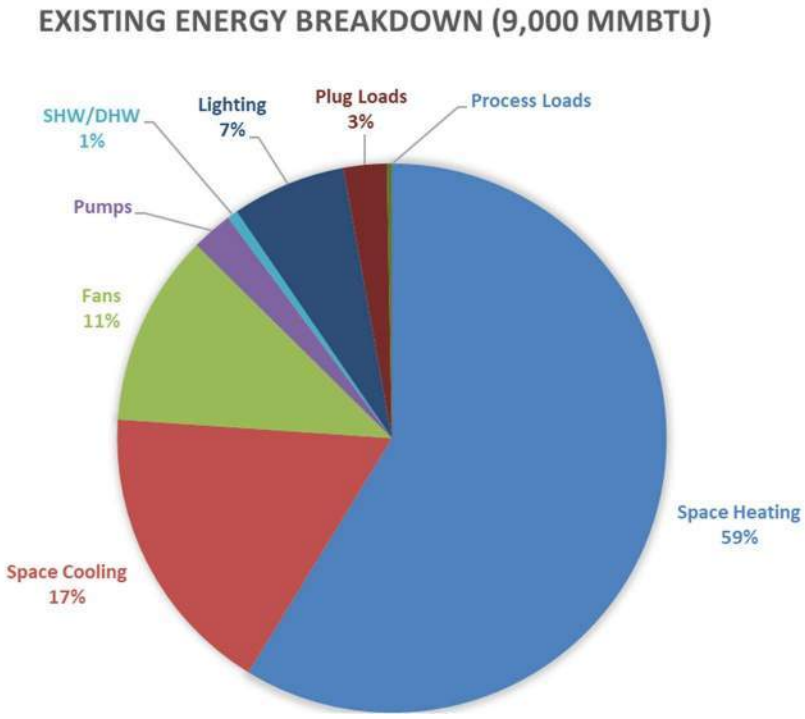


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – Lighting Upgrades

This measure proposes upgrading all remaining fluorescent lighting to Light-emitting diode (LED) lightbulbs with motion sensors and dimming functionality where appropriate to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements. Incorporating lighting controls allows for better management and customization of lighting systems, leading to reduced energy consumption, and increased overall efficiency by limiting the time lighting is on to only when necessary. For indoor lighting, lighting controls consist of occupancy, daylighting, timers, scheduling, and dimming features to optimize light levels based on external lighting availability and usage of a space. For outdoor lighting, the lighting controls consist of motion sensors, photocells, and timers to turn the lighting ON/OFF. The current lighting in the Public Works building is approximately 6% LED, 7% incandescent, and 87% fluorescent and the estimated wattage is approximately 0.92 W/ft². See Section 2.1.3 for the lighting counts used to estimate energy consumption.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.

Figure 9: Example Fixture with Integrated Occupancy Controls



Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Lights are assumed to be on 10 hours per day for 256 days of the year and 24 hours per day for exit signs.
- This measure assumes lighting savings of approximately 20W per lamp replaced.
- Wattage was assumed to be 12W per LED bulb and between 28-32W per fluorescent bulb.
- LED upgrades cost an average of $215/fixture, which assumes a full fixture replacement with integrated controls. The measure assumes 1,038 fixtures are being replaced.
- Existing LED fixtures are excluded from this measure. Controls for existing LED fixtures do not produce substantial savings due to the low number of fixtures and existing low energy use. As existing LEDs require replacements, a new fixture with integrated controls is recommended.
- O&M savings assume an average cost of $3.81/lamp/year, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. Engage a lighting vendor to identify fixture types and determine actual costs for implementation. This measure is recommended for implementation, dependent on final cost of implementation.

ECM Savings and ROM Cost:

Table 10. ECM 1 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est. Project Cost	Simple Payback (Yrs)
LED Upgrade	0	126,785	432	56	$8,199	$13,946	$223,170	10.1
Overall % Reduction	0.0%	11.8%	4.8%	7.5%		9%		

4.2 ECM 2 – Retro-commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and restore systems to their original design intent. In the Public Works building, HVAC systems currently operate 24/7 to maintain occupied setpoints, even during periods of limited or no occupancy. This results in excess heating and ventilation energy use. RCx presents an opportunity to verify and optimize temperature setpoints, occupancy schedules, and control strategies to ensure systems operate efficiently while still supporting the unique operational requirements of the facility.

Specific opportunities include:

- Optimize HVAC scheduling where appropriate
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Hot water and chilled water supply reset
- Discharge air setpoint reset
- Outside air temperature lockouts
- Outside air damper control
- Duct static pressure reset
- Repair airside or waterside economizing
- Demand-controlled ventilation

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 10% reduction in estimated cooling and heating end use energy consumption.
- Project cost is estimated at $0.4 per square foot of building area.

- This measure supports electrification readiness indirectly by ensuring electric systems are optimized and operating efficiently.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: This measure proposes engaging a third-party contractor to determine if this building is eligible for the DTE RCx program and systematically evaluate and prioritize major HVAC and control systems and complete retro-commissioning to restore systems to their original design intent. This measure is recommended for implementation.

This measure also suggests that Oakland County increase their in-house capabilities to identify, correct, and maintain existing equipment to extend service life, maintain optimum cost of operation, and to reduce implementation costs for routine building improvements. This may require the addition of new staff members and/or additional training of existing staff members to analyze and troubleshoot building equipment issues.

ECM Savings and ROM Cost:

Table 11. ECM 2 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est. Project Cost	Simple Payback (Yrs)
RCx	508	81,857	807	64	$0	$11,538	$30,140	2.6
Overall % Reduction	10%	8%	9%	10%		8.0%		

5 Measure Requiring Additional Consideration

This section provides details on measures that were analyzed but are not recommended for immediate implementation at this time. This includes measures that require further study, such as capital-intensive replacements of existing equipment, but are not justified through energy savings alone. This section may also include measures that conflict with building electrification plans, or projects that are simply not recommended due to being financially impractical or not being technically feasible.

5.1 ECM 3 – HVAC Upgrades: Replace Dual-Duct HVAC with VAV Plus Reheat System

The Public Works Building is served by six air handling units (AHUs) and two rooftop units (RTU). Several of the AHUs, particularly ASU-1 and ASU-2, operate in a dual-duct configuration, simultaneously delivering hot and cold air to terminal boxes where it is mixed to meet zone demands. This design results in wasted heating and cooling energy.
This measure proposes replacing the dual-duct system with a Variable Air Volume (VAV) system with terminal reheat. A VAV system reduces airflow during part-load conditions and relies on localized reheat coils only when needed, eliminating simultaneous heating and cooling. This will include the installation of Variable Frequency Drives (VFDs) on supply fans, allowing them to modulate speed to match actual ventilation demand instead of running continuously at full load.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Energy savings were estimated by changes in fan efficiency and speed.
- Fan efficiency will increase from 86% to 92%. Fan speed will decrease from 100% to 70%.
- Project cost is estimated at $20,000 per fan HP.
- This measure supports electrification readiness indirectly by ensuring electric systems are optimized and operating efficiently.
- O&M savings assume 2 hrs. per week of avoided maintenance to adjust existing control issues.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Begin planning of HVAC upgrade in accordance with campus electrification plans. This will include updating HVAC systems as described in this measure, but with additional work required to electrify the natural gas heating system. Fuel switching will fundamentally change the payback of this measure, and therefore should be analyzed holistically with all projects being considered.

ECM Savings and ROM Cost:

Table 12. ECM 3 Savings and ROM Cost

Savings Summary								
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est. Project Cost**	**Simple Payback (Yrs)**
Replace dual duct HVAC w/ VAV	10,558	102,894	1,407	101	$6,760	$16,386	$1,202,000	51
Overall % Reduction	19.7%	9.6%	15.6%	13.6%		11.4%		

6 Appendix A

Table 13: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	956	$5,873	67,200	$7,212	90	120	1,051	0
Feb-23	944	$5,516	67,200	$6,330	100	125	955	0
Mar-23	976	$2,972	73,050	$6,553	98	157	918	0
Apr-23	658	$2,281	80,700	$7,101	112	183	525	28
May-23	366	$1,094	85,100	$6,711	114	187	283	76
Jun-23	87	$214	90,150	$6,752	125	196	86	139
Jul-23	9	$34	121,250	$9,814	163	226	11	227
Aug-23	42	$121	101,500	$8,064	136	202	48	141
Sep-23	166	$470	90,700	$8,349	126	205	113	85
Oct-23	458	$1,320	82,800	$6,737	111	178	415	31
Nov-23	731	$2,728	75,900	$5,829	105	177	779	0
Dec-23	726	$3,581	66,900	$4,749	90	114	834	0
Jan-24	1,166	$5,136	87,900	$2,028	118	156	1,194	0
Feb-24	818	$4,455	76,800	$7,855	114	143	874	1
Mar-24	773	$4,377	31,900	$2,574	43	69	771	2
Apr-24	417	$870	126,400	$11,087	176	287	437	21
May-24	151	$307	92,650	$8,200	125	204	148	98
Jun-24	42	$138	101,300	$9,308	141	220	51	207
Jul-24	22	$71	129,550	$11,540	174	241	18	251
Aug-24	23	$48	105,050	$9,661	141	209	37	215
Sep-24	71	$173	105,050	$8,423	146	238	84	112
Oct-24	294	$788	72,400	$6,877	97	155	356	31
Nov-24	456	$1,578	65,900	$7,109	92	154	607	4
Dec-24	919	$2,043	75,250	$6,328	101	128	1,037	0
2023 Sum	6,118	26,204	1,002,450	84,201			6,019	727
2024 Sum	5,153	19,984	1,070,150	90,990			5,614	942

7 Appendix B

Table 14. Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity	Units
ASU-1	1	Air handling unit (HHW, CHW)	OFFICE UPPER LEVEL	MCQUAY		636.5	MBH
ASU-2	1	Air handling unit (HHW, CHW)	OFFICE LOWER LEVEL	MCQUAH		449	MBH
ASU-3	1	Air handling unit (HHW, no cool)	Locker room			210.6	MBH
ASU-4	1	Air handling unit (HHW, CHW)	Shop offices			62.6	MBH
ASU-5	1	Air handling unit (HHW, CHW)	Communications shop			21.6	MBH
ASU-6	1	Air handling unit (HHW, CHW)	Drain shop offices			75.6	MBH
1 RTU	1	Rooftop Unit (NG, Dx R410A)		BRYANT	580JE04A072A2A0AAA	6	TON
2 RTU	1	Rooftop Unit (NG, Dx R410A)		CARRIER		6	TON
Chiller 1	1	Water cooled chiller	Whole building	York	VSD351 K -46		
N/A	1	Cooling tower		Bac	3412A-JM	450	TON
Boiler 1,2	2	Boiler (NG)		P-K Mach	MODEL C-1500	1440	MBH
DWH	1	Domestic water heater		RHEEM	A101813705	200 in	MBH
N/A	1	Air Compressor		Dayton	3n735	10	HP
CHWP-1,2	2	Chilled Water Pumps				20	HP
CWP-1,2	2	Condenser water pumps				20	HP
Baseboard Pump #3	1	Pump				3	HP
Baseboard Pump #4	1	Pump				3	HP
RAF-1	1	Exhaust fan	ASU-1			17680	CFM
RAF-2	1	Exhaust fan	AU-2			12450	CFM
EF-1	1	Exhaust fan	Utility Room			370	CFM
EF-2	1	Exhaust fan	Locker room toilets			1250	CFM
EF-3	1	Exhaust fan	Shower room			1000	CFM
EF-4	1	Exhaust fan	Office toilets			1370	CFM

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity	Units
EF-5	1	Exhaust fan	Blueprint Room #115			1000	CFM
EF-6	1	Exhaust fan	Dark room			220	CFM
EF-7	1	Exhaust fan	Active Storage #139			250	CFM
EF-8	1	Exhaust fan	Basement storage			2400	CFM
EF-9	1	Exhaust fan	Elevator Mach. Room			100	CFM
EF-10	1	Exhaust fan	Toilet Room #228A			60	CFM
EF-11	1	Exhaust fan	Testing Lab G15			390	CFM
EF-12	1	Exhaust fan	First Aid G18A			340	CFM
EF-13	1	Exhaust fan	Comm. Shop G7			800	CFM
EF-14	1	Exhaust fan	Welding Shop G13B			2300	CFM
EF-15	1	Exhaust fan	DFO Storage			7000	CFM
EF-18	1	Exhaust fan	Welding Shop Hood			1200	CFM
EF-19	1	Exhaust fan	Electrical Room #114			3600	CFM
	1	Mini Split System	Conference room			NA	NA

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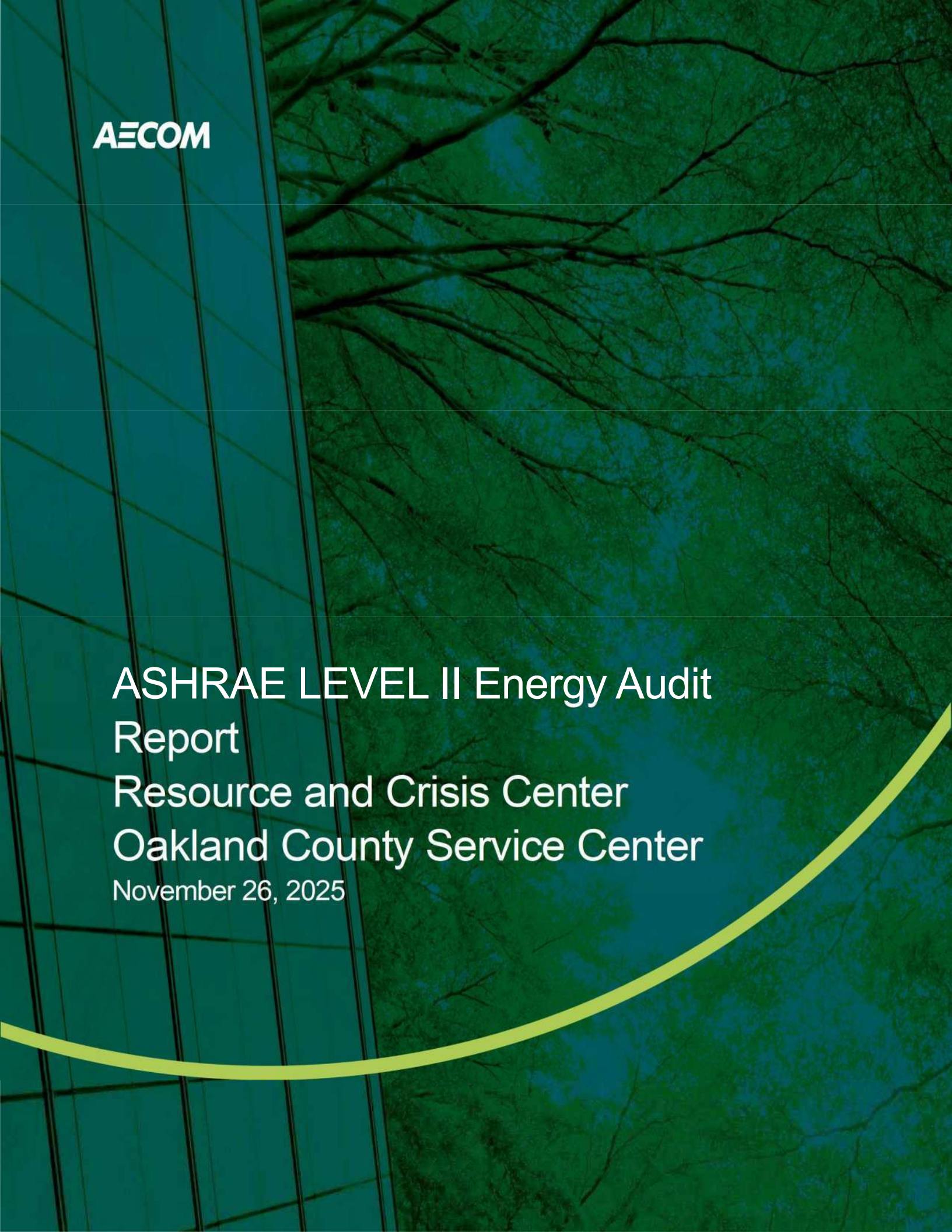

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ASHRAE LEVEL II Energy Audit Report
Resource and Crisis Center
Oakland County Service Center

November 26, 2025

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

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Prepared by:
AECOM

Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Resource and Crisis Center, 32 East, in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Resource and Crisis Center is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Friday, April 11, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates four Energy Conservation Measures (ECMs) for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The four listed measures represent a projected 13% annual energy cost savings with an aggregate simple payback of 4.6 years. All measures are prioritized as “Recommended” for implementation.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in the Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be “electrification-ready” to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE’s prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Resource and Crisis Center Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	MTCO2e	$/yr	$/yr	$	Years
1	Building Retro-commissioning	High	R	112,402	0	23	193	616.2	74	$0	$14,410	$36,877	2.6
2a	Replace fluorescent bulbs with LED equivalents	High	R	175,412	44	0	0	598.5	77.7	$6,115	$19,295	$141,925	5.6
2b	Install motion sensors on lighting fixtures	High	R	40,511	0	0	0	138.2	17.9	$0	$4,456	$39,536	8.9
3	Implement temperature setbacks during unoccupied hours for lab RTU	High	R	19,699	0	134	0	80.7	16.1	$0	$2,836	$1,500	0.5
4	Turn of kitchen exhaust when not in use	High	R	1,452	0	0	48	62.5	6.4	$0	$642	$100	0.2
			Sum	**349,477**	**44**	**158**	**241**	**1,496**	**192**	**$6,115**	**$41,639**	**$219,938**	**4.6**
			Overall % Reduction	13%	6%	4%	13%	13%	13.44%		13%		

Notes

Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu

*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Resource & Crisis Center is 49,169 ft^2 and operates to provide crisis services to the Oakland County community. The building includes offices, meeting rooms, conference rooms and residential spaces including bedrooms and a dining area. The building was originally built in 1977 and major renovations were made in 2012. An assessment of the Building Management System (BMS) indicated that heating and cooling is provided to the facility 24hrs per day, seven days per week. It is assumed that portions of the facility operate on a standard office building schedule, with separate areas such as the residential areas being occupied continuously. AHU-01, 02, 04 and RTU operate 24/7 365 days, but AHU-3 has a schedule.

2.1 Building Systems

2.1.1 Building Envelope

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	Masonry construction	Good appearance from visual inspection, however older construction and may not be adequately insulated
Roof	Flat roof with black membrane	Assumed R-20 or less (age-dependent)
Glazing	Single pane with a very low to low window to wall ratio	Poor

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The building was renovated around 2012 with most of the major HVAC upgraded at that time. The equipment is in good condition and the plant room is well maintained. The building has four air handling units (AHUs), with two per floor and each serving a different wing. The AHUs utilize chilled water from the chiller system for cooling and hot water (that is produced from a steam to hot water heat exchanger) for heating. Additionally, a rooftop unit (RTU) serves the lab and has direct expansion (DX) cooling and natural gas fired heating. The lab is expected to be moved to the 2nd floor of the Medical Examiner facility by late Fall 2025. The variable air volumes (VAVs) that serve the spaces are equipped with hot water reheat and the return ductwork has CO_2 sensors that control the outside air damper and VAV positions.

The building's cooling demand is handled by two 70-ton chillers located on the roof. When the outside temperature is above 55°F, the chilled water system operates providing 42°F chilled water to the system. When the outside temperature rises above 80°F for 5 minutes, the lag chiller turns on to support the primary. When the outside air temp drops below 70°F, turn off the lag chiller.

Heating hot water (HHW) is generated by two 940 MBH HHW heat exchangers connected to the district steam loop system. The 1/3rd and 2/3rd steam control valves for the lead heat

exchanger modulate to maintain the heating hot water system set point that is setback based on the outside air temperature with the minimum supply temperature set at 100°F. The pumps are variable speed and operate in a lead/lag sequence. Seven hot water unit heaters with a total heating capacity of 93.3 MBH, five cabinet unit heaters (CUH) with a total heating capacity of 150 MBH, and two AC units at 3.5 ton each provide additional space conditioning. The total cooling capacity of the systems which operate this building is 150 tons and total heating capacity is 160 tons.

Two HHW pumps each with 2-horsepower (HP) motors, two primary chilled water pumps with 1.5-HP motors, two secondary chilled water pumps with 3-HP motors are used to distribute hot and chilled water throughout the facility.

2.1.2.2 Plumbing

Two SNR151-100 Lochinvar Shield domestic hot water heaters, sized at 150,000 BTUh each and a thermal efficiency of 96%, serve the facility. Per the manufacturer's product website, these are both 90-gallon tanks.

2.1.2.3 Building Controls

The building is a fully direct digital control (DDC) facility with a Niagara BMS.

2.1.3 Lighting Systems

During the site visit, lighting fixtures were found to be recessed, ceiling-mounted, suspended, or lay-in, depending on the room. Fixture wattages varied and included 34W, 54W, 64W, 96W, and 128W.

Based on the drawings, the lighting fixture counts are as follows:

Table 3: Lighting Summary

Lower Level	
Total Fixtures	Lamps per Fixture
20	1 lamp
69	3 lamp
51	2 lamp (64W)
47	2 lamp (52W)
2	4 lamp
163	N/a (fluorescent round fixtures)
Upper Level	
Total Fixtures	Lamps per Fixture
180	2 lamp
183	3 lamp
2	4 lamp
94	N/a (fluorescent round fixtures)

There are approximately 811 total light fixtures in the building. The approximate total wattage is 76,996 watts. The approximate area per drawing is 49,169 ft^2. The calculated lighting density is 1.54 W/ft^2.

2.1.4 Electrical Infrastructure

The facility is powered by two 750 kVA transformers located in the Mechanical Room, supplying a main electrical service rated at 480/277V, 1600A, 3-phase. Although a single line diagram is available, the two utility meters are currently off and demand data is not accessible. Backup power is provided by a 750-kW generator. The facility also includes additional transformers: a 45 kVA unit with a 480V delta configuration on the first floor, a 225 kVA 480V transformer in the electrical room, and a 50 kVA unit rated at 120/240V.

3 Utility Billing Analysis

3.1 Utility Type and Usage

The Resource and Crisis Center receives local utility electric service, natural gas service, and is connected to the Service Center steam network. Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

Steam usage is still tracked but appears under electricity, which reflects the energy needed to power steam boilers, and natural gas at the central heating plant.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed include the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 4: Total Energy Usage and GHG Emissions (2024)

Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	2,665,313 kWh	9,094	$293,184	$0.11/kWh	*0.0004427*	1,180
Natural Gas	3660 Therms	366	$1,761	$4.98/MCF	*0.05249*	19
Steam	1,911 klbs	2,281	$19,105	$10/klbs	*0.119*	227
Total		11,741	**$314,050**			**1,427**

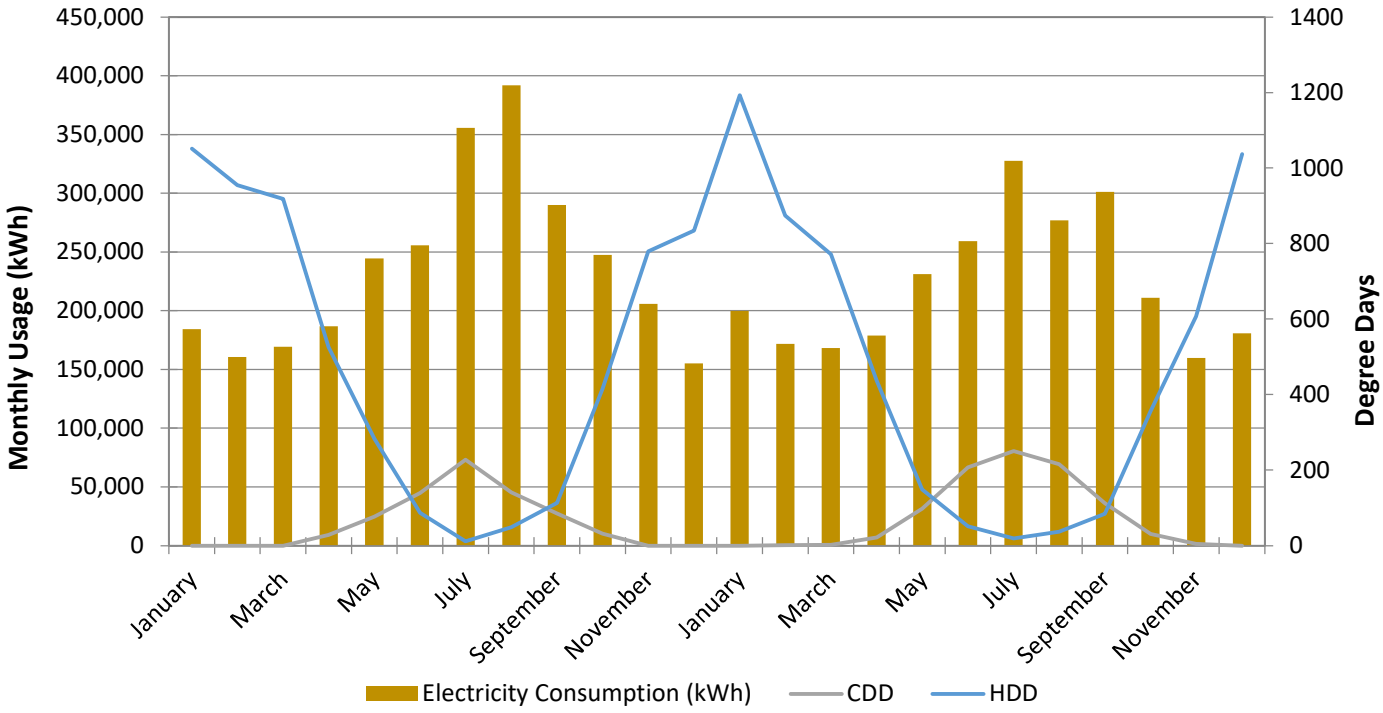
**Natural Gas (1 MCF = 103,800 BTU); Electricity (1 kWh = 3,413 BTU)*
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage shows a mild correlation to weather data, indicating that a significant portion of

electricity usage consists of baseload usage. This usage does not vary much from month to month and includes loads such as lighting, fans, and pump loads. The annual usage for the baseline 12-month period from January to December 2024 is 2,665,313 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 5: Electric Capacity Results

Maximum Building Capacity at Service Transformer	1500 kW
Maximum Capacity at Switchgear (A*V*Ph)	1330 kW
Estimated Peak Demand	680 kW (estimated)
Remaining Capacity	**650 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge: **$6.15/kW/Month**

Average Dollar per kWh Used in Calculations: **$0.11/kWh**

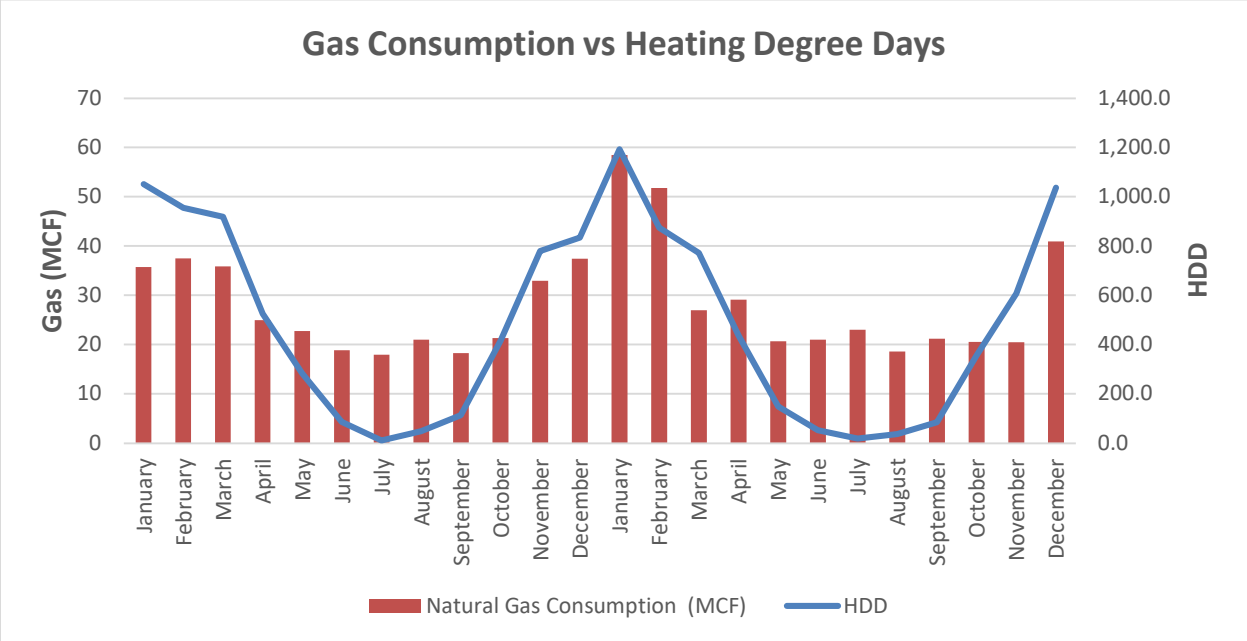
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. Natural gas usage shows a mild correlation to weather data, as natural gas is primarily used for space heating. However, there is baseload summer usage due to domestic hot water usage for bathrooms, reheat coils, and laboratory equipment. The annual usage for the baseline 12-month period from January to December 2024 is 352 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for

supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): $3.48/dTh (decatherm, or 1.038 MCF)

Constellation NG Usage Charge (Day Gas): $5.29/dTh (decatherm, or 1.038 MCF)

Average Dollar per MCF Used in Calculations: $4.98/MCF

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

3.5 Steam Usage Profile

Monthly steam usage was not provided for this building. The annual total was reported for the baseline 12-month period from January to December 2024 is 1,911 klbs. Detailed monthly steam usage is not available at this time.

3.5.1 Steam Rate Structure

Unlike electricity and natural gas, which are billed directly by external utilities, steam is an internal utility produced on campus. The cost allocation for steam is derived from the total natural gas cost at the central steam plant, as well as costs to operate the plant. Each steam-served building is billed proportionally based on its metered steam usage relative to the campus total. As a result, there are no separate delivery, demand, or third-party charges; the unit cost of steam reflects the cost of natural gas, plant operating cost and efficiency, and distribution system performance.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings.

Average Dollar per klb Used in Calculations: $10.00/thousand lbs

3.6 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 6 below.

Table 6: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$293,184
Natural Gas	$1,761
Steam	$19,105
Total	$314,050
ECI	$6.39/SF/yr

3.7 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

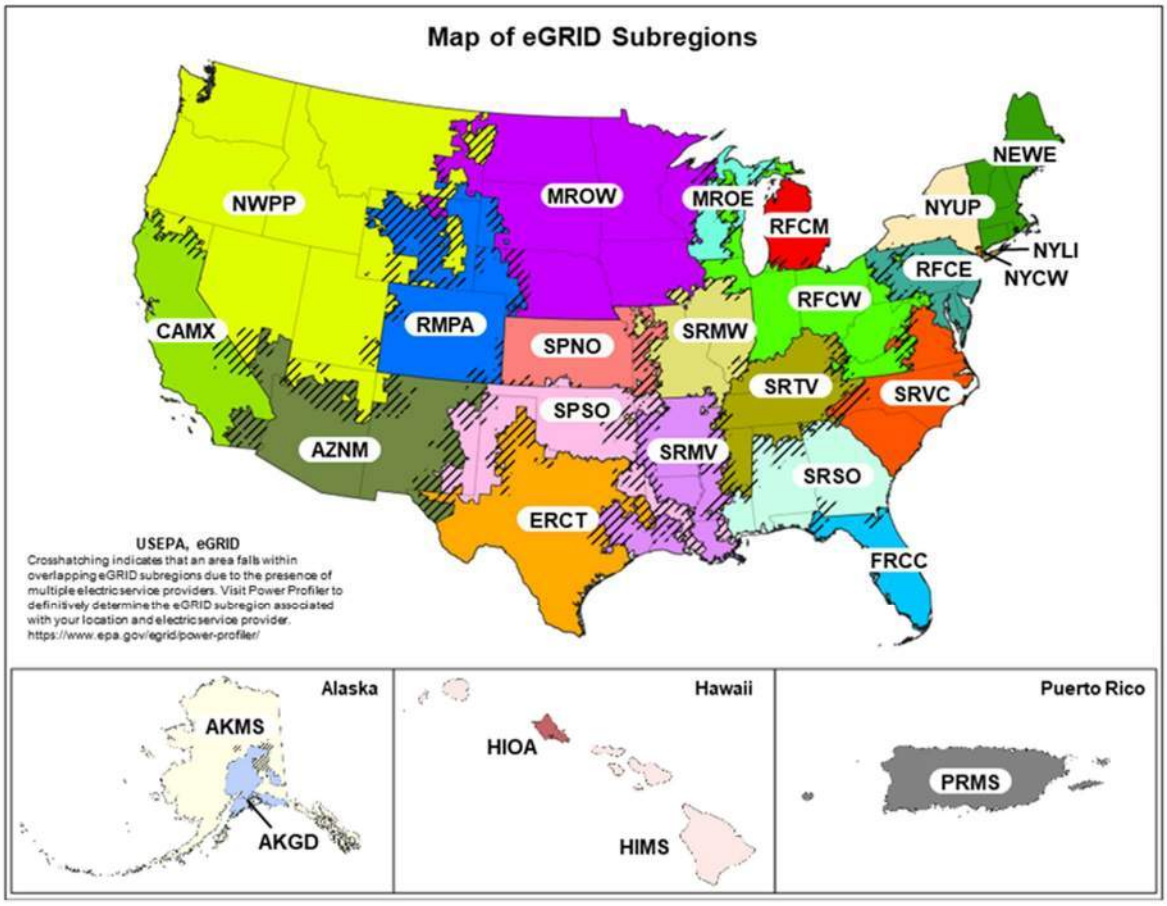
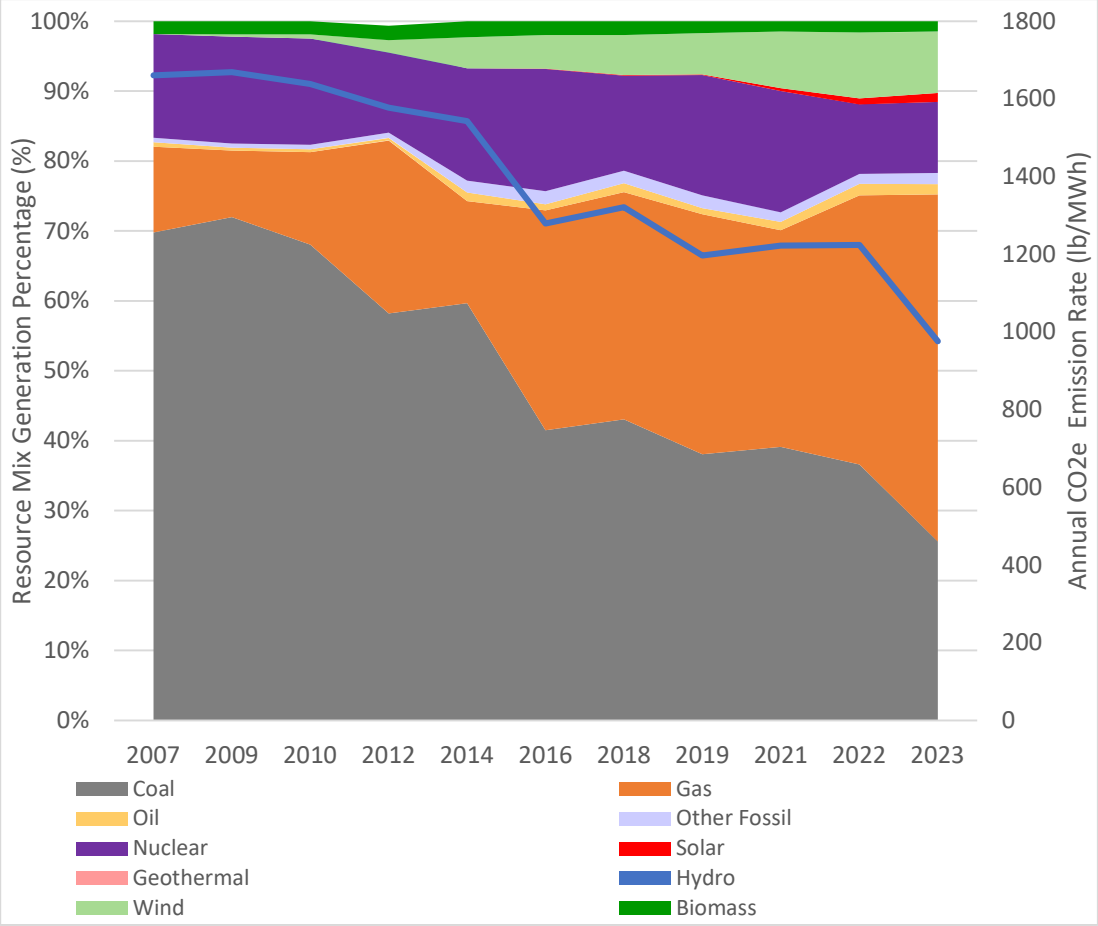


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 83 percent of carbon emissions are attributed to electricity, 16% are associated with steam, and the remaining 1% are attributed to natural gas. Natural gas combustion and imported electricity resulted in 246 tCO2e (campus-level Scope 1) and 1,180 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 1,427 tCO2e emissions. Oakland County does not currently purchase RECs to "offset" the carbon impact of imported electricity.

3.8 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different buildings' energy use, and it corresponds to the amount of energy consumed by all building systems. The Energy Use Intensity metric (EUI) is essential to comprehend building energy use per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for the Resource and Crisis Center are converted to kBTUs units, summed, and divided by the total square footage.

Table 7: Annual Utility Summary (2024)

Building:	Resource and Crisis Center					**Electric EUI:**	185	kBtu/SF/yr
GFA:	49,169	SF				**Gas EUI*:**	54	kBtu/SF/yr
eGRID Subregion:	RFCM					**Current EUI**	239	kBtu/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	2,665,313	kWh	3.412	9,094	0.0004427	1,180	$293,184	93%
Natural Gas	352	MCF	1.038	366	0.052496	19	$1,761	1%
Steam	1,911	klbs	1194	2,281	0.0000076	227	$19,105	6%
		Totals		**11,741**		**1,427**	**$314,050**	100%

*Includes direct natural gas consumption and natural gas used to produce steam at the Central Heating building.

According to the US EPA, the average site energy use intensity for a medical office, taken as the closest building use type, 97.7 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 239 kBTU/SF, which is significantly higher than the national benchmark. Space heating represents approximately 70% of aggregate EUI and 50% of annual GHG emissions (allocation of EUI and energy use distribution may vary). It's important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. However, the EUI comparison indicates there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency.

Figure 6: Average EUI per Building Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	Hospital (General Medical & Surgical)*	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.7	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	Barracks*		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	Medical Office*		232.8	97.7	Industry Survey
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient

3.9 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees and visitors. Table 8 and Figure 6 and Figure 7 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 8: Existing Energy Use per Category

End Use Breakdown (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBtu)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	0	233	1,929	2,523,401	51	240
Space Cooling	656,642	0	0	2,240,462	46	291
Fans	370,569	0	0	1,264,380	26	164
Pumps	96,813	0	0	330,324	7	43
DHW	0	44	0	45,831	1	2
Conveyance	0	0	0	0	0	0
Lighting	310,448	0	0	1,059,248	22	137
Plug Loads	27,601	0	0	94,176	2	12
Process Loads	0	36	0	37,154	1	2
Refrigeration	0	0	0	0	0	0
Cooking	23,040	0	0	78,612	2	10
Information Technology	3,000	0	0	10,236	0	1
TOTAL	**1,488,112**	**313**	**1,929**	7,706,138	157	906
Historical Billing	**2,665,313**	**353**	**1,911**			
Percent of Actual	56%*	100%	101%			
per sqft	**54.21**	**0.007**	**0.039**			

**Metered Electricity Use Shows 44% greater energy than expected sum of end uses. It is recommended that meter calibration and testing be conducted to better understand energy use.*

Figure 7: Existing Electricity End Use Distribution

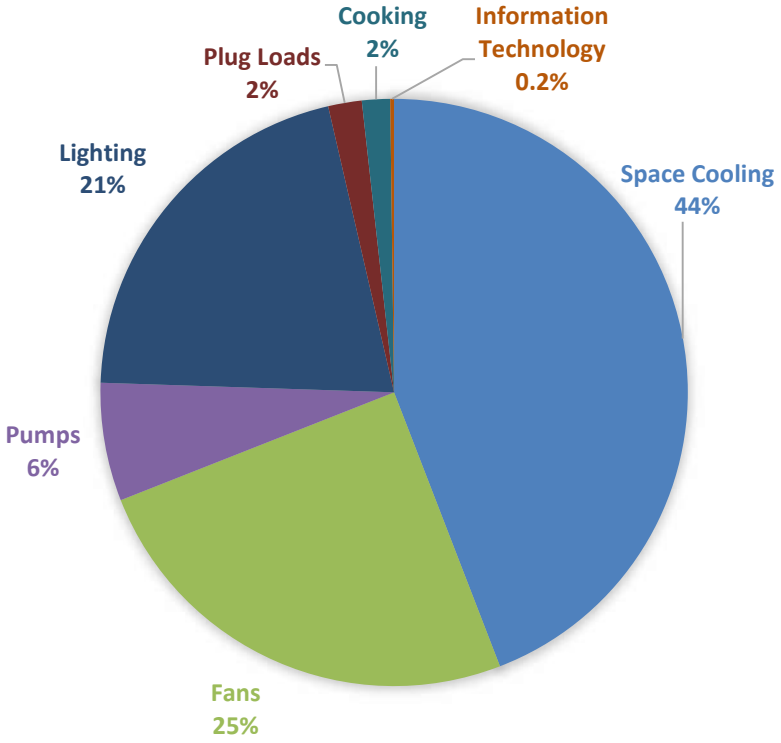
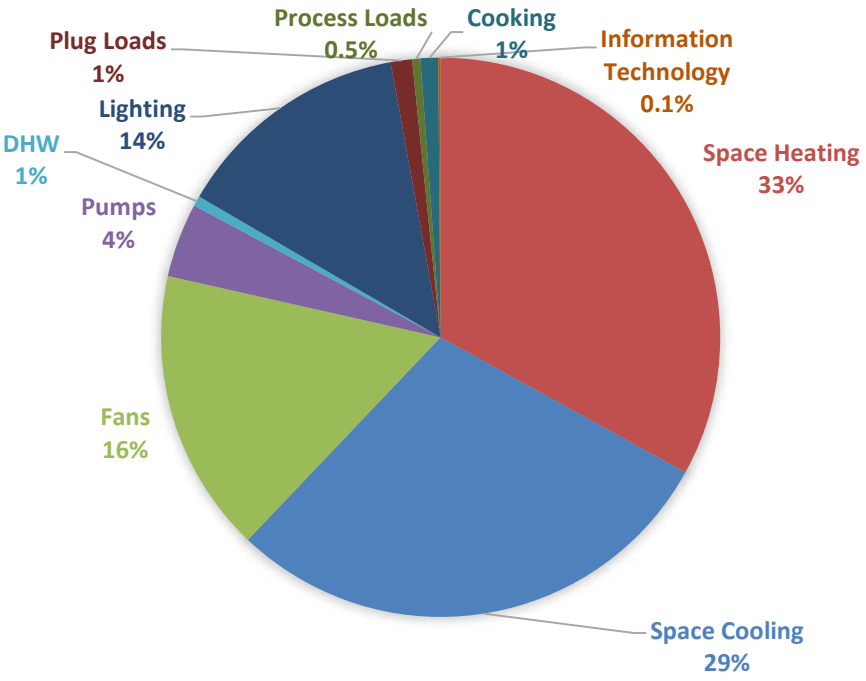


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – Retro-Commissioning

Building retro-commissioning (RCx) involves systematically evaluating and optimizing building systems, such as HVAC, lighting, controls, and other energy-consuming equipment, to improve operational efficiency and performance, and restore systems to their original design intent. The Resource and Crisis Center currently utilizes a building controls system which allows for advanced control of HVAC systems and scheduling. However, RCx is an extremely valuable measure that should be implemented to its fullest extent to ensure systems are operating effectively and efficiently. The following list represents RCx opportunities that should be evaluated to validate operation, repair if discrepancies identified or implement if not active and feasible for major HVAC systems. This effort will proactively improve building system operation and optimize energy usage.

- Implement unoccupied nighttime setback for lab space (see ECM 4)
- Turn off kitchen exhaust when not in use (see ECM 5)
- Equipment Scheduling
- Temperature and Pressure Resets
- Occupancy Sensing
- Flow Calibrations, setpoint reductions and sensor calibrations
- Submetering and Meter Calibrations

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing RCx will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 10% reduction in estimated heating and cooling end use energy consumption.

- Additional study of equipment capacity requirements can be performed as part of this measure.
- $0.50/sqft was used to estimate the cost for the 49,169 SF building.
- This measure supports electrification readiness indirectly by ensuring electric systems are optimized and operating efficiently.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: This measure proposes engaging a third-party contractor to determine if this building is eligible for the DTE RCx program and systematically evaluate and prioritize major HVAC and control systems and complete retro-commissioning to restore systems to their original design intent. This measure is recommended for implementation.

This measure also suggests that Oakland County increase their in-house capabilities to identify, correct, and maintain existing equipment to extend service life, maintain optimum cost of operation, and to reduce implementation costs for routine building improvements.

ECM Savings and ROM Cost:

Table 9: ECM 1 Savings and ROM Cost

		Savings Summary							
ECM	District Steam Savings (klbs)	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est. Project Cost	Simple Payback (Yrs)
Building Retro-commissioning	193	23	112,402	616	74	$0	$14,410	$36,877	2.6
Overall % Reduction	**10.10%**	**0.64%**	**4.22%**	**5.25%**	**5.19%**		**4.59%**		

4.2 ECM 2 – LED Lighting and Controls

This measure proposes upgrading all remaining fluorescent lighting to Light-emitting diode (LED) lightbulbs with sensors to reduce energy consumption and electrical demand. LEDs are highly energy efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements.

Incorporating lighting controls allows for better management and customization of lighting systems, leading to reduced energy consumption, and increased overall efficiency by limiting the time lighting is on to only when necessary. For indoor lighting, lighting controls consist of occupancy, daylighting, timers, scheduling, and dimming features to optimize light levels based on external lighting availability and usage of a space. For outdoor lighting, lighting controls consist of motion sensors, photocells, and timers to turn the lighting ON/OFF. The interior lighting in the Resource and Crisis Center consists of 34W, 54W, 64W, 96W, and 128W fixtures.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.



Figure 9: Example Fixture with Integrated Occupancy Controls

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting
- Lighting controls can extend the useful life of lamps, reducing the replacement costs over the life of the fixture. Lighting controls that include dimming will likely require full fixture replacement, which drive up the total cost of implementation for the measure.
- Section 2.1.3 provides the number of fixtures (811) and the number of bulbs per fixture, allowing the total number of bulbs to be estimated as 1,605. The estimated total wattage, 76,996W was used as the baseline for this measure.
- Interior lights operate 16 hours per day for 252 business days per year, which averages the different occupancy schedules for different parts of the building (24/7 and normal business hours).
- This measure assumes a 30% reduction in interior lighting utilization through implementation of controls. LED wattage is assumed to be 50% less than equivalent fluorescent lamps.
- O&M savings assume an average cost of $3.81/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- LED upgrades cost an average of $215/fixture, which include integrated control sensors and no additional wiring and control circuits. Low-cost fixtures and external controls can be used as an alternative to this implementation method. The costs have been split out between the

fixtures and controls in the summary table below, however, AECOM recommends evaluating both options for implementation.
- This measure indirectly supports electrification readiness by realizing a potential kW demand reduction that can be deployed elsewhere for new electric loads.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based on 2024 utility data.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, the subsequent steps would involve conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. Following this assessment, a controls contractor can be engaged to install the lighting controls and assist building engineers in configuring the schedule to optimize lighting usage. Provided below are the rebate opportunities for LED lighting upgrades and lighting controls from DTE.

ECM Savings and ROM Cost:

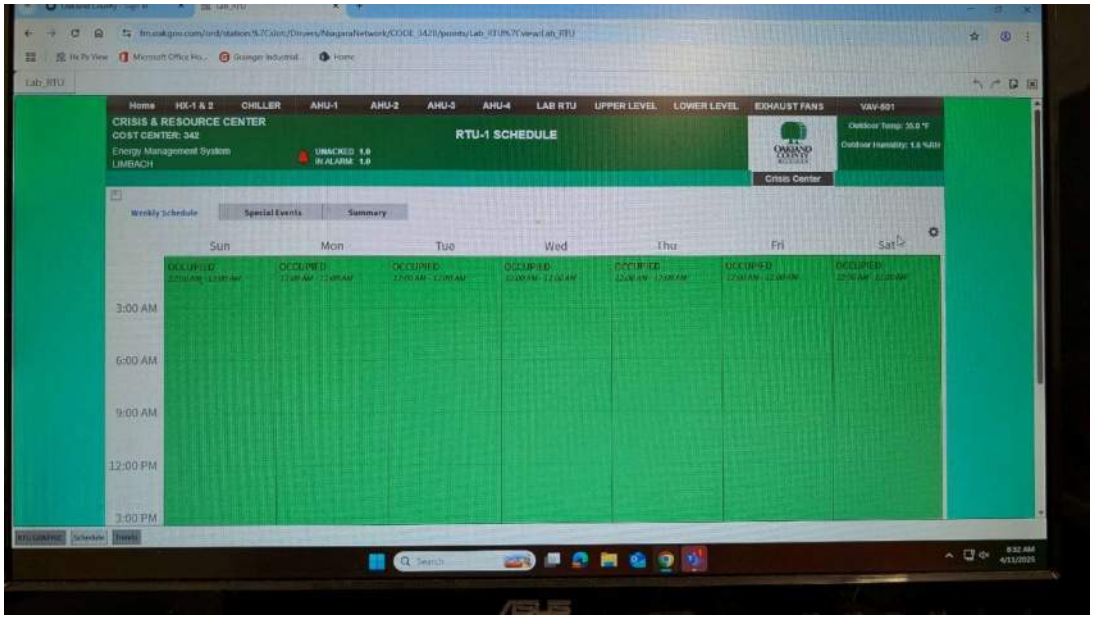
Table 10: ECM 2 Savings and ROM Cost

		Savings Summary							
ECM	District Steam Savings (klbs)	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est. Project Cost	Simple Payback (Yrs)
LED Upgrade	0	0	175,412	598.5	77.7	$6,115	$19,295	$141,925	5.6
Lighting Controls	0	0	40,511	138.2	17.9	$0	$4,456	$39,536	8.9
Total	0	0	215,293	737	95.6	$6,115	$23,752	$181,461	6.1
Overall % Reduction	**0%**	**0%**	**8%**	**6%**	**7%**		**8%**		

4.3 ECM 3 – Implement Temperature Setbacks for Lab RTU

Implementing standardized setpoints and occupancy schedules for the HVAC system can reduce energy consumption to enhance energy efficiency in areas with regular weekly occupancy. By establishing consistent temperature setpoints and aligning HVAC schedules with actual occupancy patterns, the system avoids unnecessary heating or cooling during unoccupied hours such as evenings, weekends, and holidays. This can be done by enabling seasonal occupied and unoccupied setpoints and schedules on programmable thermostats or enabling these controls in a centralized BAS where only authorized individuals can adjust as needed. This allows the HVAC system to “coast” toward unoccupied setpoints when the spaces are unoccupied and minimizes the need for the HVAC system to run. The Resource and Crisis Center is heated with four HHW AHUs plus one natural gas-fired RTU for the lab space. The 180 MBH lab RTU does not currently have an operational schedule established in the BMS and runs 24/7 (see Figure 11). However, the lab operates from 7 AM to 3:30 PM, offering an opportunity to reduce the total HVAC operation time to only business hours, which reduces energy consumption. Additional exhaust fan coordination may be required if make-up air is required at all hours.

Figure 10: Existing BMS Schedule for Lab RTU



Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- The existing RTU runs 24/7 to maintain occupied setpoints due to the current BAS scheduling.
- This measure assumes heating and cooling season energy savings due to reduced HVAC operation hours. Fan energy is assumed to be constant to satisfy make-up air needs, which can potentially also be reduced if not exhaust fans are operational during unoccupied hours.
- The occupied setpoint was assumed to be 73°F setback temperature was assumed to be 50°F for freeze protection.
- $1500 was used to estimate programming costs required to implement the setbacks.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Conduct a survey of existing control functionalities to determine any necessary upgrades and then establish seasonal setpoints (generally targeting 68-74°F when occupied and 55-60°F/80-85°F when unoccupied) and HVAC schedules that align with building occupancy patterns. Following these steps, the centralized BMS HVAC schedule should be configured accordingly. Verify and monitor to ensure the system is operating as intended and adjust as needed. This measure is recommended for implementation. It should be noted that the lab is expected to move to the Medical Examiner building in Fall 2025, so there may be more or less opportunity to setback the RTU depending on what the future plans for the space are.

ECM Savings and ROM Cost:

Table 11: ECM 3 Savings and ROM Cost

ECM	District Steam Savings (klbs)	Savings Summary							
		Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est. Project Cost	Simple Payback (Yrs)
HVAC Setbacks	0	134	19,699	81	16	$0	$2,836	$1,500	0.5
Overall % Reduction	**0%**	**14%**	**1%**	**1%**	**1%**		**1%**		

4.4 ECM 4 – Turn off Kitchen Exhaust When Not in Use

Turning off equipment when it is not in use ensures equipment runs only when needed, which provides energy savings through a reduction in operation hours. This can be done by manually turning equipment on and off as needed or by signaling the equipment to shut off through a programmable schedule with a timer or sensor. The Resource and Crisis Center has a kitchen exhaust fan that was observed to be running on the assessment day though no cooking was actively occurring. Thus, it is recommended that the fan is manually turned on and off through a switch that can be toggled by the kitchen staff, or with an electromechanical time-clock that matches the space use schedule.

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- The kitchen exhaust was assumed to run 12 hours every day of the year under the current scenario, which could be reduced to approximately 4 hours per day if only run when people are cooking.
- The exhaust fan motor HP is 0.75 with 90% efficiency.
- As this ECM only recommends implementing a practice of turning the equipment off when not in use, implementation costs are assumed to be $100, which includes printing a sign to post near the equipment switch.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Implement a standard practice of turning the fan on only when needed and ensuring it is turned off when not needed. Inform kitchen staff and post signage.

ECM Savings and ROM Cost:

Table 12: ECM 4 Savings and ROM Cost

ECM	District Steam Savings (klbs)	Savings Summary							
		Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MMBTU)	GHG Savings (tCO2e)	O&M Savings ($)	Annual Utility Cost Savings ($)	Est. Project Cost	Simple Payback (Yrs)
Turn off Kitchen Exhaust Fans	48	0	1,452	63	6	$0	$642	$100	0.2
Overall % Reduction	**2.5%**	**0%**	**0.05%**	**0.53%**	**0.44%**		**0.2%**		

5 Measure Requiring Additional Consideration

No additional measures are included in this report. Electrification measures have been evaluated and will appear in the final Electrification Report.

6 Appendix A

Table 13: Monthly Utility Data (2023 to 2024)

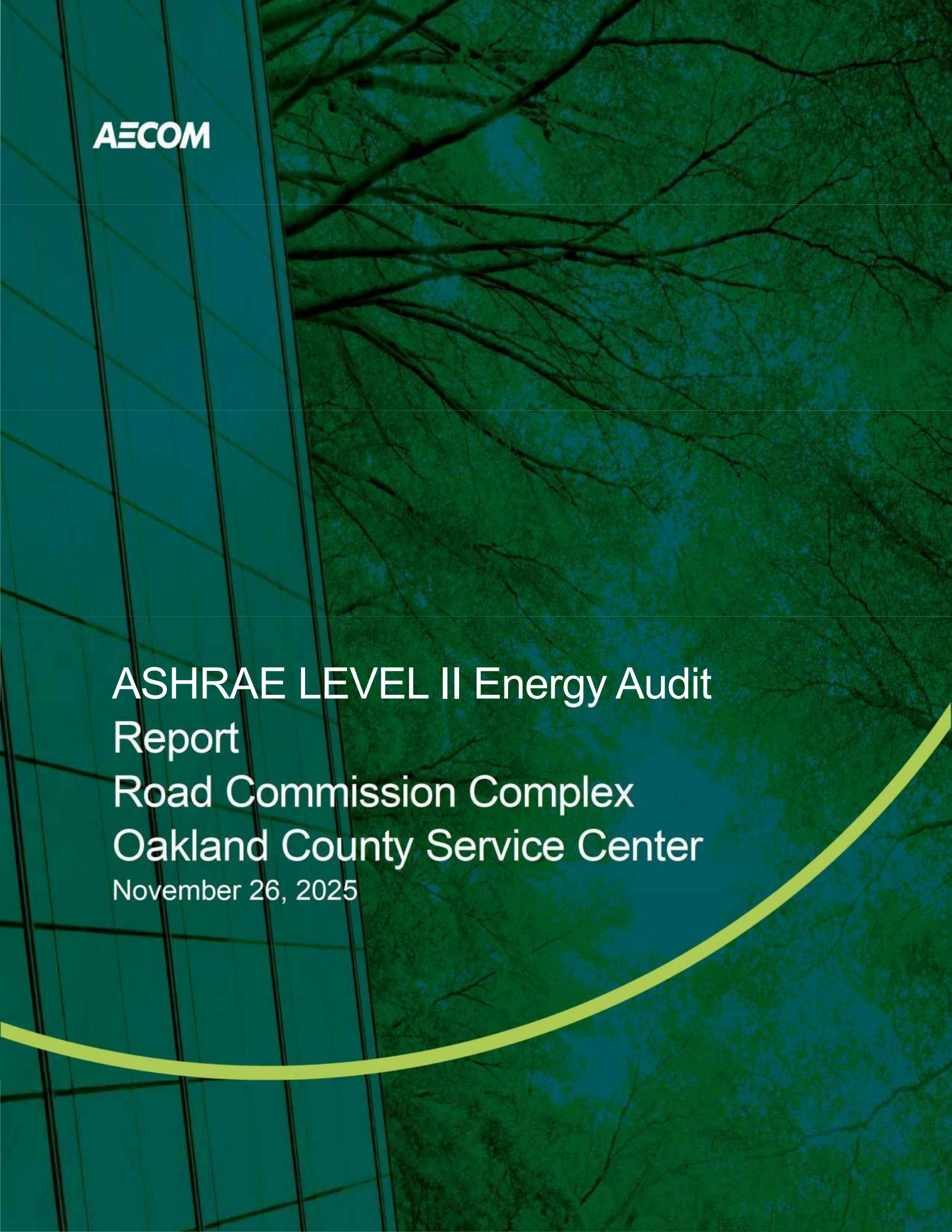
Month	Steam Consumption (klbs)	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	-	36	$52	184,269	$19,776	248	328	1,051	0
Feb-23	-	37	$55	160,405	$15,110	239	298	955	0
Mar-23	-	36	$53	169,165	$15,174	227	364	918	0
Apr-23	-	25	$38	186,686	$16,427	259	423	525	28
May-23	-	23	$35	244,383	$19,273	328	538	283	76
Jun-23	-	19	$31	255,560	$19,142	355	556	86	139
Jul-23	-	18	$26	355,689	$28,788	478	662	11	227
Aug-23	-	21	$36	391,798	$31,127	527	779	48	141
Sep-23	-	18	$31	289,997	$26,694	403	656	113	85
Oct-23	-	21	$37	247,404	$20,130	333	531	415	31
Nov-23	-	33	$55	205,716	$15,798	286	480	779	0
Dec-23	-	37	$62	154,968	$11,001	208	264	834	0
Jan-24	-	58	$94	199,675	$4,608	268	355	1,194	0
Feb-24	-	52	$86	171,581	$17,550	255	319	874	1
Mar-24	-	27	$46	168,176	$13,897	226	362	771	2
Apr-24	-	29	$51	178,705	$15,675	321	524	437	21
May-24	-	21	$92	231,059	$20,861	311	509	148	98
Jun-24	-	21	$26	259,185	$23,815	360	564	51	207
Jul-24	-	23	$16	327,455	$29,168	440	609	18	251
Aug-24	-	19	$35	277,007	$25,474	372	551	37	215
Sep-24	-	21	$40	301,174	$24,150	418	681	84	112
Oct-24	-	21	$32	210,852	$20,027	283	453	356	31
Nov-24	-	20	$31	159,800	$17,237	222	373	607	4
Dec-24	-	41	$59	180,644	$15,191	243	308	1,037	0
2023 Sum	-	324	$511	2,846,040	$238,440			6,019	727
2024 Sum	1,911	353	$608	2,665,313	$227,653			5,614	942

7 Appendix B

Table 14: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Efficiency	Capacity 2	Capacity 3
AHU-1	1	Air handling unit (CHW, HHW)		AAON M2		10 (heat) TON		10 (cool) TON	3,200 TON
AHU-2	1	Air handling unit (CHW, HHW)		AAON M2		15 TON		16 TON	4,800 TON
AHU-3	1	Air handling unit (CHW, HHW)		AAON M2		29 TON		32 TON	10,000 TON
AHU-4	1	Air handling unit (CHW, HHW)		AAON M3		37 TON		55 TON	16,150 TON
N/A	1	Rooftop unit (Dx, NG)	Lab	Bryant	580jp12d180g2a0aaa	180 MBH	82%	10 TON	4,000 CFM
Ch-1, 2	2	Air cooled chiller		MCQUAY INTERNATIONAL	AGZO70DHHNN-ER10	70 TON		82 kW	
AC-1,2	2	AC Units (Dx)		Daikin	RZR42PVJU (outdoor CU-1,2 units), FBQ42PVJU	3.5 TON			
HEX-1,2	2	Steam to hot water heat exchangers				940 MBH			
N/A	2	Domestic hot water heaters		Lochnivar Shield	SNR151-100	150 MBH	96%	90 gal	9 W
UH-1,2	2	Hot water unit heaters		Sterling	HS108A	6.9 MBH		245 CFM	9 W
UH-3 to 7	5	Hot water unit heaters		Sterling	HS118A	16.1 MBH		500 CFM	
CUH-1 to 5	5	Cabinet unit heaters		Sterling	RC-1200 (#1), RW-1120 (#2), FS-1005-04 (#3 to 5)	30 MBH			

Unit Tag	No of Units	Unit Name	Unit Serves	Make	Model	Capacity 1	Efficiency	Capacity 2	Capacity 3
HHWP-1,2	2	Heating Hot Water Pumps		B&G	Series 1510	2 HP			
PCHWP-1,2	2	Primary chilled water pumps		B&G	Series 80	1.5 HP			
SCHWP-1,2	2	Secondary chilled water pumps		B&G	Series 1510	3 HP			
EF-1	1	Exhaust fan	Toilet 229	Greenheck	G-070-G	150 CFM		0.017 HP	
EF-2	1	Exhaust fan	Soiled Utility 261	Greenheck	G-065-D	125 CFM		0.033 HP	
EF-3	1	Exhaust fan	Toilet 265	Greenheck	G-070-G	150 CFM		0.017 HP	
EF-4	1	Exhaust fan	Supply 276	Greenheck	G-060-D	5 CFM		0.017 HP	
EF-5	1	Exhaust fan	Toilet 270	Greenheck	G-060-D	75 CFM		0.017 HP	
EF-6	1	Exhaust fan	Toilet 224	Greenheck	G-060-D	75 CFM		0.017 HP	
EF-7	1	Exhaust fan	Toilet 249	Greenheck	G-060-D	75 CFM		0.017 HP	
EF-8	1	Exhaust fan	JC 218.2	Greenheck	G-060-D	75 CFM		0.017 HP	
EF-9	1	Exhaust fan	Toilet 207	Greenheck	G-070-G	150 CFM		0.017 HP	
EF-10	1	Exhaust fan	Kitchen Exhaust	Greenheck	CUBE-0180HP-7	1,600 CFM		0.75 HP	
EF-11	1	Exhaust fan		Greenheck	30-BISW-21	1,350 CFM		0.5 HP	
EF-12	1	Exhaust fan		Greenheck	12-BISW-21	775 CFM		0.5 HP	
RF-4	1	Exhaust fan, VFD		Greenheck	33-BISW-21	15,000 CFM		10 HP	
SF-1	1	Exhaust fan	Elec 244	LJ Wing	HLC-25-1F	4,300 CFM		0.5 HP	
SF-2	1	Exhaust fan	Elec 244	Greenheck	SBS-3H36	7,000 CFM		1 HP	
SF-3	1	Exhaust fan		Greenheck	SQ-160-A	3,500 CFM		2 HP	
TF-1	1	Exhaust fan		Greenheck	SP-A510	350 CFM			



AECOM

ASHRAE LEVEL II Energy Audit Report
Road Commission Complex
Oakland County Service Center

November 26, 2025

Quality information

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Revision	Revision date	Details	Authorized	Name	Position

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OAKLAND COUNTY, MI Government

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Disclaimer

The intent of this report is to present the results of the ASHRAE Level II Energy Audit of select facilities within the Oakland County Service Center located in Pontiac, Michigan.

Although the observations and proposed measures in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results following the implementation of any measures presented herein may vary. As a result, AECOM is not liable if estimated energy or financial savings are not realized. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

This report is produced for guidance only and consists of projected estimates. In no event will AECOM be liable for the failure of the building owner to achieve a specified amount of energy or demand savings or any incidental or consequential damages of any kind in connection with this report resulting from the future installation of energy conservation measures presented herein.

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1 Introduction

1.1 Executive Summary

AECOM is tasked with conducting an Energy Audit of the Oakland County Road Commission Complex in accordance with ASHRAE Standard 211-2018. The Oakland County government is seeking to meet state and local energy reduction mandates in an effort to reduce its facilities' cost of ownership, to improve energy efficiency and water conservation, to provide safe, healthy, and productive built environments, and to promote sustainable environmental stewardship. This ASHRAE Level II energy audit report aims to support the Oakland County government by analyzing its facilities' energy consumption and energy-consuming systems to identify energy conservation measures (ECMs). The ECMs are further classified into "Recommended" or "Considered but Requires Further Investigation or Not Recommended" measures based on simple payback period or foreseen feasibility issues.

The Oakland County Road Commission Complex is located within the Oakland County Service Center; the Service Center is divided into an East Campus and a West Campus. For purposes of this report, the terms "Service Center" and "campus" are used herein interchangeably.

This ASHRAE Level II Energy Audit Report has been prepared in accordance with the defined scope of work. AECOM will revise the report based upon comments from the Oakland County facility management team to ensure it aligns with the County's goals for the study. The final version will be submitted within one month of receiving comments from the County representatives.

The goal of this report is to identify key actions that Oakland County can take for immediate benefits, along with both short-term and long-term strategies to achieve sustainability and net-zero objectives. This energy audit adheres to the specified ASHRAE Standard 211-2018 and provides actionable recommendations for energy efficiency improvements.

After reviewing the initial materials, including floor plans, as-built drawings with equipment inventories, and utility data, AECOM coordinated with Oakland County to arrange a site visit for field data collection. This visit, conducted on Wednesday April 9, 2025, was used to verify critical information and assumptions, observe current operations, and conduct spot measurements to confirm building system functional performance.

A team of AECOM engineers conducted the field data collection. They obtained information through interviews with facility personnel, on-site observations, and photographic documentation. The assessment team made every effort to gather mechanical, electrical, and plumbing drawings, together with as much field data as possible.

1.2 Energy Audit Summary

This energy audit report evaluates three ECMs for achieving energy savings and sustainability goals. Table 1 provides a summary of projected energy and cost savings and simple ROI paybacks. Each measure is assigned a priority based upon the recommended implementation feasibility and its overall benefits. Specific details for each measure are provided in subsequent sections. The three listed measures represent a projected 23% annual energy cost savings with an aggregate simple payback of 8 years. All three measures are prioritized as "Recommended" for implementation.

ECMs focus on enhancing the energy efficiency of energy consuming systems and operations practices. ECMs serve to improve occupant comfort, improve system performance, and reduce operating costs. This report focuses primarily on immediate energy efficiency opportunities. Longer-term electrification and decarbonization opportunities will be included in Final Electrification Plan. However, if immediate HVAC upgrades are necessary, the recommended upgrades should be "electrification-ready" to enable Oakland County to meet its decarbonization goals from reduced regional grid emissions and/or a renewable energy procurement strategy favoring electricity consumption in place of natural gas consumption.

Integrating ECMs into capital planning ensures that energy efficiency is considered alongside other asset management needs such as lifecycle replacement, deferred maintenance, and modernization projects. ECMs can be bundled with planned capital upgrades to leverage synergies (e.g., combining controls upgrades and optimization with routine HVAC replacements, a roof replacement with insulation improvements), minimize downtime, and maximize return on investment. Embedding ECMs in the long-range capital plan allows decision-makers to compare energy and decarbonization projects against competing priorities, evaluate financing options (e.g., energy-service performance contracts, utility rebates or incentives, federal rebates), and track actual versus projected savings over time. The result is a strategic, data-driven approach that embeds sustainability into core business decisions while improving resilience and reducing total cost of ownership.

DTE offers a comprehensive energy rebate program for its commercial customers which covers a wide array of energy conservation measures[1]. Prior to implementation, all measures should be strategically evaluated for eligibility for DTE's prescriptive and/or custom rebates to maximize payback and cost savings. Many of the measures recommended may be eligible, however the program typically requires pre-approval and currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures[2].

[1] DTE Rebate Programs for Businesses | DTE Energy
[2] 2025 Program Rebate Catalog

Table 1: Road Commission Complex Proposed Energy Savings Summary

Energy Conservation Measures													
ECM #	**Measure Description**	**Priority**	**Measure Status**	**Year -1 Electricity Savings**	**Demand Reduction**	**Year -1 Gas Savings**	**District Steam Savings**	**Total Energy Saved**	**Year - 1 GHG Savings**	**O&M and Water Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	R, NR, RS	kWh/yr	kW	MCF/yr	k lbs/yr	MMBTU	MTCO2e	$/yr	$/yr	$	Years
1a	LED Lighting & Controls	MED	R	79,749	22	0	0	272	35.3	$2,839	$8,772	$118,250	10
1b	Controls on Existing LEDs	MED	R	12,165	0	0	0	42	5.4	$0	$1,338	$13,750	10
2	BAS Installation & HVAC Setback	MED	R	37,695	0	38,130	0	3,942	218.4	$0	$22,449	$159,750	7
3	Air Compressor Optimization	HIGH	R	8,127	0	0	0	28	3.6	$0	$894	$3,000	3
Sum of Recommended Measures				137,736	22	38,130	0	4,283	263	2,839	33,453	294,750	8
Overall % Reduction				20%	10%	25%	0%	24%	24%	--	23%	--	--

Notes
Cost savings estimates use current 2024 Oakland County billed utility rates
GHG savings estimates use 2023 eGRID RCFM emissions factor and standard NG combustion emissions factor
Measure Status: Recommended (R); Further Study Recommended (RS), Not Recommended (NR)
Electricity Saved: 1 kWh = 3,412 Btu = 3.412 kBtu = .003412 MMBtu
*Where demand reduction varies with load, the peak reduction is listed

2 Existing Conditions and Observations

The Road Commission Complex is a group of buildings with a total area of approximately 159,750 ft² and the primary structure, the Paul Van Roekel (PVR) is approximately 100,000 ft². The PVR building is half office space, half storage/workshop/maintenance/lab area. The buildings have been constructed over multiple decades, dating back to approximately 1955. There is significant deferred maintenance on mechanical and lighting systems.

2.1 Building Systems

2.1.1 Building Envelope

Table 2: Building Envelope Summary

Envelope Component	Construction Description	Construction Performance*
Exterior Wall	The RCC has multiple stand-alone buildings as part of the complex. The main building is masonry construction with the other structures primarily aluminum construction.	Medium to poor
Roof	Roofs were not accessible during the site visit	N/A
Glazing	Double pane	Medium

* Performance criteria have been assumed based on data available to AECOM and should not be taken as 100% accurate

2.1.2 Mechanical Systems

2.1.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

The main building has eight furnaces – 1A, 1B, 2, 3, 4A, 4B, 5A, 5B – with unknown capacity as the units were older without clear name plate information. Rooftop Units (RTU) #2 and #4 serve the office area and the fleet maintenance garage for cooling with constant volume boxes with branch controls that can be manually adjusted for occupant comfort. The rooftop units (RTUs) are natural gas fired.

Zone 1 (highway maintenance) is served by furnaces 1A and 1B. Zone 2 (Northwest side) served by Furnace 2. Zone 5 (traffic safety east side) served by furnace 5A and 5B. Zone 4 (East side/North end) is served by furnaces 4A and 4B. Zone 6 (DCS sensor room) served by furnace 6. Zone 3 (coffee room/conf. room) is served by furnace 3. Furnaces are direct expansion (DX) cooled. Furnaces are fed off domestic hot water.

The Fleet Maintenance Garage (Building #6) - has a large makeup air unit that is turned on if trucks are idling to provide ventilation. Old infrared unit heaters are used for heating. The other side of the fleet maintenance garage has a wall thermostat which is very old heated by tube heaters, other units were steam heaters which are abandoned in place. Another thermostat is used to operate a unit heater which is operational. The office area of the fleet maintenance garage is serviced by one RTU and has another makeup air unit.

The Receiving Area (between Building #6 and #4)- has four unit heaters on the corners. This primary space is heat only and does not have any RTU for cooling. The stock room is served by an RTU and a small office area is served by a separate RTU.

Highway Maintenance (Building #4) has two tube heaters. It has one exhaust and one make-up air unit (MAU) which is operated daily for about an hour to provide fresh air. Tube heaters are on a central thermostat. One tube heater is on the garage main door and is controlled by a local thermostat so that if the bay door is going to be open for a while heat can be provided. One air compressor in this building but is not used heavily when compared to the air compressor used in Building #6. The office area is served by a rooftop unit which has a thermostat in the office and has heating and cooling capabilities.

The Material Lab (Building #7) holds the Buildings and Grounds area and the sign shop. The building has two RTUs which has 2 zones, one for the sign shop and other for the rest of the areas, with local thermostat control. There is a MAU for the asphalt lab which has heating only and is only needed whenever the lab is in use. The cooling is taken care of by the RTU. MAU can run for 12 hours a day between April and November when testing is required. The sign shop has a work area with a dedicated RTU and the office area in the sign shop has its own dedicated RTU. The old air compressor serving the building is set at 150 pounds per square inch (PSI). The Material Lab and Buildings and Grounds sections also have two dedicated RTUs for the shop and their respective office areas.

Building #5 is a warehouse which has a tube heater and a small RTU for the office area. This building does not have cooling and will get hot in summer.

The Electrical Shop (Building #8) – has five Bard units at the perimeter of the building provide heating and cooling to the building and the office area in the building. Three of the Bard units will continue to serve the building, but two are scheduled to be replaced late Spring or early Summer 2025.

2.1.2.2 Plumbing

There are 4 to 5 natural gas fired domestic water heaters for the entire complex. Half of them are newer and half of them are about 20 years old.

2.1.2.3 Building Controls

The RCC does not have a building management system, and all equipment is locally controlled.

2.1.3 Lighting Systems

Lighting for the buildings is mostly a mix of T-8 fluorescent and LED space lighting, both 4ft and 8ft configurations. High-bay space lighting in the warehouse areas are provided. An exact lighting count was not provided but estimated can be developed from the building as-built drawings.

The garage uses light emitting diode (LED) fixtures with two lamps each, but the exact number of fixtures is unknown since drawings were not available. Some other areas have recessed fixtures with two fluorescent lamps. Based on the building size of 159,750 square feet, it is estimated that there are about 1,100 fixtures, each with two lamps, totaling 2,200 lamps. It is assumed that 50% of the lamps are fluorescent (32 watts each) and 50% are LED (12 watts each). Using these assumptions, the estimated total lighting load is about 48,400 watts.

The approximate total LED wattage is 13,200 watts. The approximate total fluorescent wattage is 35,200 watts. The approximate area per drawing is 159,750 ft² with an approximate lighting density of 0.302W/ft².

2.1.4 Electrical Infrastructure

The primary building electrical service consists of a 1600A, 240/120V Delta 3-phase main distribution panel fed from a pad-mounted 750 kVA transformer. Additional smaller transformers, ranging from 25 to 150 kVA, supply power to smaller buildings, though these are not expected to impact the electrification project. The facility is powered by two high-voltage feeders (Feeder A and Feeder B), each rated at 14.4 kV and 600 amperes, providing redundancy and capacity for high energy demand. According to the client-provided one-line diagram, the site has two main transformers: one dedicated to the Paint Shop and the other serving the Main Building. Each transformer is rated at 333/75 kVA and configured in an open delta, providing 240/120V service.

Backup power is provided by a 130 kW Generac diesel generator supporting critical building systems, with an additional 162.5 kVA outdoor generator also confirmed on-site.

Reviewing the provided photos, two electric meters were identified. The first, located in the garage, is a SANGAMO meter (No. 72848063) showing a reading of 7,928 × 160 kWh. The second meter (No. 72948059) has a reading of 9,220 × 80 kWh and may serve up to three buildings.

3 Utility Billing Analysis

3.1 Utility Type and Usage

The Oakland County Road Commission Complex receives electric service, natural gas service, and is not connected to the steam network. There are at least 3 natural gas meters that were observed during the site visit (outside PVR, Building #5, and Building #8), however natural gas bill data was not available for this building, therefore natural gas usage was estimated using the billed data from the Materials Management Facility and extrapolating to the estimated heated square footage of the Road Commission Complex.

Utility billing is managed through two separate arrangements for both natural gas and electricity. Oakland County receives two bills per utility each month: one from the local distribution utility for delivery charges, and one from an energy supplier for the supply cost.

For natural gas, Consumers Energy serves as the local distribution utility, billing fixed monthly service charges and volumetric distribution charges. Gas supply is purchased separately from Constellation, which charges based on a fixed rate per MCF.

For electricity, DTE Energy serves as the local distribution utility, billing for demand charges, fixed monthly service charges, and per-kWh distribution charges. Electricity supply is purchased separately from Direct Energy under a long-term contract, with charges based on a fixed rate per kWh.

AECOM analyzed the 2024 monthly billing statements received in PDF format for both delivery and supply services. The utility data reviewed includes the following:

- **Electricity:** DTE Energy (delivery/demand) and Direct Energy (supply)
- **Natural Gas:** Consumers Energy (delivery) and Constellation (supply)

The following table summarizes the estimated total energy consumption by utility type for the baseline year. Fixed utility and usage-based costs are used in energy efficiency measure cost savings estimates.

Table 3: Total Energy Usage and GHG Emissions (2024)

Utility	Annual Usage	Annual Usage (MMBTU)	Annual Cost ($)	Avg. Unit Cost	CO2 Coeff	GHG (tCO2e)
Electricity	673,920 kWh	2,299	$74,131	$0.11	0.0004427	298
Natural Gas	14,875 MCF	15,440	$74,112	$4.98	0.0549206	817
Total	--	17,739	$148,244	--	--	1,115

**Natural Gas (1 MCF = 1,038,000 BTU); Electricity (1 kWh = 3,413 BTU)*

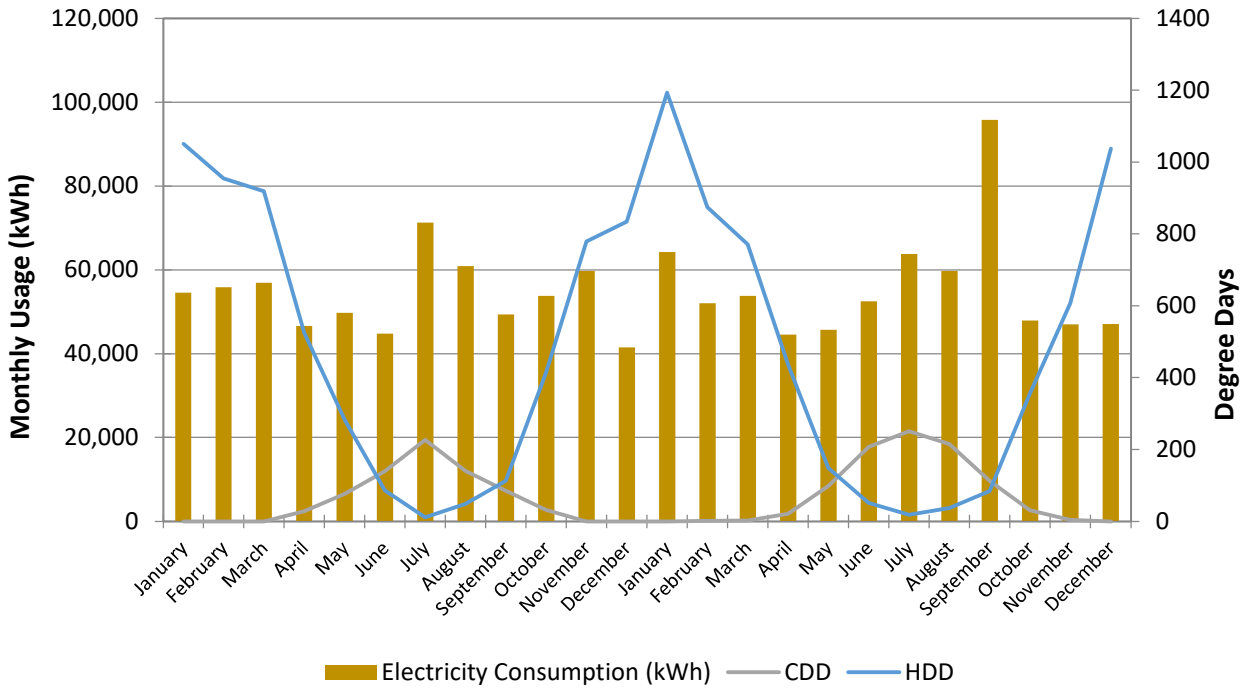
***CO2 coefficients are RFCM eGRID regional emissions factor (electricity) and standard emission coefficient for natural gas combustion*

3.2 Electricity Usage Profile

Figure 1 shows the monthly electricity usage profile for 2023 and 2024 and local monthly weather data indicated by cooling degree days (CDD) and heating degree days (HDD). Electricity usage does not show a strong correlation to weather data, indicating the majority of electricity usage consists of baseload usage. This usage does not vary much from month to month and includes

loads such as lighting, fans, and process loads. There is one anomaly in September 2024 that shows unusually high usage compared to the same period the previous two years. This may have been due to operational changes with cooling systems or a billing error. The annual usage for the baseline 12-month period from January to December 2024 is 673,920 kWh. Detailed monthly electricity usage and costs are in Appendix A.

Figure 1: Electricity Usage Profile (January 2023 to December 2024)



3.3 Building Electrical Capacity Analysis

The building is not currently tracking electrical demand (kW) and is billed based on the consumption meter (kWh) only. The total cost of energy for the campus master meter, which includes both consumption and demand, is rolled into one cost and split proportionally based upon the energy consumption of each building. Consequently, energy demand reduction savings will not be realized directly at each building and will be shared across the campus.

AECOM has developed a methodology to estimate peak demand using the building's metered electricity consumption, the peak demand of the master meter, the building type, and the seasonal energy use profile. Using these inputs, the monthly and annual peak demand has been estimated and is provided below.

Table 4: Electrical Capacity Results

Maximum Building Capacity at Service Transformer	500 kW
Maximum Capacity at Switchgear (A*V*Ph)	576 kW
Estimated Peak Demand	118 kW (estimated)
Remaining Capacity	**382 kW**

Figure 2: Estimated Electricity Demand Profile



3.3.1 Electric Utility Rate Structure

The facility's electricity is billed under a dual structure consisting of supply charges from Direct Energy and delivery and demand charges from DTE Energy.

- **Direct Energy (Supply):** The facility is under a long-term contract with Direct Energy, billed on a fixed $/kWh basis for all electricity consumed. This charge represents the commodity cost of electricity.
- **DTE Energy (Delivery & Demand):** DTE bills a fixed monthly service charge, distribution charges based on kWh delivered, and demand charges based on the facility's monthly peak demand (kW).

Electricity billing does not provide monthly peak electrical demand or demand billing charges. Actual bills with demand, usage charge details, and billing rate classification are needed to analyze the electric rate structure. The current utility rate is reasonable when compared to commercial rates in the state. As the rates are set by the base and do not contain manageable components such as demand rates, time-of-use, or real-time pricing, Oakland County does not presently have the ability to lower rates.

The campus is fed from a master electric meter that records both usage and demand from DTE. Oakland County purchases electricity from Direct Energy and pays a delivery fee to DTE. The total cost of electricity is then split proportionally to all connected buildings based on the electric consumption readings at the individual building submeters. The total cost is then charged to each building as a blended per kWh rate. This arrangement accurately distributes the cost of electricity consumption but shares the cost of energy demand across all buildings based on their usage. This means that buildings with low peak demand, but high usage, are paying less than they would if the billing structure included demand charges. The rates for the master meter are as follows:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge: **$6.15/kW/Month**

Average Dollar per kWh Used in Calculations: **$0.11/kWh**

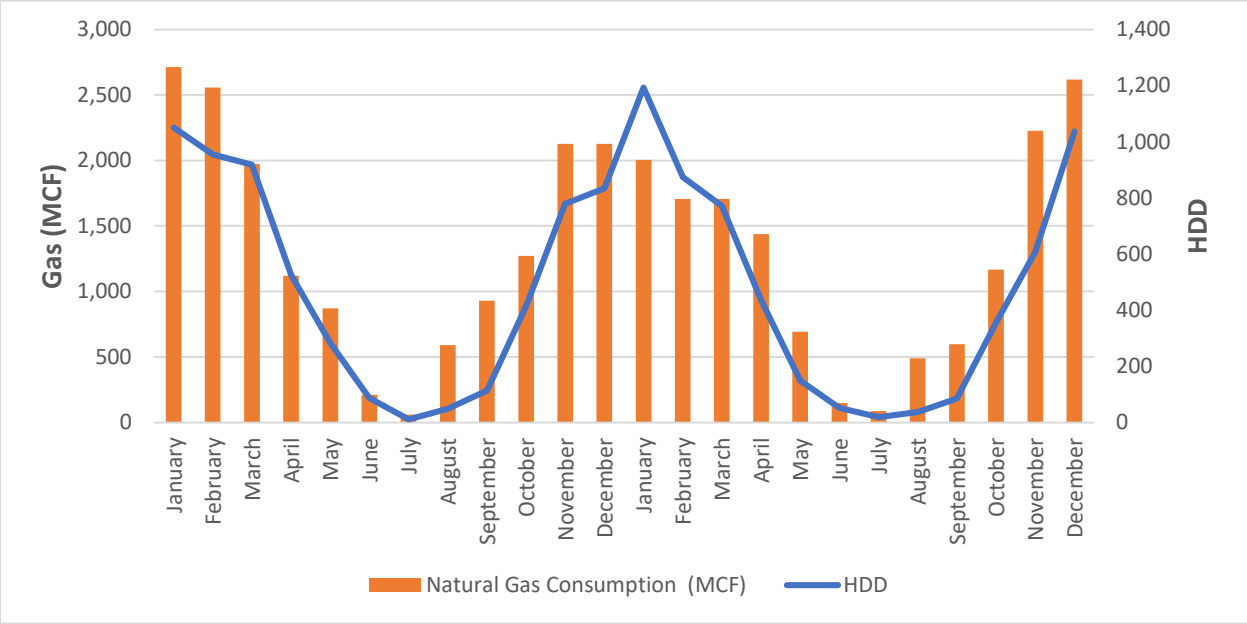
Electric Demand Charges are based on the peak demand for the current calendar year, which typically occurs in summer corresponding with peak cooling season. The peak demand for the campus was approximately 5583 kW, which is billed each month of the year at the specified rate. The campus is also subject to a Power Factor adjustment fee of ~$3/kVAR, however the campus power factor does not fall below the threshold that would trigger a monthly charge (PF<80%).

Because demand charges are based on the **annual peak**, electrification of heating systems will have a much lower impact on overall energy cost because it will only apply consumption and the additional demand over the summer peak. Analysis of energy efficiency and electrification measures in future project deliverables will consider this billing structure and optimize appropriately.

3.4 Natural Gas Usage Profile

Figure 3 shows the estimated monthly natural gas usage profile for 2023 and 2024 and local monthly weather data indicated by HDD. As mentioned previously, this usage is estimated based on the billed usage for the Materials Management facility and extrapolated to the heated square footage of the Road Commission Complex since natural gas data was not available for this facility. The estimated natural gas usage shows a direct correlation to weather data, as natural gas is primarily used for space heating. The estimated annual usage for the baseline 12-month period from January to December 2024 is 14,875 MCF. Detailed monthly natural gas usage and costs are in Appendix A.

Figure 3: Natural Gas Usage Profile (January 2023 to December 2024)



3.4.1 Natural Gas Rate Structure

The campus natural gas consumption is primarily for space heating in the winter, however, there is also domestic hot water, laundry, and kitchen equipment that use gas during all months of the year. Gas is billed with a similar structure to electricity, with two entities billing separately for

supply and delivery. Buildings receiving natural gas are billed independently from the master account, which is the primary account and uses 80% of the total energy delivered. The natural gas rates for the campus are given below:

Consumer's Energy Natural Gas Delivery Charge: $1.33/MCF (1000 cubic feet)

Constellation NG Usage Charge (fixed Fee): $3.48/dTh (decatherm, or 1.038 MCF)

Constellation NG Usage Charge (Day Gas): $5.29/dTh (decatherm, or 1.038 MCF)

Average Dollar per MCF Used in Calculations: $4.98/MCF

The natural gas usage charge is split into two components, a fixed fee charge and a day-gas charge, which fluctuates based on the market rate for gas. The day-gas charge can range from $1-$6/dTh but typically averages to be less than the fixed rate fee over the course of the year.

Building 22 East operates as the central steam heating plant, providing heating and domestic hot water loads for sixteen separate buildings. The steam plant receives natural gas from the master gas meter and the steam is distributed to buildings which are billed individually for steam use. The cost of the steam is based on the total natural gas utility cost and is billed proportionally based on steam meter readings at the individual buildings. Buildings not connected to the steam plant typically only pay for natural gas with consumption happening directly on-site.

3.5 Energy Cost Index

The energy cost analysis is based on the information provided from the County for calendar year 2024 with the total annual billed amount for each utility. The annual costs by energy type and energy cost index (ECI) per square foot are shown in Table 5 below.

Table 5: Energy Cost Index (ECI)

Energy Type	Annual Cost ($)
Electricity	$74,131
Natural Gas	$74,112
Total	$148,244
ECI $/yr/sf	$0.93

3.6 Carbon Emissions

Federal agencies reporting their annual emissions from energy consumption use the Environmental Protection Agency's (EPA) Emissions and Generation Resource Integrated Database (eGRID) to determine the carbon impact of their energy use. This database is updated approximately every two years with the emissions factor for each North American Electric Reliability Corporation sub-region, shown in Figure 4 (on the following page). Each emissions factor is based on the mix of generation resources within the sub-region and is represented in pounds of carbon dioxide equivalent per unit of electricity generation (lb CO2e/MWh). Oakland County is located within NERC's RFCM sub-region, which includes most of Michigan.

Figure 4: Map of eGRID Subregions

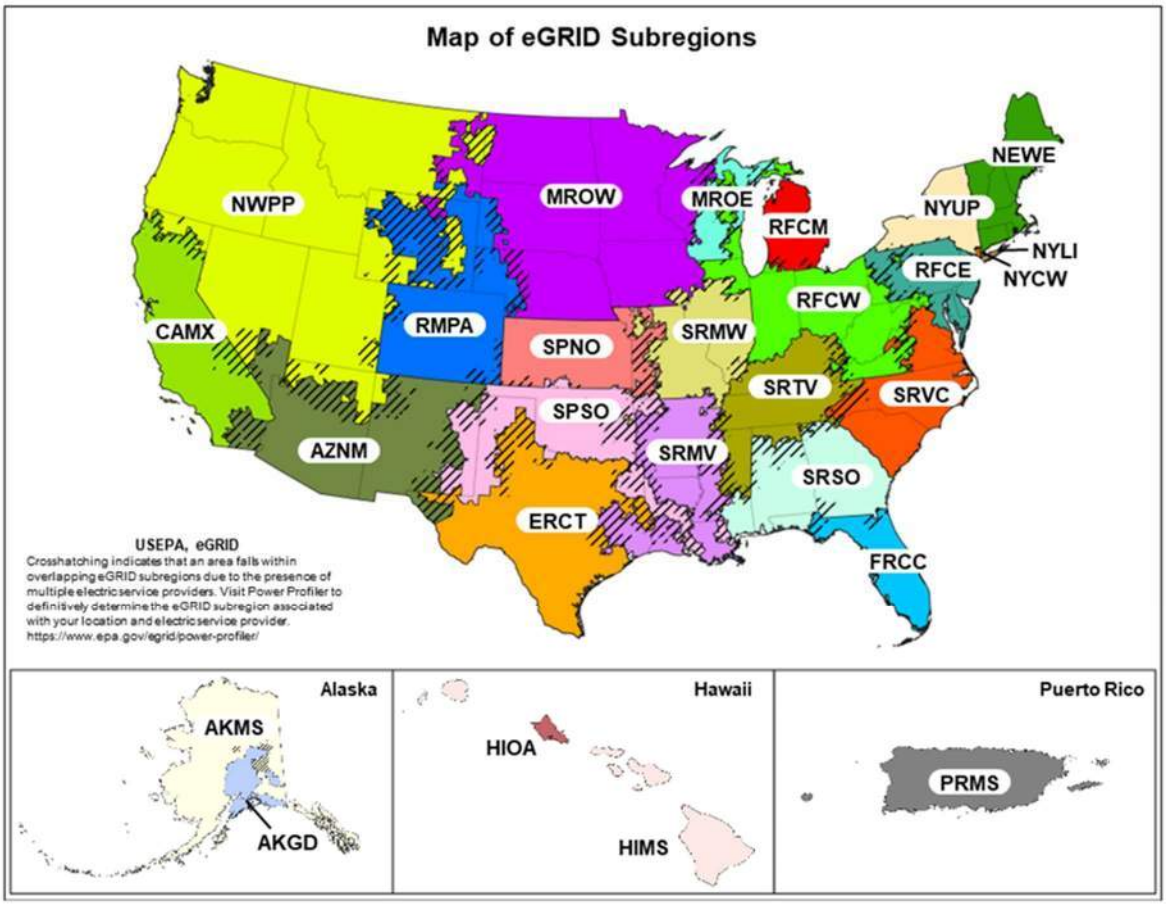
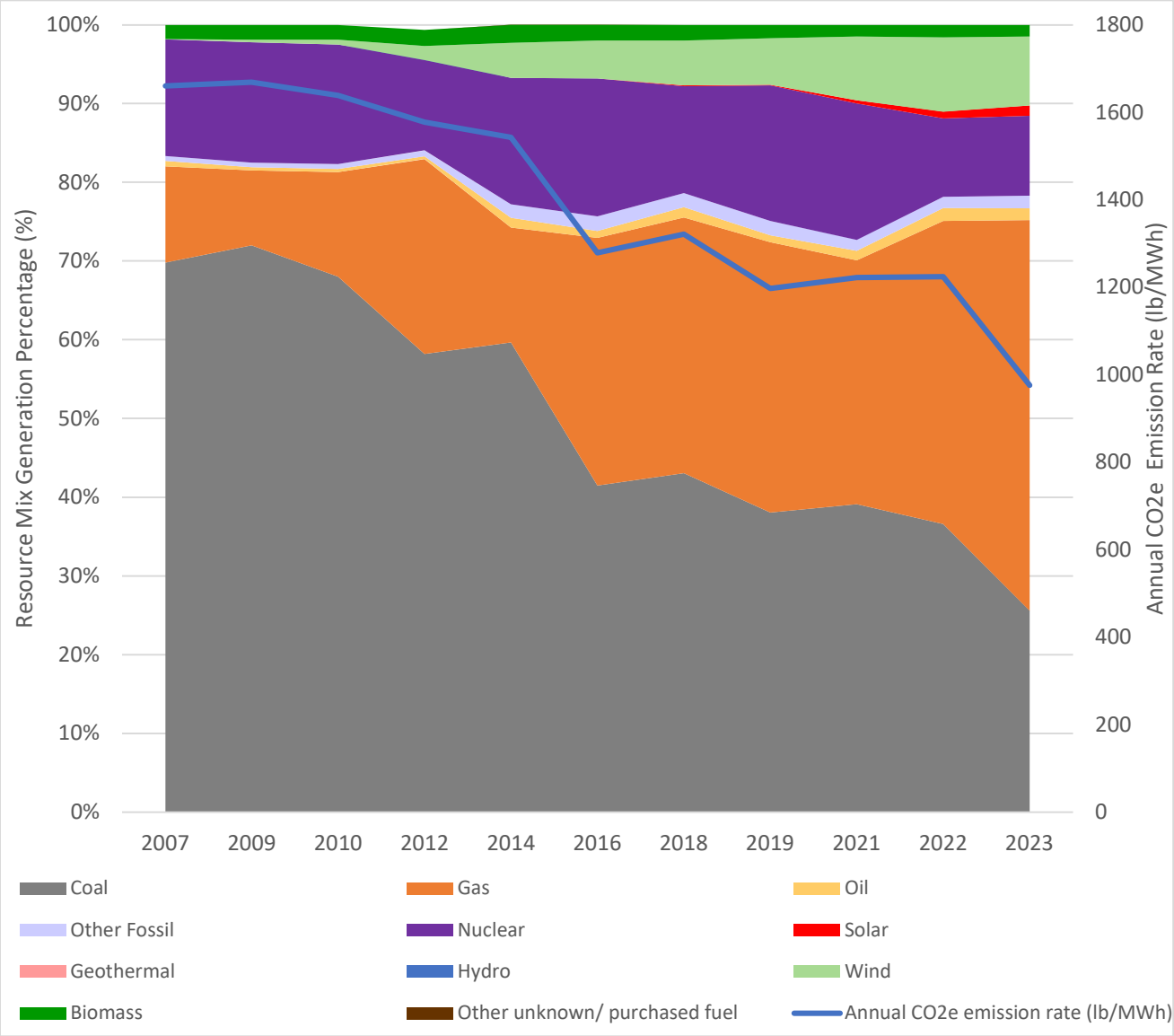


Figure 5 (on the following page) displays the RFCM eGRID emissions factor and grid generation mix over time. RFCM's electric generation mix historically relied on coal generation to meet the majority of regional demand, but over the past couple of decades has shifted away from coal and steadily increased natural gas generation. The regional resource mix is currently 11.6 percent renewable (accounting for hydro, wind, solar, and biomass generation) and 20.3 percent carbon-free, which consists of renewable sources and nuclear. The current 2023 CO2e emissions factor for the RFCM sub-region is 976 lb. CO2e/MWh, which is significantly higher than national average of 767.2 lb. CO2e/MWh, largely due to the significant reliance on fossil fuels within the region.

Figure 5: RFCM eGRID Generation Mix and Emissions Factor



Scope 1 emissions consist of the emissions generated from on-site fuel combustion, and Scope 2 emissions are based on the emissions factor of imported secondary energy sources such as purchased electricity. Approximately 73 percent of carbon emissions are attributed to natural gas and 27 percent are associated with electricity. Natural gas combustion and imported electricity resulted in 817 tCO2e (campus-level Scope 1) and 298 tCO2e (campus-level Scope 2) emissions, respectively, for a total of 1,115 tCO2e emissions. Oakland County does not currently purchase RECs to “offset” the carbon impact of imported electricity.

3.7 Energy Use Intensity and Benchmarking

Site energy use is a widely used measure for comparing different building efficiency, and it corresponds to the amount of energy consumed for heating and electricity for all building systems utilized by a building through utility bills. The Energy Use Intensity (EUI) is essential to comprehend building energy-efficiency per square foot within a year. The EUI in this study is measured in one thousand (Kilo) British Thermal Units (kBTU) of energy used yearly per square foot. British Thermal Units, or BTUs, is a basic unit of measurement for fuels' energy or heat content. Electricity and natural gas usage for the Road Commission Complex are converted to kBTUs units, summed, and divided by the total square footage.

Table 6: Annual Utility Summary (2024)

Building:	Road Commission Complex				**Electric EUI:**		14	kBTU/SF/yr
GFA:	159,750	SF			**Gas EUI:**		97	kBTU/SF/yr
eGRID Subregion:	RFCM				**Current EUI**		111	kBTU/SF/yr
Annual Utility Summary								
Energy Type	**Total Annual Use**		**Conversion Factor**	**MMBTU**	**CO2 Coeff**	**GHG (tCO2e)**	**Annual Cost ($)**	**Cost %**
Electricity	673,920	kWh	3.412	2,299	0.0004427	298	$74,131	50%
Natural Gas	14,875	MCF	1.038	15,440	0.0549206	817	$74,112	50%
Totals				17,739		1,115	$148,244	100%

According to the US EPA, the average site energy use intensity for a repair services facility is 47.9 kBTU/SF/yr. The total EUI for the existing condition of the building is calculated as 111 kBTU/SF, which is over double the national benchmark. It's important to note that the national benchmark does not factor in the variance of weather conditions given that Oakland County is in one of the colder regions of the country with higher heating requirements. Nevertheless, the EUI comparison and site observations indicate there is still an opportunity to optimize existing systems to reduce energy consumption and improve facility energy efficiency. However, it is critical to obtain the billed natural gas data to understand the facility's actual EUI as natural gas usage has a significant impact due to the amount of space heating.

Figure 6: Average EUI per Counseling Category Type (Source EPA's Portfolio Manager)

ENERGY STAR® PortfolioManager® Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
	Wholesale Club/Supercenter*		120.0	51.4	CBECS - Retail Store
Technology/Science	**Data Center*** *(Average PUE presented in place of EUI: PUE = Total Energy / IT Energy)*		1.82	1.82	EPA - Data Center
	Laboratory		318.2	115.3	CBECS - Laboratory
	Other – Technology/Science		89.3	40.1	CBECS - Other
Services	**Data Center*** *(Average PUE presented in place of EUI: PUE = Total Energy / IT Energy)*		1.82	1.82	EPA - Data Center
	Personal Services (Health/Beauty, Dry Cleaning, etc.)		96.9	47.9	CBECS - Service
	Repair Services (Vehicle, Shoe, Locksmith, etc.)				
	Other - Services				
Utility	Drinking Water Treatment & Distribution *(Average EUI presented in Energy per Flow in gallons per day)*		5.90	2.27	AWWA - Water Treatment Plant
	Energy/Power Station		89.3	40.1	CBECS - Other
	Wastewater Treatment Plant* *(Average EUI presented in Energy per Flow in gallons per day)*		7.51	2.89	AWWA - Wastewater Plant
	Other - Utility		89.3	40.1	CBECS - Other
Warehouse/Storage	Self-Storage Facility		47.8	20.2	CBECS – Non-refrigerated Warehouse
	Warehouse/Distribution Center	**Distribution Center***	52.9	22.7	CBECS – Non-refrigerated Warehouse & Distribution Center
		Non-Refrigerated Warehouse*			
		Refrigerated Warehouse*	235.6	84.1	CBECS – Refrigerated Warehouses
Other	Other		89.3	40.1	CBECS - Other

3.8 End Use Distribution

The table below shows the estimated energy usage distribution as instructed in ASHRAE Guideline 211-2018. Energy usage of each system category was calculated based on the utility data analysis, equipment specifications and condition, and site operations. Local weather BIN data for Oakland County Michigan is used for configuring the heating and cooling loads. The domestic hot water usage is calculated based upon an annual hot water usage estimation by factoring in the water heater efficiency and number of employees. Table 7 and Figure 7 and Figure 8 below show the full estimated distribution of each end use and its contribution to site energy consumption, EUI, and GHG emissions.

Table 7: Existing Energy Use per Category

End Use Distribution (Existing)						
End Use Category	**Electricity (kWh)**	**Natural Gas (MCF)**	**District Steam (k lbs)**	**Site Energy Total (kBTU)**	**EUI**	**GHG Emissions (tCO2e)**
Space Heating	58,704	14,694	0	15,452,427	97	833
Space Cooling	59,828	0	0	204,133	1	26
Fans	128,647	0	0	438,943	3	57
Pumps	0	0	0	0	0	0
DHW	0	181	0	187,956	1	10
Conveyance	0	0	0	0	0	0
Lighting	168,395	0	0	574,563	4	75
Plug Loads	33,357	0	0	113,813	1	15
Process Loads	180,008	0	0	614,188	4	80
Refrigeration	10,505	0	0	35,841	0	5
Cooking	10,932	0	0	37,299	0	5
Information Technology	23,545	0	0	80,337	1	10
TOTAL	**673,920**	**14,875**	**0**	**17,739,500**	**111**	**1,115**
Historical Billing	673,920	14,875	0			
Percent of Actual	100%	100%	0%			
per sqft	4.2	1.0	0			

Figure 7: Existing Electricity End Use Distribution

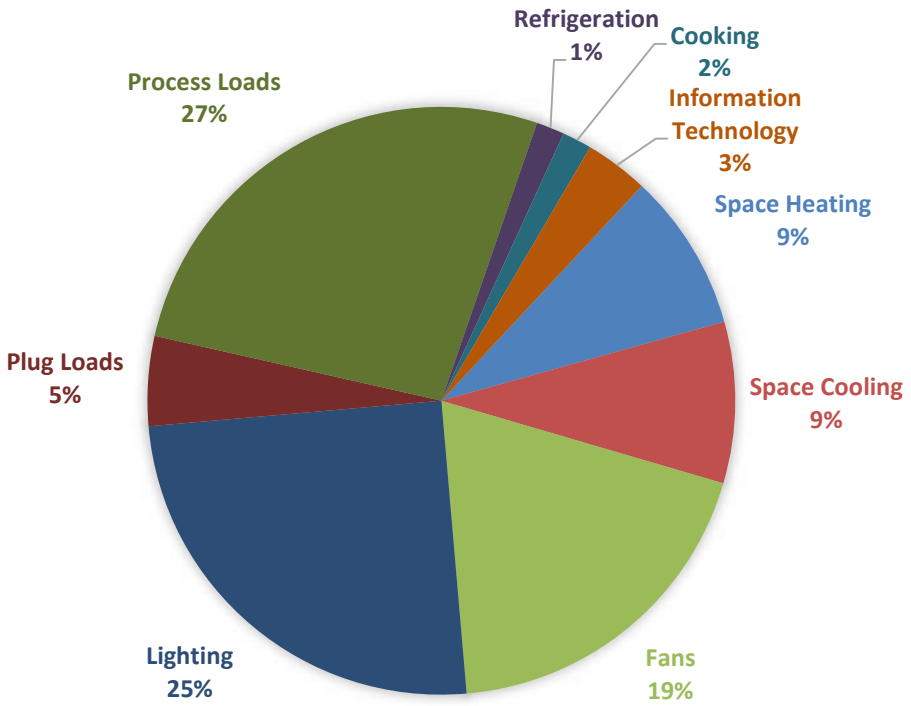
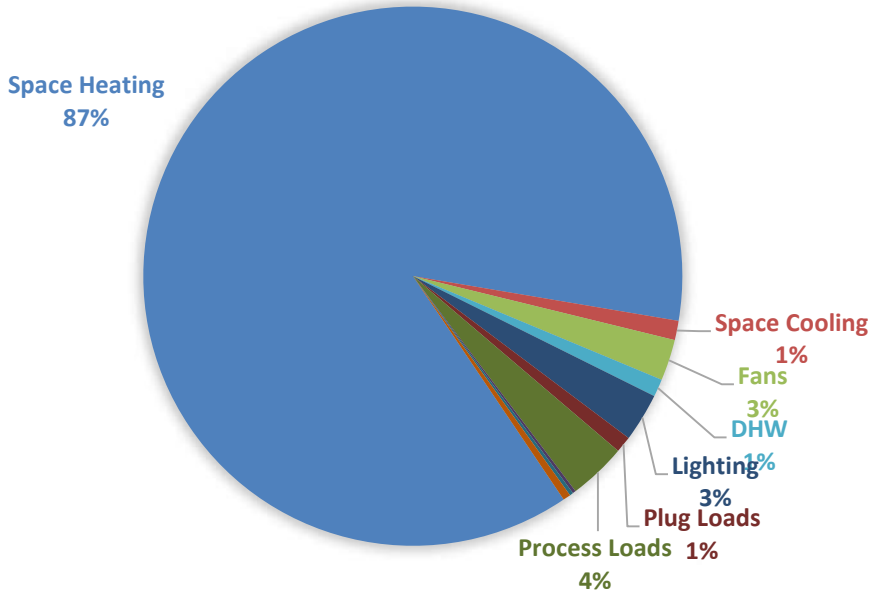


Figure 8: Existing Energy End Use Distribution



4 Energy Conservation Measures

The measures discussed in this section are economically viable when bundled together but are not necessarily intended to meet decarbonization goals. However, these measures can be used as an enabling factor for potential capital improvement measures, meaning these measures can offer either mutually exclusive projects or interact with other future projects aiming for full decarbonization. This list does not mandate the installation of each measure but it reveals their potential impact from an economic and energy standpoint. The main goal of these measures is to provide options for facility management and establish a baseline before proceeding with the implementation of selected projects. Some of these measures may interact with capital improvement projects whereby project selection and planning must be carefully scrutinized to avoid double-counting energy savings.

Individual measure cost estimates are rough orders of magnitude (ROM) values that show an estimated cost for each measure. After the project enters the design phase, more precise cost estimates will be developed. The cost estimates use information from various sources, including RS Means, vendor quotations, and previous work on comparable projects.

4.1 ECM 1 – LED Lighting and Controls

This measure proposes upgrading all remaining fluorescent lighting to light-emitting diode (LED) lightbulbs with motion sensors and dimming functionality where appropriate to reduce energy consumption and electrical demand. LEDs are highly energy-efficient as most of the electrical energy supplied to the fixture is converted into light. They outperform traditional fluorescent bulbs, resulting in lower electrical energy demand and consumption. LEDs also have a much longer lifespan compared to traditional bulbs. LED lightbulbs can last tens of thousands of hours, reducing the frequency of replacements. The current interior lighting in the Road Commission Complex is approximately 50% LED and 50% fluorescent and the estimated wattage is approximately 0.3 W/ft^2. Minimally occupied warehouse spaces are ideal areas for motion sensors.

The pricing of this measure includes replacement fixtures for the fluorescent lighting, which include new fixture housings, lamps, and integrated sensors for occupancy control and dimming. Alternative implementation strategies exist, such as direct LED replacement lamps, however these alternatives have limited control capabilities which would limit savings potential.



Figure 9: Example Fixture with Integrated Occupancy Controls

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing LED lighting will allow for greater control through dimming, occupancy, and daylighting.
- Interior lights are assumed to be on 12 hours per day for 256 days of the year.
- This measure assumes a 0.14 W/ft² or approximately 45% reduction in interior lighting power and a 30% reduction in hours of operation for adding new controls.
- O&M savings assume an average cost of $2.15/lamp, which assumes a lamp life that is 40% shorter for linear fluorescent compared to LED and an existing lamp replacement cost of $28 each.
- LED upgrades cost $215/fixture, which include integrated control sensors and no additional wiring and control circuits. Low-cost fixtures and external controls can be used as an alternative to this implementation method. This measure assumes all remaining fluorescent lamps are converted to LEDs, estimated at 550 total fixtures.
- Lighting controls for existing LEDs assume $250/sensor and one sensor for every 10 fixtures with approximately 50% of existing fixtures already LED.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings.

Next Steps: Develop a detailed installation plan, considering factors such as fixture compatibility, wiring requirements, and scheduling to minimize disruption to operations. For lighting controls, the subsequent steps would involve conducting a thorough examination of the lighting infrastructure to determine the feasibility of installing and implementing controls within the current system. Following this assessment, a controls contractor can be engaged to install the lighting controls and assist building engineers in configuring the schedule to optimize lighting usage. This measure is recommended for implementation. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 8: ECM 1 Savings and ROM Cost

Savings Summary								
ECM	Gas Savings (MCF)	Electric Savings (kWh)	Energy Savings (MBTU)	GHG Savings (tCO2e)	Annual Utility Cost Savings ($)	O&M Savings ($)	Est Project Cost ($)	Simple Payback (Yrs)
LED Upgrade & Controls	0	79,749	272	35	$8,772	$2,839	$118,250	10
Lighting Controls on Existing LEDs	0	12,165	42	5	$1,338	$0	$13,750	10
Total	**0**	**91,914**	**314**	**41**	**$10,111**	$2,839	$132,000	10
Overall % Reduction	**0**	**13.6%**	**1.8%**	**3.6%**	**6.8%**	--	--	--

4.2 ECM 2 – BAS Installation and Commissioning

This combined measure involves installing a building automation system (BAS) and completing retro-commissioning (RCx) once the BAS is operational. Together, these steps enable centralized control, improve system coordination, and ensure building operations are optimized for efficiency and reliability.

BAS Integration

BAS integration refers to connecting and coordinating various building systems and components through a centralized control platform. The goal is to enhance the overall efficiency, functionality, and manageability of building operations. While BAS installation does not directly yield energy savings, it enables the optimization of other measures.

In the Road Commission Complex, BAS integration would allow centralized monitoring and optimization of the various HVAC systems throughout the nine buildings. This includes furnaces, makeup air units, gas-fired infrared and unit heaters, BARD units, RTUs, etc. These systems are currently locally controlled by various vintages and types of controllers, with minimal to no scheduling and setback functionality. This results in excessive heating, cooling, and fan runtime in spaces that are typically only occupied during core business hours on weekdays.

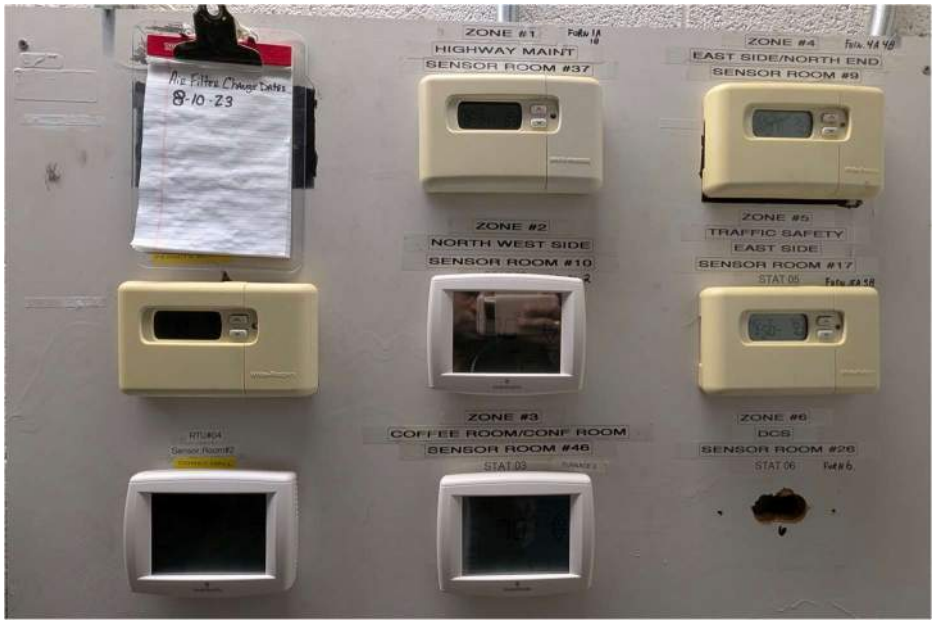


Image 1: Existing Local Controls

Commissioning

With BAS installed, the Road Commission Complex will have centralized visibility and control of major HVAC systems for the first time. Commissioning is a critical follow-on activity to ensure the BAS is properly configured, sequences of operation are optimized, and long-standing inefficiencies are resolved. Commissioning includes systematically evaluating and fine-tuning HVAC, controls, and other energy-consuming systems to restore them to design intent and reduce energy waste.

The following list represents commissioning opportunities that should be evaluated to validate operation, repair if discrepancies identified or implement if not active and feasible for major HVAC systems. This effort will proactively improve building system operation and optimize energy usage.

- Optimize HVAC scheduling
- Optimize HVAC occupied and unoccupied setpoints
- Eliminate simultaneous heating and cooling
- Testing, adjusting, and balancing airside systems
- Restore equipment to automatic control
- Replace or calibrate faulty sensors, actuators, and/or flow meters
- Discharge air setpoint reset
- Outside air temperature lockouts

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Implementing a BAS will have no change to existing controls capabilities and will increase customization of equipment.
- Commissioning will improve equipment operations, extend useful life, and reduce energy costs.
- Energy savings assume a 20% reduction in estimated fan and cooling end use energy consumption and 25% reduction in space heating end use energy consumption.
- BAS installation and commissioning cost assumes combined cost of $1/sqft.
- A Microsoft Excel™ spreadsheet was used to determine the energy savings based upon 2024 utility cost data.

Next Steps: Identify equipment to be connected to the central control system and engage a building controls integration company to plan and cost the system integration. Coordinate with planned capital upgrades and renovations where possible to optimize benefits. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 9: ECM 2 Savings and ROM Cost

	Savings Summary							
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
BAS Installation & Commissioning	3,673	37,695	3,942	218	$0	$22,449	$159,750	7
Overall % Reduction	25%	6%	22%	20%	--	15%	--	--

4.3 ECM 3 - Air Compressor Optimization

This ECM proposes conducting a compressed air leak survey, repairing any identified leaks, and optimizing system pressure based on end-use operation. Compressed air systems commonly have leaks throughout the distribution system (couplings, disconnects, any kind of fittings) that contribute to wasted energy. A common industry rule of thumb is that a not well-maintained system will typically have 20% to 30% losses, while a well-maintained system will typically only have approximately 10% losses. There are currently three compressed air systems used in Buildings 4, 6, and 7. The compressor motors range in size from 5 HP to 15 HP each and the operating pressure for each system is 150 psi. Staff reported the compressor in Building 6 is new and has had distribution leaks checked and resolved but end-use equipment only require a minimum of 90 psi. The other two compressor systems are older and have not had a recent leak survey or repairs down the line.



Image 2: Existing Air Compressors

Assumptions:

- Implementation of this measure will not adversely affect occupant health or safety.
- Air compressors operate approximately 2-4 hours per day to maintain system pressure.
- Compressed air pressure is currently 150psi for all systems and can be safely stepped down to 100psi. This measure assumes 5% savings per 10psi reduction.
- This measure assumes the system currently has approximately 20% losses and can be reasonably reduced to 10% losses after a leak survey, repairs, and system optimization.
- Cost assumes $1,000 per compressor.
- A Microsoft Excel™ spreadsheet was used to determine energy savings based upon 2024 utility costs.

Next Steps: Identify a contractor to conduct a leak survey and repairs and submit application for DTE compressed air audits with leak repair rebate. Conduct leak survey and make necessary repairs. Once leaks are resolved, step down system pressure from 150 psi to100 psi in 10 psi increments and test end use equipment at each step to ensure pressure meets end use requirements. This measure is recommended for implementation.

ECM Savings and ROM Cost:

Table 10: ECM 3 Savings and ROM Cost

	Savings Summary							
ECM	**Gas Savings (MCF)**	**Electric Savings (kWh)**	**Energy Savings (MBTU)**	**GHG Savings (tCO2e)**	**O&M Savings ($)**	**Annual Utility Cost Savings ($)**	**Est Project Cost**	**Simple Payback (Yrs)**
Air Compressor Optimization	0	8,127	28	4	$0	$894	$3,000	3
Overall % Reduction	0%	1%	0%	0%	--	1%	--	--

5 Considered But Not Currently Recommended

No additional ECMs have been considered.

6 Appendix A

Table 11: Monthly Utility Data (2023 to 2024)

Month	Natural Gas Consumption (MCF)	Natural Gas Cost	Electricity Consumption (kWh)	Electricity Cost	Average Demand (kW)	Max Demand Estimate (kW)	HDD	CDD
Jan-23	2,714	$16,666	54,560	$5,856	248	97	1,051	0
Feb-23	2,558	$14,951	55,840	$5,260	239	104	955	0
Mar-23	1,973	$6,009	56,880	$5,102	227	122	918	0
Apr-23	1,119	$3,878	46,640	$4,104	259	106	525	28
May-23	871	$2,607	49,760	$3,924	328	110	283	76
Jun-23	210	$521	44,800	$33,556	355	97	86	139
Jul-23	58	$235	71,280	$5,769	478	133	11	227
Aug-23	590	$1,701	60,880	$4,837	527	121	48	141
Sep-23	930	$2,639	49,360	$4,544	403	112	113	85
Oct-23	1,271	$3,663	53,760	$4,374	333	115	415	31
Nov-23	2,128	$7,938	59,760	$4,589	286	140	779	0
Dec-23	2,128	$10,499	41,520	$2,947	208	71	834	0
Jan-24	2,004	$8,824	64,240	$1,482	268	114	1,194	0
Feb-24	1,705	$9,287	52,000	$5,319	255	97	874	1
Mar-24	1,705	$9,652	53,760	$4,337	226	116	771	2
Apr-24	1,438	$2,998	44,560	$3,909	321	104	437	21
May-24	693	$1,408	45,680	$4,202	311	101	148	98
Jun-24	147	$476	52,480	$4,822	360	114	51	207
Jul-24	85	$274	63,760	$5,680	440	119	18	251
Aug-24	489	$1,043	59,760	$5,496	372	119	37	215
Sep-24	596	$1,447	95,760	$7,679	418	217	84	112
Oct-24	1,167	$3,128	47,920	$4,552	283	103	356	31
Nov-24	2,226	$7,703	46,960	$5,066	222	110	607	4
Dec-24	2,618	$5,820	47,040	$3,956	243	80	1,037	0
2023 Sum	16,551	$71,307	645,040	$84,862			6,019	727
2024 Sum	14,875	$52,060	673,920	$56,500			5,614	942

*Natural gas billed data not available, estimated based on Materials Management Building billed data

7 Appendix B

Table 12: Building Equipment List

Unit Tag	No of Units	Unit Name	Unit Serves	Capacity	Efficiency	Approx Year Installed
RTU 2	1	Rooftop units, constant volume, cooling only	Office area and fleet maintenance garage			
RTU 4	1	Rooftop units, constant volume, cooling only	Office area and fleet maintenance garage			
N/A	1	Makeup air unit	Fleet maintenance garage (Building #6)			
N/A		Infrared unit heaters	Fleet maintenance garage (Building #6)			
N/A	4	Unit heaters (receiving area is heat only)	Receiving area (between Buildings #4 and #6)			
N/A	1	Rooftop unit	Stock room			
N/A	1	Rooftop unit	Office area			
N/A	2	Tube heaters	Highway maintenance (Building #4)			
N/A	1	Make up air unit	Highway maintenance (Building #4)			
N/A	1	Rooftop unit	Highway maintenance (Building #4)			
N/A	1	Small rooftop unit (heat only)	Warehouse (Building #5)			
N/A	1	Tube heater	Warehouse (Building #5)			
N/A	1	Rooftop unit	Material lab (Building #7) (Sign shop zone)			
N/A	1	Rooftop unit	Material lab (Building #7) (Sign shop office)			
N/A	1	Rooftop unit	Material lab (Building #7) (Zone for everywhere else)			

Unit Tag	No of Units	Unit Name	Unit Serves	Capacity	Efficiency	Approx Year Installed
N/A	1	Makeup air unit (heat only)	Asphalt Lab (Building #7)			
N/A	1	Air Compressor	Building #7			
N/A	5	Heat and cool	Electrical Shop (Building #8)	Bard		
1A,1B	2	Furnaces (DHW)	Zone 1 - highway maintenance			
2	1	Furnaces (DHW)	Zone 2 - northwest side			
3	1	Furnaces (DHW)	Zone 3 - coffee roon/conference room			
4A, 4B	2	Furnaces (DHW)	East side/north end			
5A, 5B	2	Furnaces (DHW)	Traffic safety east side			
N/A	4 to 5	Domestic water heaters (NG)	Entire complex			

Memo

AECOM
400 Monroe Street
Detroit, MI 48226
aecom.com

Project name:
Oakland County Energy Plan

From: Katrina Lewis

Date:
Aug 01, 2025

To: Chase Sperry
Senior Facilities Project Manager
Oakland County

CC: Misty Raatz
Senior Faclities Representative
Oakland County

On-Site Renewable Opportunities

In alignment with its long-term sustainability and climate action objectives, Oakland County (“the County”) has established a target of achieving net-zero greenhouse gas (GHG) emissions by the year 2050, with an interim milestone of reducing carbon emissions by 50% by 2035. These commitments underscore the County’s strategic priority to decarbonize its operations and transition toward a cleaner, more resilient energy future.
To support the realization of these goals, AECOM was engaged to conduct a comprehensive assessment of 36 County-owned and operated facilities located within the main government campus area. As part of this engagement, the study aims to evaluate current energy performance, identify opportunities for load reduction, and assess the technical and economic feasibility of integrating on-site renewable energy generation systems—particularly solar photovoltaic (PV) technologies—across the campus. The focus is to reduce the County’s reliance on grid-supplied electricity, lower operational GHG emissions, and improve long-term energy resilience and cost stability.
This document presents the analysis and findings associated with Deliverable 6: Site-Specific On-Site Renewable Opportunities. It includes identification of candidate facility locations for renewable system deployment, assessment of viable renewable technology options, estimated system capacities, and preliminary economic considerations. This deliverable forms a key component of the County’s broader decarbonization roadmap and supports data-driven decision-making toward achieving its interim and long-term carbon reduction targets.

Executive Summary

This report presents a comprehensive assessment of on-site solar PV opportunities for the Oakland County campus as part of the County’s broader goal to reduce carbon emissions and advance sustainability. The analysis focused on evaluating the technical feasibility, electrical infrastructure capacity, economic viability, and GHG reduction potential of installing PV systems across multiple campus locations.

Using detailed site assessments and building-level electrical capacity data, the study identified approximately 2.9 MW-AC of PV capacity that can be accommodated within existing electrical constraints. Modeled annual solar generation is estimated at around 4,300 MWh, representing an 18% offset of the campus’s electricity consumption. This translates to an annual reduction of approximately 1,896 metric tons of CO_2 equivalent, which is significant given Michigan’s fossil fuel–intensive grid where coal and natural gas comprise about 75% of electricity generation. Additional capacity can potentially be installed at the sites identified in this report, up to 7.1 MW-AC or enough to offset 44% of the campus electricity consumption, but more accurate electrical system metering data is required to understand the current peak demand and potential solutions to the electrical systems constraints discussed. Additionally, PV capacity can be increased by including additional array locations, such as rooftop and carport arrays. These systems would require the same electrical analysis to understand infrastructure constraints.

Economic analysis shows that, due to relatively low local electricity rates and substantial capital and interconnection costs, most ground-mounted PV installations are not financially attractive under current conditions, with payback periods exceeding

typical system lifespans, even when factoring in a 30% federal Investment Tax Credit (ITC). However, rooftop PV installations present a more cost-effective alternative by eliminating interconnection costs, reducing capital expenditures by over 40%, and shortening payback periods from 42 to 24 years, or as low as 12 years when incorporating utility rate escalation and system degradation.

This study highlights the importance of renewable energy deployment to meet Oakland County's decarbonization goals, while also providing critical insights into the technical and financial challenges that must be addressed. The report concludes with recommendations for refining assumptions, conducting detailed life cycle cost assessments, and developing phased implementation strategies to maximize the value of solar investments at the campus.

Goal and Scope

Oakland County established a goal to achieve net-zero carbon emissions by 2050, with an interim target of reducing carbon emissions by 50% by 2035. To support this effort, AECOM is conducting an energy study for 36 County-owned and operated facilities located within the main campus area and managed by Facilities Management. As part of this broader decarbonization effort, the County is evaluating the feasibility of deploying on-site renewable energy systems to reduce emissions associated with electricity use.

This portion of the study is focused on assessing on-site renewable energy opportunities across the campus. The scope includes identifying potential locations for renewable energy installations, such as rooftop, carport, and ground-mounted systems, simulating expected annual energy generation from these systems, and developing rough order of magnitude (ROM) cost estimates for implementation, and assessing GHG emission reduction potentials.

Framework

To support Oakland County's carbon reduction goals through on-site renewable energy generation, this analysis follows a structured approach to evaluate the technical and financial viability of PV systems at the main campus. The methodology integrates site-specific constraints, utility parameters, and economic considerations to inform future investment decisions. The key steps of the analysis include:

- Identify potential PV installation sites by assessing rooftop, carport, and ground-mounted areas and use PV modeling tools to determine the maximum feasible installed capacity at each location.
- Evaluate the existing electrical infrastructure to understand the capacity and limitations of the existing electrical infrastructure in accommodating additional PV generation.
- Review applicable net energy metering (NEM) policies and interconnection rules to identify system size limitations, export constraints, and compensation mechanisms under current utility regulations.
- Analyze current utility tariffs and rate structures to estimate potential cost savings from PV generation.
- Develop capital cost estimates and perform payback analysis based on current market pricing for PV system components and installation, incorporating labor, permitting, and engineering costs.
- Quantify GHG reduction potential by modeling avoided emissions based on current grid emission factors and estimated annual PV generation output.

Potential PV Installation Sites

As part of the on-site renewable energy assessment, Oakland County provided a marked-up map of the main campus highlighting potential areas for solar installation (Figure 1). These areas were color-coded based on current use and anticipated future developments. Sites marked in pink were deemed unsuitable due to physical or operational constraints. Blue areas are associated with tentative relocation plans, and orange zones are designated for future development, both of which introduce long-term uncertainties. As a result, no systems were considered for these locations. Only the remaining feasible sites were advanced for technical evaluation.

For these viable locations, a high-level array design and capacity assessment was conducted using HelioScope, an industry-standard tool for modeling solar system performance. HelioScope allows for rapid simulation of energy output by

incorporating variables such as shading, orientation, tilt, spacing, and equipment specifications. Using this tool, system layouts were generated for each site, and the potential installation capacities were estimated.

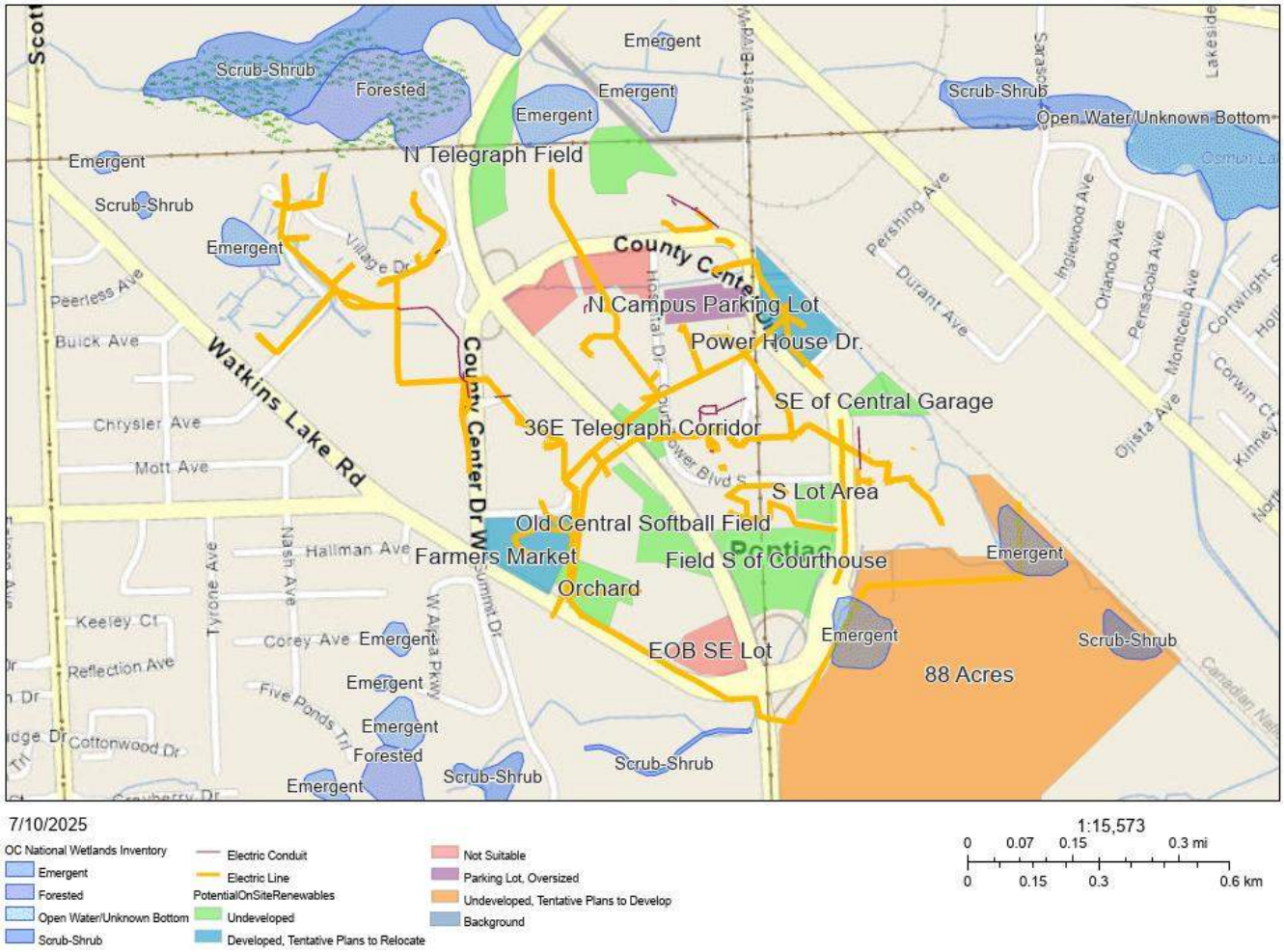


Figure 1: Potential PV installation areas

To facilitate reference and analysis throughout the study, each identified area on the campus map was assigned a unique identifier numbered 1 through 15. This consistent labeling allows for clear documentation of site-specific assessments and findings. The assigned numbers correspond to the areas illustrated in Figure 2, which includes both feasible and infeasible locations for solar deployment based on site constraints and future development considerations.

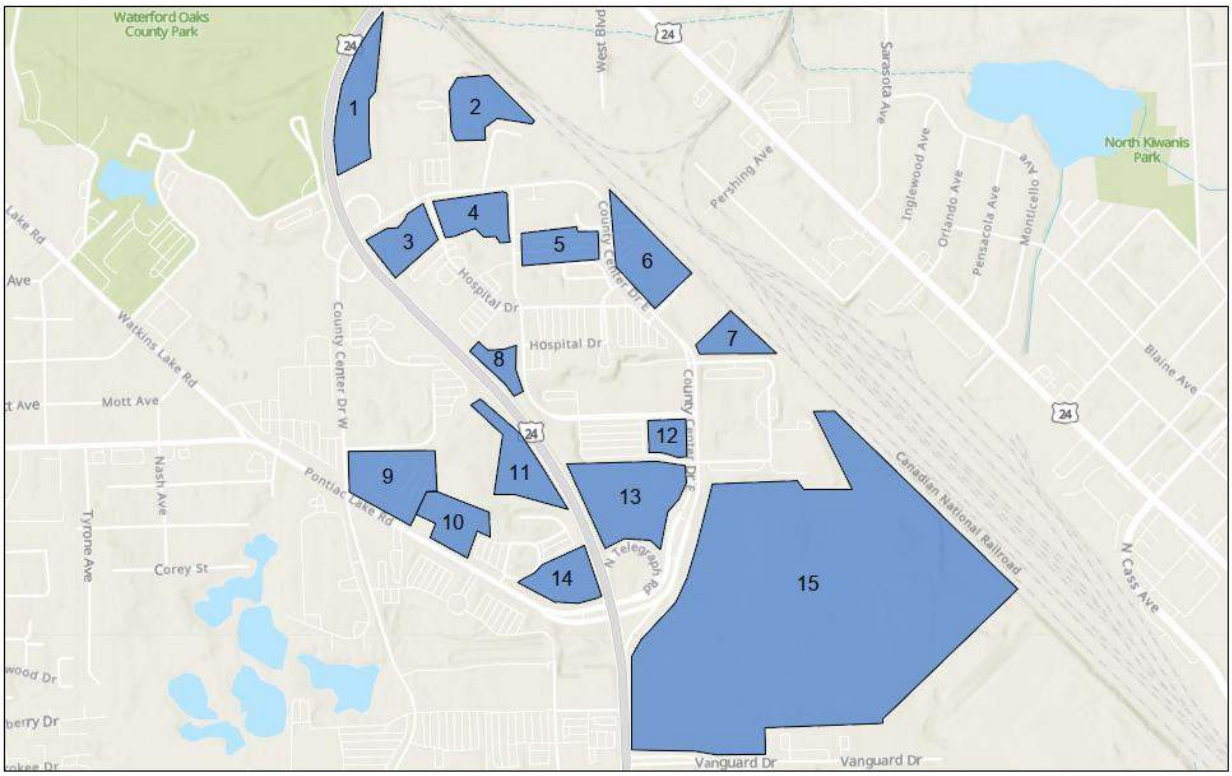


Figure 2: PV installation areas (numbered)

Table 1 presents the results of the HelioScope modeling, detailing the estimated installation capacities and system types for each designated area. The total potential capacity across all feasible locations is approximately 7.1 MW-DC. In developing the conceptual layouts, existing site features such as buildings and mature trees were carefully considered. Shading impacts from these obstacles were accounted for in the modeling process, with design strategies aimed at minimizing associated energy losses. The analysis assumed that no tree removal would occur, and layout adjustments were made accordingly to preserve existing vegetation while maximizing system performance.

Table 1. Potential PV capacity installation at designated areas

Site #	PV Installation Capacity (kW-DC)	System Type	Note
1	1,180	Ground-Mount Tracker	
2	1,020	Ground-Mount Fixed	
3	Infeasible	NA	Not suitable for PV installation
4	Infeasible	NA	Not suitable for PV installation
5	1,680	Parking Canopies	
6	Infeasible	NA	Plans to relocate
7	407	Ground-Mount Tracker	
8	109	Ground-Mount Fixed	
9	Infeasible	NA	Plans to relocate
10	286	Ground-Mount Fixed	
11	880	Ground-Mount Fixed	
12	Not considered	NA	Area covered by large trees
13	1,560	Ground-Mount Fixed	
14	Infeasible	NA	Not suitable for PV installation
15	Infeasible	NA	Plans to develop

Figure 3 through Figure 10 illustrate the proposed PV system layouts for the eight sites identified as feasible for installation. In these layouts, green circles indicate the locations of existing trees. To assess the potential impact of tree shading on system performance, tree heights were estimated using Google Earth elevation data. This information was then incorporated into the HelioScope modeling to simulate shading effects accurately. Based on this analysis, array layouts were strategically adjusted to reduce shading-related generation losses, while maintaining the existing trees to the extent possible.



Figure 3: Site 1 PV Layout

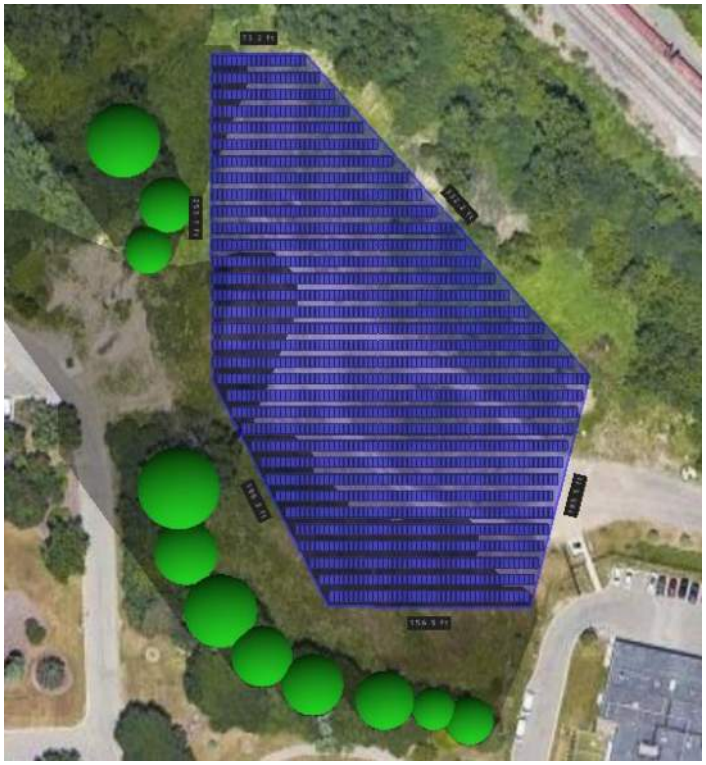


Figure 4: Site 2 PV Layout



Figure 5: Site 5 PV Layout



Figure 6: Site 7 PV Layout



Figure 7: Site 8 PV Layout



Figure 8: Site 10 PV Layout

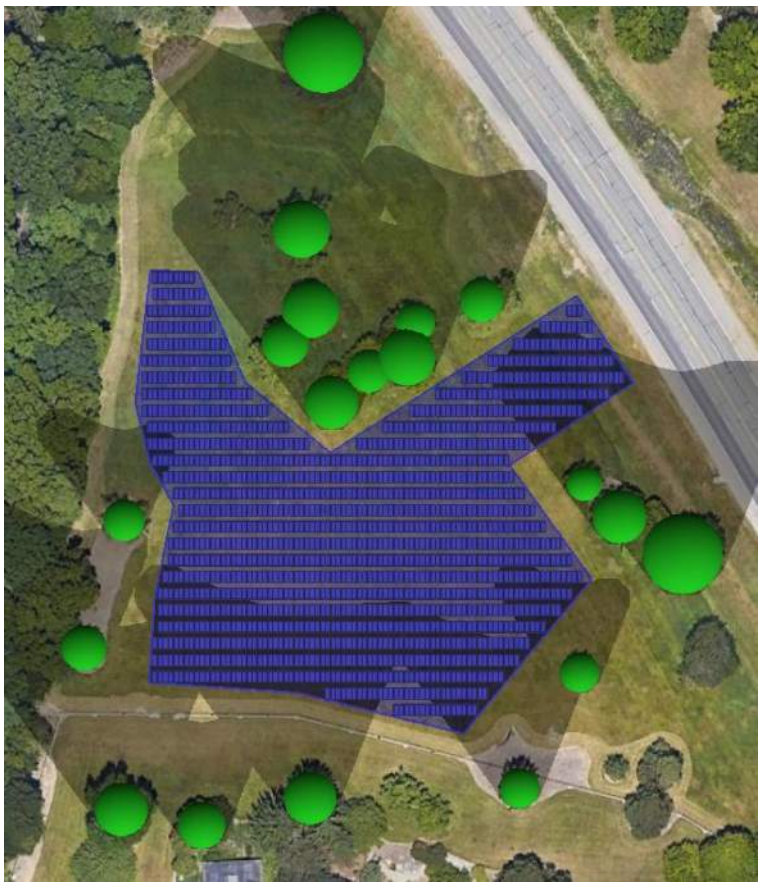


Figure 9: Site 11 PV Layout

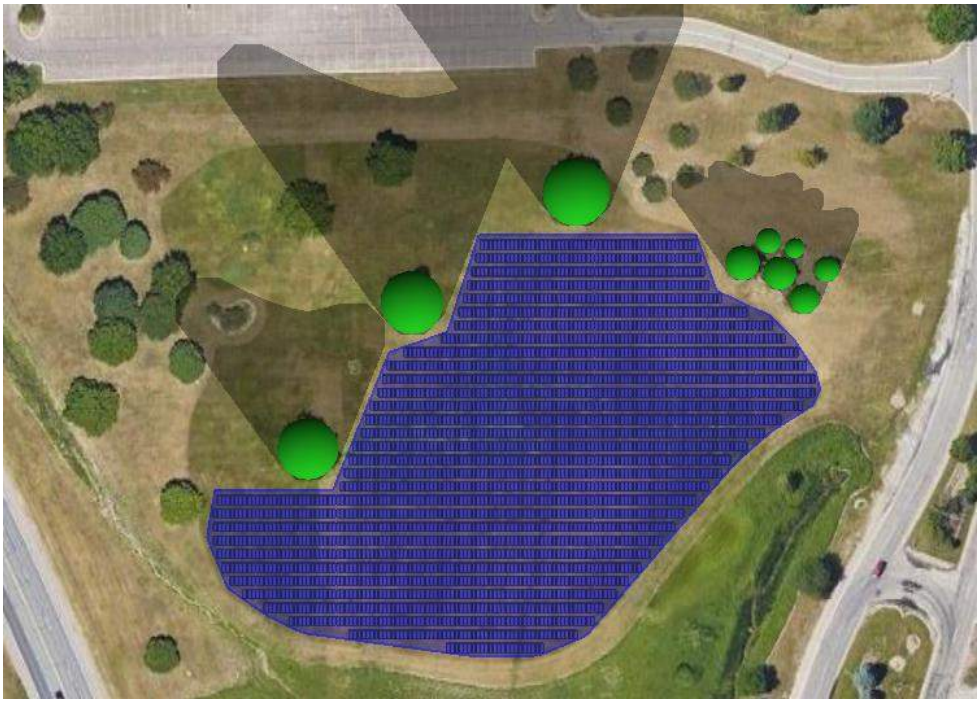


Figure 10: Site 13 PV Layout

Electrical Infrastructure Capacity

A comprehensive site visit was conducted to collect the necessary data for evaluating the existing electrical infrastructure across the campus facilities. During this visit, detailed information was gathered regarding the capacities and configurations of the main switchboards and distribution panels at each building. This data formed the basis for assessing the available electrical capacity to accommodate new solar PV installations without necessitating major upgrades.

Using the collected information, an analysis was performed to quantify the remaining capacity within each building's electrical switchgear that could be utilized to interconnect potential PV systems. The results of this capacity assessment are summarized in Table 2, which outlines the maximum allowable PV capacity that can be safely integrated at each location, considering existing load demands and infrastructure limits.

Table 2. Oakland County buildings available electrical capacity for PV integration

Building	Building Power	Renewable Power (kVA – kW)
95 west – public works bldg	750 kVA, 480/277V, 600A, 3PH	150 kVA - 120 kW
51 west – credit union	167/50 kVA,400A,240/120 1PH	10 kVA – 8 kW
59 west – road commission complex	333/75 kVA, 600A, 240/120, 1PH	15 kVA – 12 kW
83 west – H bldg	150 kVA, 400A, 208/120 V, 3PH	30 kVA – 24 kW
81 west- G bldg	150 kVA, 600 A, 208/120V, 3PH	30 kVA – 24 kW
65 west – A bldg.	300 kVA, 1200A, 208/120 V, 3PH	60 kVA – 48 kW
85 west – kitchen	225 kVA, 400 A, 480/277 V, 3PH	45 kVA – 36 kW
87 west – school	300 kVA, 600 A at 120/208V, 3PH	60 kVA – 48 kW
77west &75 west – D bldg. & cnslng center	150 kVA, 800 A, 120/208 V, 3PH	30 kVA – 24 kW
73 west & 71 west – C & B bldgs	150 kVA,120/208, 600A 3PH	30 kVA – 24 kW

63 west – J bldg.	750 kVA,480/277 V, 1200 A, 3PH	150 kVA – 120 kW
57 west – patrol services bldg.	225 kVA, 4.5kV-208/120V, 600A, 3PH	45 kVA – 26 kW
49 west	1000/1999 kVA,1600A 480/277V, 3PH	200 kVA – 160 kW
47 west – administrative annex I	500 kVA,1600A, 120/208V, 3PH	100 kVA – 80 kW
41 west – executive office bldg..	1000 kVA, 480/277V, 1600A, 3PH	200 kVA – 160 kW
34 east – north Oakland health center	750 kVA, 480/277,1200A, 3PH	150 kVA – 120 kW
32 east – cmha-resource & crisis center	750 kVA, 480/277V, 1600A, 3PH	150 kVA – 120 kW
28 east – medical examiners facility	750 kVA, 480/277V, 2000A, 3PH	150 kVA – 120 kW
22 east – L bldg & central heating plant	300 kVA,120/240V, 1000A, 3PH	60 kVA – 48 kW
20 east – central services	150 kVA, 120/240V, 400A, 1PH	30 kVA – 24 kW
30 east – little oaks	150 kVA, 600A, 208/120V, 3PH	30 kVA – 24 kW
26 east – north office bldg.	500 kVA 480/277V, 800A, 3PH	60 kVA – 48 kW
18 east – administrative annex II	500 kVA, 120/240V, 1600A, 1PH	60 kVA – 48 kW
16 east – central garage	150 kVA,120/240V, 600A, 1PH	30 kVA – 24 kW
38 east – sheriff's administration	750 kVA, 4.8kV-480/277V, 1200A, 3PH	150 kVA – 120 kW
42 east – animal shelter	750 kVA, 1000A, 480/277V, 3PH	150 kVA – 120 kW
24 east – D bldg	300 kVA,240/120V, 1PH, no longer in use	60 kVA – 48 kW*
Materials management	300 kVA or 500 kVA, 480/277V, 400A, 3PH	60 kVA – 48 kW
26 east – medical control center	130 kVA, 1200A, 120/240V	26 kVA – 20.8 kW
10 east – main jail complex	750 kVA,208/120V, 2500A, 3PH	150 kVA – 120 kW
10 east – south addition of the jail	1500AA/2000FA kVA, 2500A, 480Y/277V 3PH	300 kVA – 240 kW
8 east – east annex	750 kVA, 480/277V, 1200A, 3PH	150 kVA – 120 kW
12 east – courthouse east wing	500 kVA, 208/120V, 1600A, 3PH	100 kVA – 80 kW
12 east – courthouse chiller substation	1500 kVA, 480/277V 3PH, 3200A	300 kVA – 240 kW
12 east – courthouse tower section	750 kVA, 208/120V, 3000A	150 kVA – 120 kW
12 east – courthouse west wing	300 kVA, 280Y/120V,1000A	60 kVA – 48 kW
14 east – courthouse west wing extension	1000 kVA 480V ,1200A	200 kVA – 160 kW

* for building 24, a 48 kW-DC system will generate more than twice the annual usage of the building. Therefore, the selected PV size for this building is reduced to 12 kW-AC.

PV System Allocation

Two potential configurations for integrating onsite PV systems into the campus electrical network were considered:

- **Connection at the Main Distribution Panel:**
  In this configuration, all installed PV arrays would be connected behind the campus master meter at the main medium-voltage distribution panel. Because the campus distribution operates at medium voltage, the PV system output would require step-up transformers to match the distribution voltage level. While this centralized connection approach could potentially simplify system management, the need for additional transformers and associated equipment would significantly increase capital costs and project complexity. Due to these substantial cost implications, this configuration was excluded from further detailed evaluation.

- **Connection at the Building Level:**
  The alternative approach involves connecting each PV array installation directly to the electrical infrastructure of one or more buildings within the campus. Allocation of PV capacity to specific buildings is determined based on factors such as the available installed capacity at each PV site, the electrical infrastructure capacity of the nearby buildings, and their physical proximity to the PV arrays. This decentralized connection strategy reduces the need for costly medium-voltage step-up equipment, and allows for a more modular deployment of solar resources across the campus.

The next phase of the analysis involves systematically mapping each potential PV installation site to the specific buildings it can serve within the campus's electrical distribution network. This mapping enables the determination of optimal PV system sizes for each site, ensuring that the solar energy produced can be efficiently consumed by the connected building loads. Such a site-to-building allocation approach facilitates the development of a campus-wide solar deployment strategy that effectively balances the electrical infrastructure's capacity constraints with the renewable energy generation potential.

The figure below illustrates the locations of campus buildings (building numbers are shown in black font), annotated with their respective electrical capacity values (displayed in red font), and their organization into groups labeled A through G. Adjacent to these, the proposed PV systems are indicated by yellow boxes. Each PV system is assigned to one or more building groups based on proximity and available capacity. Within the red-bordered areas, the aggregate available electrical capacity for each building group is specified. Since the electrical capacity of the buildings is a key limiting factor, the sizes of the PV arrays were adjusted accordingly, with the final installed capacities shown in yellow font. This ensures that the designed PV systems align with the buildings' ability to safely and effectively integrate the generated power.

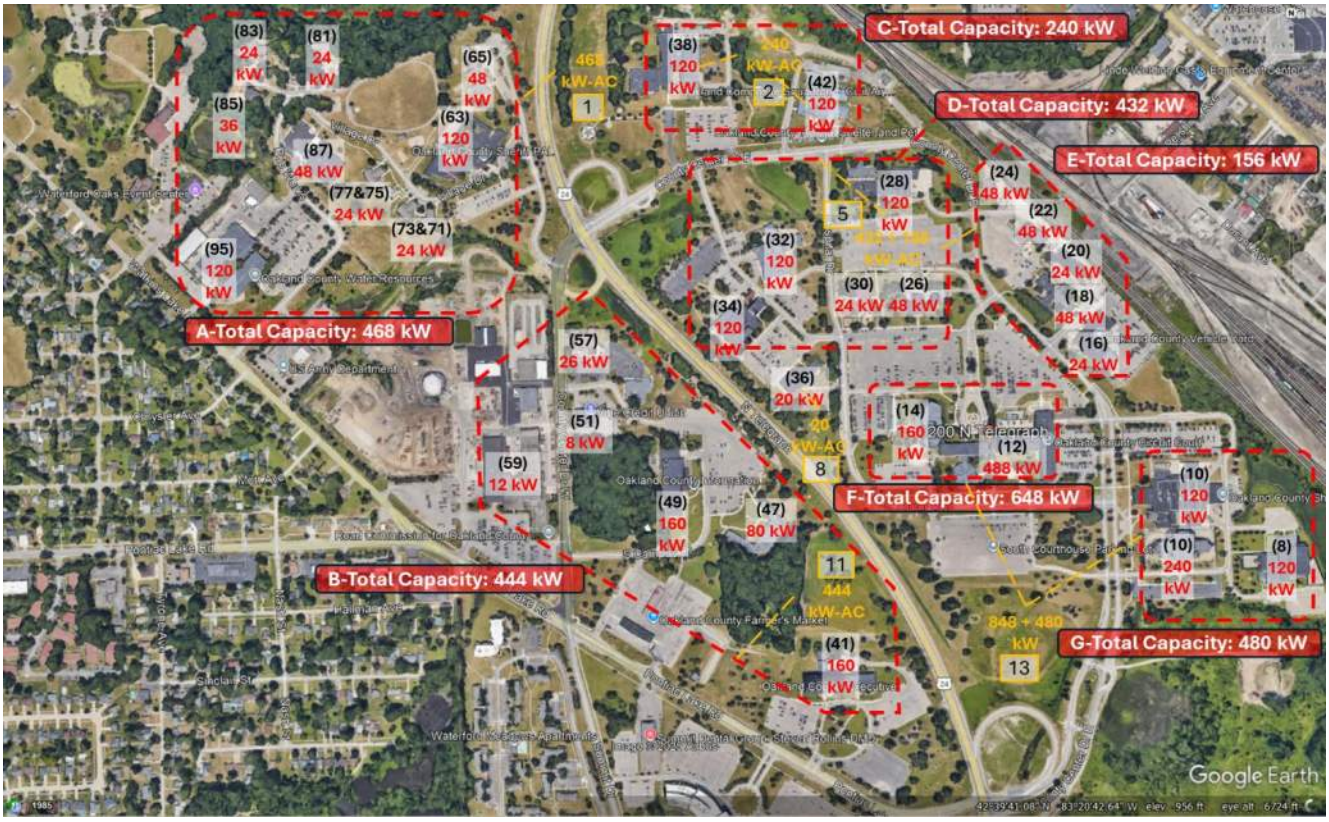


Figure 11: Solar PV systems allocation

Table 3 summarizes the adjusted capacities of the PV systems after accounting for the electrical capacity constraints, annual electricity consumption, and the specific building groups each array will serve. Due to the limitations imposed by the available electrical infrastructure at the building level, the total installed capacity is reduced to approximately 2.9 MW-AC. Despite this reduction, the combined annual energy generation from the optimized PV arrays is estimated to be approximately 4,300 MWh per year, reflecting a substantial contribution toward the campus's energy needs.

Table 3. Adjusted PV capacities based on buildings electrical capacity

PV Site #	Adjusted PV Installation Capacity (kW-AC)	System Type	Annual Generation (MWh/yr)
1	468	Ground-Mount Tracker	623
2	240	Ground-Mount Fixed	361
5	588	Parking Canopies	916
7	0	Ground-Mount Tracker	0
8	20	Ground-Mount Fixed	29
10	0	Ground-Mount Fixed	0
11	446	Ground-Mount Fixed	672
13	1,128	Ground-Mount Fixed	1,701
Total	**2,890**		**4,305**

Net Energy Metering

Net Energy Metering (NEM) policies represent a critical factor influencing the financial viability and potential cost savings of on-site solar PV installations. These policies govern how excess electricity generated by the PV system can be credited or compensated when exported back to the utility grid. Limitations or restrictions within the NEM framework—such as caps on export capacity, billing structures, or compensation rates—can significantly affect the overall economics of the solar project and the magnitude of utility bill reductions achievable. Understanding the specific NEM requirements applicable to the campus is therefore essential to accurately estimate the economic benefits and optimize system design.

DTE Energy no longer offers traditional NEM for new solar customers. Instead, commercial solar PV systems fall under DTE's Rider 18 Distributed Generation Program, which uses an Inflow–Outflow billing mechanism.[1]

- **Eligibility:** Commercial systems up to 150 kW are eligible. Larger systems may fall under different provisions.
    - Too large of system for Distributed Generation Rider 18 program. Would require a custom interconnection agreement and likely would fall under Category 4 Interconnection procedures.
    - Not eligible for Rider 18's inflow/outflow credit structure. Compensation is typically arranged via PPA or wholesale market rates.
- **Inflow Charges:** You pay the full retail rate for all electricity you draw from the grid.
- **Outflow Credits:** You receive a credit for excess electricity sent back to the grid, but only for the power supply portion of the retail rate—not the full retail rate as under the old NEM program.
- **Smart Meter:** A bidirectional smart meter is required to measure both inflow and outflow separately.
- **Credit Banking:** Excess outflow credits can roll over month to month and are stored in an "excess generation bank," but they cannot offset certain fixed charges like securitization.
- **Application Process:** Includes submitting an interconnection application, paying a fee (typically $50 for systems under 150 kW), and signing an interconnection agreement.

Based on the PV capacities established through the electrical system analysis, the combined annual energy generation from all solar installations is estimated to be approximately 4,300 MWh per year. In comparison, the total annual electricity consumption of the buildings listed in the table is approximately 24,000 MWh per year. This indicates that the solar generation could offset roughly 18% of the campus's total electricity demand, excluding any impacts from future energy efficiency improvements or electrification initiatives.

Due to the lack of detailed hourly load profiles, it is conservatively assumed that no excess power will be exported to the utility grid, and that all generated solar energy will be consumed onsite. It is important to note that most buildings on the

[1] https://aurorasolar.com/blog/what-to-know-about-dtes-net-metering-replacement-in-michigan/ https://solutions.dteenergy.com/dte/en/Services/CleanVision-Service/Rooftop-Solar-and-Private-Generation/p/ROOFTOP_SOLAR#about

campus are served behind a single master meter, which increases the likelihood that any surplus generation from one building or facility can be utilized by other buildings within the campus's internal distribution network. This internal load sharing effectively minimizes the potential for exported energy and maximizes self-consumption within the campus.

Interconnection Requirements

Integrating on-site renewable energy systems with the utility grid requires a structured review process to ensure safety and reliability. Projects are categorized by size and complexity, with different application fees and review tracks, from Fast Track to full Study Track, based on technical evaluations of grid impact. Compliance with equipment standards and protective measures is essential, and detailed studies may be necessary for larger systems. The following summarizes the key interconnection requirements relevant to the campus PV installations.

- Category 2 – Commercial; 20 kW-150 kW AC; may require Supplemental Review depending on grid conditions; more detailed engineering review and possibly telemetry or advanced protection schemes; application fee = $50
- Category 3 – Commercial; 150 kW-550 kW AC; application fee = $150
- Category 4 – Commercial; 550 kW-2 MW AC; application fee = $250
- Category 5 – Commercial; over 2 MW AC; application fee = $500

Track assignment—Fast Track, Supplemental Review, or Study Track—is determined by a series of technical screens that evaluate your system's potential impact on DTE's grid. **Initial Review:** DTE runs a set of predefined screens (e.g., system size vs. feeder capacity, voltage limits, protection coordination). If your system passes all screens, it qualifies for Fast Track—a quicker, less intensive review. **Supplemental Review:** If one or more Fast Track screens fail, DTE may offer a Supplemental Review. This involves deeper analysis to determine if the system can still interconnect safely without a full study. If risks are manageable (e.g., minor voltage rise, no reverse power flow issues), the project may still proceed without a full study. **Study Track:** If the system fails Supplemental Review or is too large/complex, it enters the Study Track. This includes a system impact study (evaluates how the system affects grid reliability) and a facilities study (identifies any upgrades needed and their costs).[2]

Key factors that influence track assessment:

- Exporting systems are more likely to require studies.
- If the system exceeds local capacity, it triggers further review.
- Sub-transmission or networked areas often require more scrutiny.
- Non-certified inverters or relays may push the project into Study Track.

Application Process: You must submit a detailed application through DTE's interconnection portal, including engineering specs, site plans, and equipment certifications.

Studies: DTE may require a feasibility study, system impact study, and facilities study to assess grid compatibility and any necessary upgrades.

Standards: Equipment must comply with IEEE 1547.1-2020 and UL 1741 (2021 edition) standards for advanced inverter functions.

Communication & Control: DTE may require real-time telemetry, SCADA integration, and cybersecurity protocols for systems over 1 MW.

Metering: A bi-directional revenue-grade meter is required, and DTE may also require a separate generation meter.

Protective Relays: Must include anti-islanding protection and may require a transfer trip scheme.

Testing & Commissioning: You'll need to perform operational testing and submit commissioning reports. DTE may inspect the site before granting permission to operate.

[2] https://www.dteenergy.com/content/dam/dteenergy/deg/website/hybris/rooftop-solar/InterconnectionAgreementLevel123.pdf

Solar Incentives

Various federal, state, and local incentive programs are designed to encourage the adoption of solar energy by reducing upfront costs and improving project economics. These incentives include tax credits, accelerated depreciation, production-based credits, and financing programs that can significantly impact the financial viability of solar installations. Understanding the current incentive landscape is essential when evaluating the economic feasibility of PV projects.

Federal Incentives

- **Investment Tax Credit (ITC)** – covers 30% of eligible system costs through 2032. Applies to commercial systems that are purchased or financed (not leased).
    - "One Big Beautiful Bill" proposes phasing down the commercial ITC starting in 2026: 60% of the credit in 2026, 20% in 2027, and 0% after 2027.[3]

- **Modified Accelerated Cost Recovery System (MACRS)** – According to the IRS Publication 946 (2024) and IRS clean energy cost recovery guidance, solar PV systems placed in service after Dec 31, 2024, still quality as 5-year property under MACRS (qualitied solar facilities per IRC 45Y, qualified energy property per IRC 48E, energy storage technologies)
    - "One Big Beautiful Bill" proposes disqualifying clean energy projects from MACRS in future years, but as of now, MACRS is still fully in effect for 2025 installations.[4]

- **Production Tax Credit (PTC)** – If not pursuing ITC, offers up to $0.0275 per kWh (base credit of $0.005 per kWh) for the first 10 years of generation if wage and apprenticeship rules are met through 2032
    - "One Big Beautiful Bill" could phase down or eliminate the PTC for projects starting construction after 2026, depending on the final version of the legislation

State & Local Incentives

- **Michigan Property Tax Exemption** – Solar systems are exempt from increased property tax assessments
- **Renewable Energy Renaissance Zones (RERZ)** – Provide up to 15 years of tax exemptions (property, income, and business taxes) for qualifying solar projects in designated zones
- **Michigan Saves Commercial Energy Loan Programs** – Offers low-interest loans for energy efficiency and renewable energy projects, including solar

  Lean & Green Michigan (C-PACE Financing) – Enables long-term financing (up to 25 years) for solar and energy upgrades, repaid via property tax assessments

Since many solar incentives are set to phase out or change in the coming years, no incentives were assumed in the initial economic feasibility calculations to maintain a conservative baseline. To provide a comprehensive analysis, however, sensitivity scenarios incorporating the current 30% federal Investment Tax Credit (ITC) were included. Payback periods for each project were calculated both with and without the ITC to demonstrate the potential influence of available incentives on project financials.

Capital Cost

Estimating capital costs is a critical step in evaluating the feasibility of solar PV installations. Accurate cost assumptions help determine the economic viability of each system configuration and allow for meaningful comparison across different installation types. At this stage, rough order-of-magnitude (ROM) cost estimates are developed to guide decision-making and identify potential financial constraints or trade-offs.

The following capital cost benchmarks were used for the various PV systems:

- Ground-Mount Tracker: $3,750/kW-DC[5]

[3] https://electrek.co/2025/06/17/home-solar-battery-incentive-over-180-days-after-trump-signs-latest-senate-bill/

[4] https://www.irs.gov/credits-deductions/cost-recovery-for-qualified-clean-energy-facilities-property-and-technology

[4] https://www.irs.gov/publications/p946

[5] https://www.solarreviews.com/blog/are-solar-axis-trackers-worth-the-additional-investment#:~:text=How%20much%20does%20a%20solar,you%20save%20by%20going%20solar?

- Ground-Mount Fixed: $2,500/kW-DC[6]
- Parking Canopies: $4,500/kW-DC[6]
- Rooftop- Fixed: $2,000/kW-DC[7]

An annual operation and maintenance (O&M) cost of $17/kW-DC was assumed for all system types. It should be noted that tracking systems typically incur higher O&M expenses due to the presence of moving components.

Given that many buildings are located at a considerable distance from their associated PV arrays, interconnection costs can be substantial. To account for this, distances between each building and its assigned array were measured, and an interconnection cost of $50 per linear foot was applied. This rate includes trenching, backfill, conduit installation, conductor material, and street crossing requirements. It should be noted that the cost estimates presented here are preliminary and intended for high-level planning only. A detailed engineering assessment will be required to refine installation and interconnection costs.

While rooftop PV installations were not prioritized by the Oakland County team, they were still evaluated due to their lower installation and interconnection costs compared to ground-mounted and canopy systems. The economic feasibility of rooftop PVs, alongside other system types, is presented in the following sections.

Utility Cost Saving

To estimate the potential utility cost savings from the proposed solar PV installations, a blended rate approach was used due to the absence of hourly electrical load profiles, which would otherwise allow for separate analysis of energy and demand charge reductions.

Annual electricity consumption data was collected for each building from 2022 to 2024, along with total electricity cost records over the same period. A blended electricity rate was calculated for each building by dividing the total electricity cost by total consumption, capturing all charges, including energy charges, demand charges, and other fees.

The average blended rate across all buildings was determined to be approximately $0.084 per kWh. This rate was then applied to the projected annual generation of the PV systems assigned to each building or facility to estimate the annual utility cost savings. These results are presented in the next section.

Economic Feasibility Assessment

To evaluate the financial viability of integrating solar PV systems at the Oakland County campus, both capital costs, including system installation and interconnection expenses, and ongoing O&M costs were considered. These were compared with the projected utility cost savings to determine the net annual savings for each system. The total capital cost of the project is estimated to be around $12.3 million.

Table 4 summarizes the results, including the simple payback period for each system, calculated with and without the 30% ITC. Even with the ITC applied, the analysis shows that the high capital costs, especially for parking canopies and long interconnection distances, combined with relatively low electricity rates (~$0.084/kWh), result in payback periods that exceed the typical useful life of PV systems (25–30 years). In a few cases, by considering the ITC incentives, payback periods drop to around 20 years but still fall short of making the projects economically attractive under current conditions.

Table 4. Results of the economic feasibility assessment

Building	PV Capacity (kW-AC)	PV System CapEx ($)	Interconnection Cost ($)	O&M Cost ($/yr)	Net Saving ($/yr)	Payback time w/o incentives (yrs)	Payback time w/ incentives (yrs)
95 west- public works building	120	$540,000	$100,000	$2,040	$11,204	57	40
83 west – H bldg	24	$108,000	$90,000	$408	$2,716	73	51

[6] From previous projects
[7] https://www.nrel.gov/solar/market-research-analysis/solar-installed-system-cost

81 west- G bldg	24	$108,000	$75,000	$408	$2,164	85	59
65 west – A bldg.	48	$216,000	$20,000	$816	$4,384	54	38
85 west- KITCHEN	36	$162,000	$85,000	$612	$3,337	74	52
87 west- SCHOOL	48	$216,000	$75,000	$816	$4,406	66	46
77west &75 west- - D bldg. & CNSLNG CENTER	24	$108,000	$47,500	$408	$2,214	70	49
73 west & 71 west – C & B bldgs	24	$108,000	$55,000	$408	$2,266	72	50
63 west – J bldg.	120	$540,000	$15,000	$2,040	$11,126	50	35
51 west- credit union	8	$24,000	$85,000	$136	$860	127	89
59 west- road commission complex	12	$36,000	$110,000	$204	$1,558	94	66
57 west – patrol services bldg.	26	$78,000	$85,000	$442	$2,803	58	41
49 west	160	$480,000	$65,000	$2,720	$17,222	32	22
47 west – administrative annex I	80	$240,000	$22,500	$1,360	$8,677	30	21
41 west – executive office bldg..	160	$480,000	$10,000	$2,720	$17,421	28	20
38 east - sheriff's administration building	120	$360,000	$12,500	$2,040	$12,876	29	20
42 east – animal shelter	120	$360,000	$5,000	$2,040	$13,084	28	20
34 east – north Oakland health center	120	$648,000	$32,500	$2,040	$13,413	51	36
32 east- cmha- resource & crisis center	120	$648,000	$12,500	$2,040	$13,527	49	34
28 east – medical examiners facility	120	$648,000	$7,500	$2,040	$13,509	49	34
30 east – little oaks	24	$129,600	$7,500	$408	$2,733	50	35
26 east – north office bldg.	48	$259,200	$12,500	$816	$5,400	50	35
22 east – L bldg. & central heating plant	48	$259,200	$32,500	$816	$5,231	56	39
20 east – central services	24	$129,600	$32,500	$408	$3,058	53	37
18 east – administrative annex II	48	$259,200	$25,000	$816	$5,373	53	37

16 east – central Garage	24	$129,600	$47,500	$408	$2,643	67	47
24 east – D building	12	$64,800	$20,000	$204	$1,343	63	44
12 east – courthouse east wing	80	$240,000	$45,000	$1,360	$52,606	31	22
12 east – courthouse chiller substation	240	$720,000	$45,000	$4,080			
12 east – courthouse tower section	120	$360,000	$45,000	$2,040			
12 east – courthouse west wing	48	$144,000	$45,000	$816			
10 east – main jail complex	120	$360,000	$42,500	$2,040	$38,808	30	21
10 east – south addition of the jail	240	$720,000	$35,000	$4,080			
8 east – east annex	120	$360,000	$50,000	$2,040	$12,960	32	22
26 east – medical control center	20	$60,000	$15,000	$340	$2,085	36	25
14 east – courthouse west wing extension	160	$480,000	$50,000	$2,720	Unknown	NA	NA
Total	**2,890**		**$12,343,200**				

To reduce overall system costs and eliminate interconnection expenses, rooftop PV installations were explored as an alternative. Assuming similar electricity generation potentials, similar utility savings are expected. However, the total capital cost could be lowered by over 40%, from approximately $12.3 million to around $7 million. This reduction significantly improves the financial outlook, bringing the overall project payback period down from 42 years to 24 years. With the application of the 30% ITC, the payback period could be further shortened to roughly 17 years. Results are presented in Table 5.

Table 5. Economic performance of different PV types

Building	PV Capacity (kW-AC)	Total CapEx ($)	Net Savings ($/yr)	Payback time w/o incentives (yrs)	Payback time w/ incentives (yrs)
Ground-Mounts	2,890	$12,343,200	$291,000	42	30
All Rooftop	2,890	$6,936,000	$291,000	24	17

To improve the accuracy of the financial analysis, it is important to factor in both utility rate escalation and PV system degradation over time. Assuming utility rates increase by 2% annually and PV system output declines by 0.5% per year, the payback period for the investment improves significantly. As shown in the table below, under these assumptions, the payback period decreases from 24 years to 17 years without the ITC, and to approximately 12 years with the 30% ITC applied.

Table 6. Economic performance of different PV types over the life of the system (25 years)

Building	PV Capacity (kW-AC)	Total CapEx ($)	Net Savings ($/yr)	Payback time w/o incentives (yrs)	Payback time w/ incentives (yrs)
Ground-Mounts	2,890	$12,343,200	$412,482	30	21
All Rooftop	2,890	$6,936,000	$412,482	17	12

GHG Emission Saving

The implementation of approximately 2.9 MW-AC of solar PV across the Oakland County campus is expected to generate around 4,300 MWh of clean electricity annually. Using the Michigan grid emission factor stated below, this generation would offset approximately 1,896 metric tons of CO_2e per year. This represents a reduction of roughly 18% of the campus's total annual electricity consumption from the grid, and therefore can be expected to avoid approximately 18% of the campus's current GHG emissions associated with electricity use. This level of reduction marks a significant step toward meeting decarbonization goals and reducing the environmental impact of campus operations.

As illustrated in Figure 12, the electricity generation mix in Michigan is still heavily reliant on fossil fuels, with natural gas and coal making up nearly 75% of the grid supply. Moreover, the grid emissions intensity in Michigan is significantly higher than the national average, which amplifies the environmental impact of every kilowatt-hour drawn from the grid.

Given these conditions, investing in renewable energy generation, whether on-site or off-site, is a critical strategy for reducing Scope 2 emissions and meeting sustainability goals. On-site solar PV not only reduces emissions but also enhances energy independence and resilience, making it an essential step toward decarbonizing the County's operations.

- RFC Michigan (RFCM) subregion = 970.6 lbs/MWh = 0.00044042 $mtCO_2e/kWh$[8]
- National average = 767.2 lbs/MWh
- Oakland County has a 26.5% higher emissions rate than the national average.

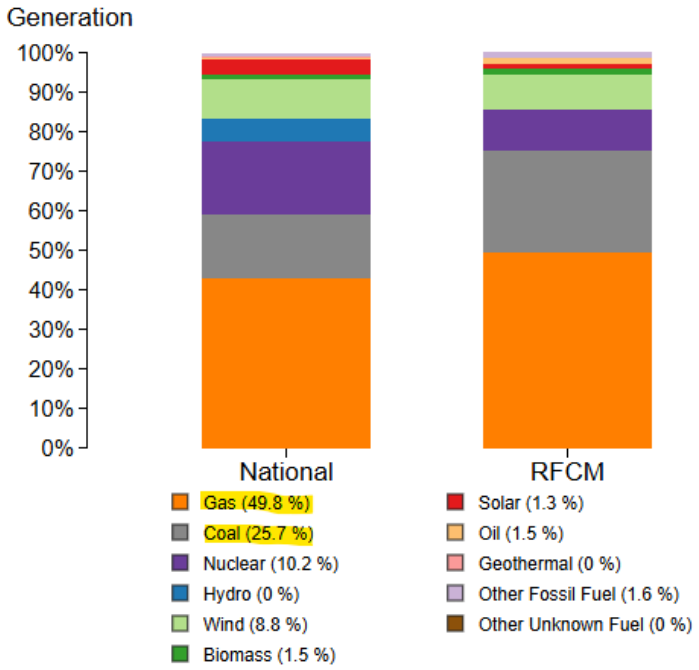


Figure 12- National and RFCM power generation source breakdown

[8] https://www.epa.gov/egrid/power-profiler#/RFCM

Key Findings

The following are some of the key findings from the analysis conducted for the Oakland County campus renewable energy opportunities:

- Due to electrical and building-level constraints, only about 2.9 MW-AC of solar PV can be installed across the Oakland County campus, despite having sufficient physical space for larger systems.
- The proposed PV systems are expected to generate approximately 4,300 MWh/year, offsetting around 18% of the campus's total electricity consumption, which represents a meaningful contribution to reducing grid dependence.
- Given the low average electricity rate (~$0.084/kWh) and high capital and interconnection costs, most PV system configurations are not economically viable under current conditions. Even with a 30% ITC, the payback periods generally exceed the expected system lifespan.
- Exploring rooftop PVs, which eliminate interconnection costs and have lower installation expenses, significantly improves project economics, reducing payback from 42 to 24 years, and as low as 12 years when factoring in utility rate escalation and PV degradation over time.
- The implementation of PV systems is estimated to reduce Scope 2 GHG emissions by approximately 1,896 metric tons CO_2e annually, equivalent to about 18% of the campus's current emissions. Given that 75% of Michigan's grid mix comes from fossil fuels—substantially higher than the national average—onsite renewable generation plays a critical role in advancing the County's decarbonization goals.

Next Steps

To advance the renewable energy efforts at the Oakland County campus, the following next steps are recommended:

- Identify and prioritize feasible PV system scenarios based on the findings of this analysis.
- Review and refine input assumptions, including load profiles, utility rates, and interconnection costs, to enhance model accuracy.
- Conduct a more detailed life cycle cost analysis incorporating sensitivity assessments to thoroughly evaluate financial feasibility under various conditions.
- Develop a phased implementation plan outlining project milestones, timelines, and resource requirements to support decision-making and deployment.

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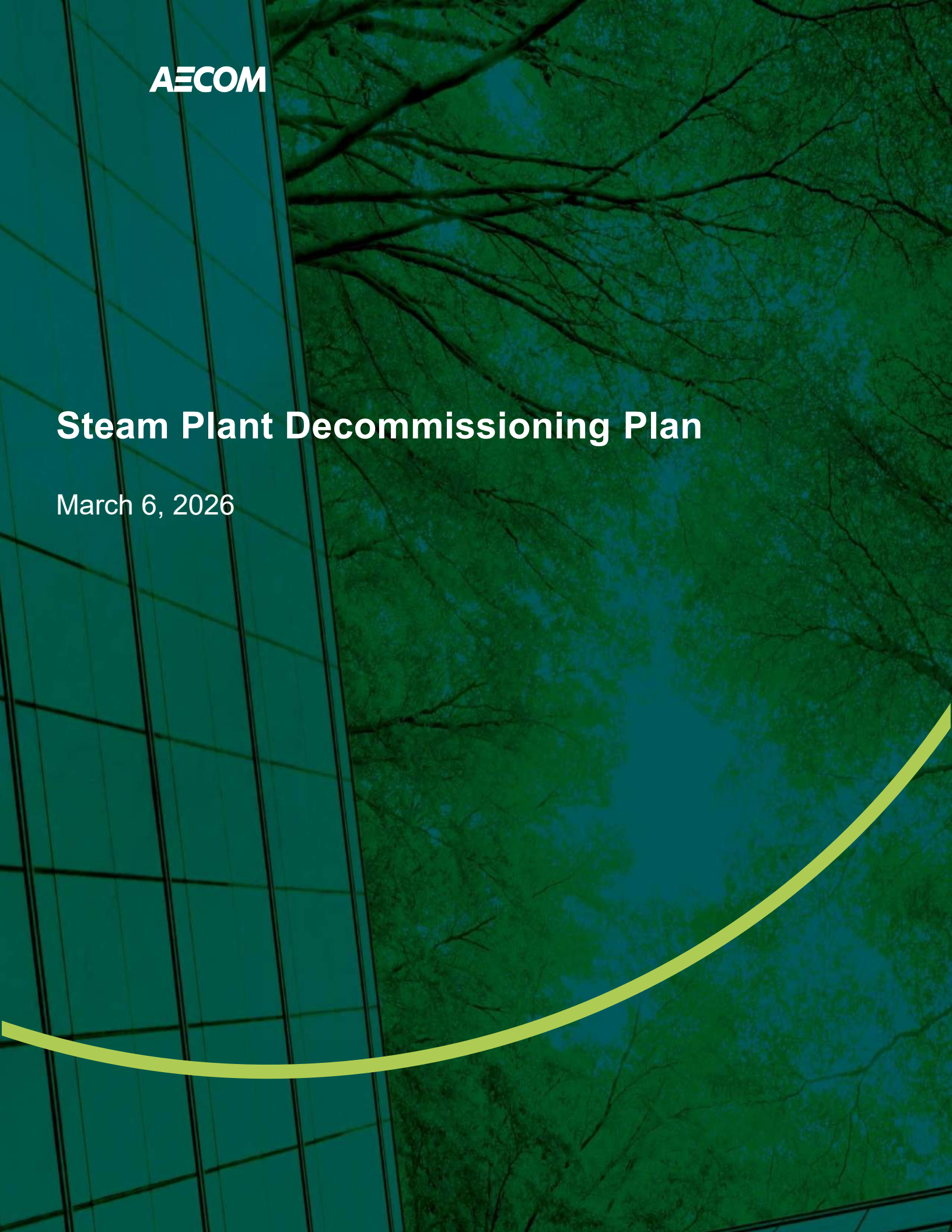

Steam Plant Decommissioning Plan

March 6, 2026

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1. Introduction

The Steam Plant Decommissioning Plan (“the Plan”) was developed to outline a strategy for phasing out Oakland County’s (“the County”) central steam plant and transitioning facilities to alternative heating sources. This Plan builds upon the findings of the Immediate Future Needs Memo, which identified low- and no-cost measures that should be implemented in the near term regardless of the County’s ultimate decarbonization pathway, and the Energy Audit Reports that specified recommended Energy Conservation Measures (ECMs). In contrast, this document is focused on medium- and long-term decisions regarding the steam system itself. The recommendations presented here are designed to align with broader campus planning efforts while recognizing that certain actions such as reducing steam waste, repairing malfunctioning equipment, and right-sizing heating loads are prerequisites for any future electrification or HVAC upgrades.

AECOM recommends that Oakland County pursue the phased strategy outlined in this Plan, which will enable the County to meet near-term operational needs while positioning facilities for a full transition away from steam as part of its long-term decarbonization strategy. This Plan will be used to inform the framework for the steam plant-connected buildings in the Electrification Plan. The Electrification Plan will provide more detail on the timing and specific decarbonization strategies for each building, as well as address non-steam plant buildings.

2. Executive Summary

Oakland County currently operates a central steam plant that provides energy for heating and domestic hot water to a network of County-owned facilities. The system is fueled by natural gas, and relies on an aging underground distribution system that requires frequent maintenance and repair. Based on manual operator logs of make-up water requirements, AECOM estimates that at least 15% of the steam energy is lost through leaks and condensate losses in the distribution system. The central plant’s boilers are approaching the end of their useful life, and the County is faced with a critical decision: whether to reinvest in the existing infrastructure or to pursue a phased transition toward decentralized, electrified systems, or adopt a hybrid approach that blends elements of both.

This Plan presents a comprehensive strategy for decommissioning the central steam plant. It begins with an overview of current steam plant performance, followed by a building-level summary of steam loads, a description of the methodology used to calculate demand, and a step-by-step approach to phasing out steam. The phasing strategy is based upon the minimum load in which the steam plant can continue operations, building load size, and proximity to the plant. The recommended approach is to begin with efficiency measures and the disconnection of low-load, peripheral buildings, followed by the conversion of medium-load facilities, and concluding with the transition of anchor buildings that represent the majority of steam demand. Once these anchor buildings are converted, the central plant can be fully decommissioned. Using this approach the plant will be able to meet minimum loads and maintain optimal levels of efficiency in existing operations

This phased plan provides Oakland County with a clear, actionable pathway to eliminate its reliance on steam by 2036 while maintaining reliability, minimizing costs, and advancing the County’s goals of reducing county operation greenhouse gas emissions by 50% by 2035 and reaching net-zero by 2050.

3. Methodology

AECOM developed a high-level methodology to evaluate Oakland County's central steam system and outline a phased decommissioning strategy. The approach was designed to provide the County with a clear understanding of overall demand patterns, building-level reliance on steam, and the relative timing of opportunities for transition. It combined quantitative analysis of available steam production data with building-level demand modeling and scenario testing to assess future pathways.

3.1 Data Collection and Verification

This analysis was based on a full year of operational data collected from the County's central boilers. Each boiler is equipped with two types of meters: fuel gas meters, which measure the amount of natural gas consumed, and steam flow meters, which record the amount of steam produced. These readings were taken across three standard operating periods each day: first shift (06:30–14:30), second shift (14:30–22:30), and third shift (22:30–06:30). This approach provided insight into both daily peaks and minimums and intra-day variation in steam demand.

AECOM carefully reviewed the raw data to confirm its accuracy. Some readings showed clear errors—such as unusually high values or fuel readings entered into steam fields. To avoid skewed results, these outliers were removed using conservative limits that preserved true high-load days. This process produced a clean dataset that reflects actual operating conditions and forms the foundation for the following analysis.

AECOM also reviewed the steam line configuration and steam tunnel condition provided by the County, shown in **Figure 1**. Some of the periphery tunnels were in the best condition, with the worst condition tunnels being those between Little Oaks and the North Oakland Health Center, and between the Courthouse and the Information Technology (IT) Building. These findings highlight opportunities to consider selective maintenance or reuse of existing tunnels as part of future system planning. For example, the corridor between Law Enforcement and the Courthouse may be suitable for reuse in the Electrification Plan, and the fair-condition tunnel on the east side of the Courthouse could potentially be leveraged to avoid routing through the north side, where a section is in critical condition.

Figure 1. Steam Tunnel Condition



3.2 Calculation of Load Profiles

Using the steam dataset, AECOM calculated the peak steam production for each shift and aggregated the results to develop daily, monthly, and seasonal load profiles for 2024. This step helped quantify how steam demand fluctuates across different timescales and identify the range of operating conditions that any future system must accommodate.

Monthly Load Summary

Table 1 summarizes the monthly peak and minimum non-zero loads, as determined from the dataset. These values represent the full operational range of the steam plant throughout calendar year 2024, which was used for this analysis as the most recent full year of available operational data. The values highlight both the periods of highest heating intensity and the lowest sustained demand during off-peak conditions.

Table 1. Monthly Peak and Minimum Loads

Month	Peak Load (lb/hr)	Min Non-Zero Load (lb/hr)
Jan	29,219	15,435
Feb	28,422	8,186
Mar	26,350	8,695
Apr	25,190	8,249
May	19,102	7,836
Jun	16,143	6,735
Jul	17,258	5,498
Aug	14,471	5,494
Sep	16,675	7,274
Oct	21,799	8,249
Nov	23,611	9,524
Dec	28,281	14,054

These monthly figures as shown in **Figure 2** demonstrate the pronounced seasonal variability of the system, with the winter months recording significantly higher peak loads compared to the summer period. Even during lower-demand months, however, the system maintains a continuous base load, reflecting ongoing requirements for domestic hot water and the absorption chiller operation at the Sheriff Administration (Sheriff Admin) Building, which uses the steam system as the heat source.

Shift-Level Trends

AECOM also analyzed the shift-level data to determine when steam is used most throughout the day. The highest demand typically occurred during the morning shift (06:30–14:30), when buildings were reheated from nighttime setback levels and occupancy began. For example, several April and February mornings exceeded 20,000 lb of steam, representing some of the year's highest short-term loads. In contrast, afternoon periods during mild weather often dropped below 8,000 lb, reflecting only the baseline heating and hot water needs. These results show that short-duration spikes during morning warm-up periods, particularly in transitional months, are just as critical to consider as seasonal averages when planning for future replacement systems.

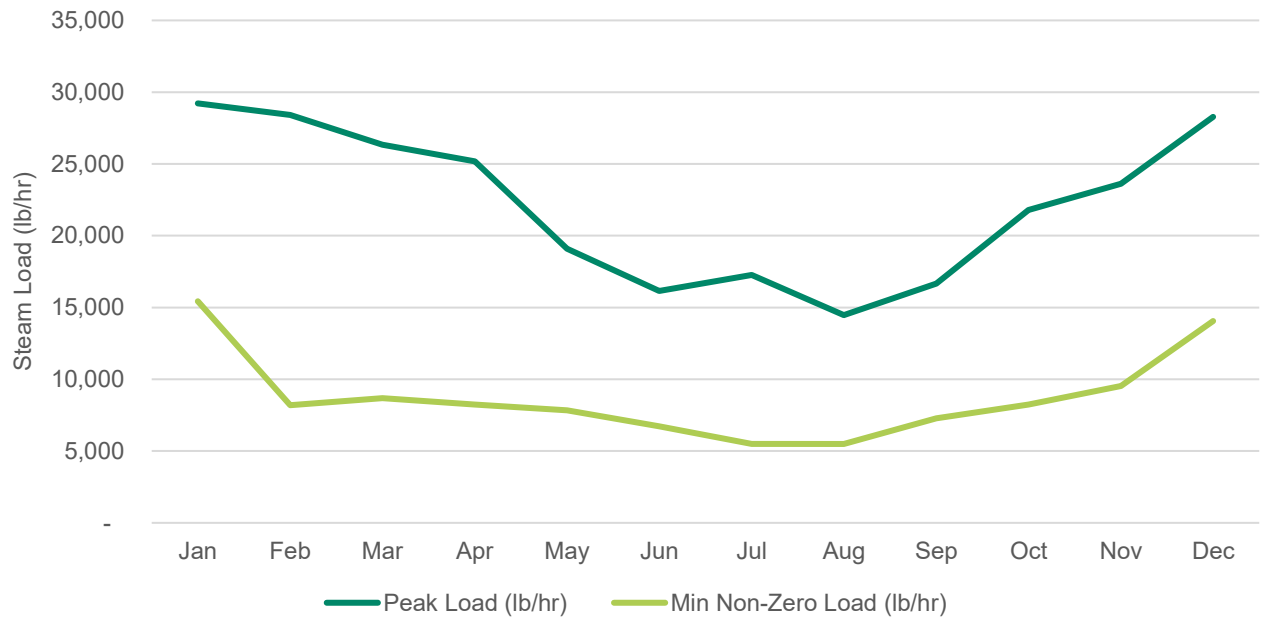

Figure 2. Monthly Steam Load Profile (showing peak and minimum loads across 2024)

Seasonal Load Summary

Table 2 and

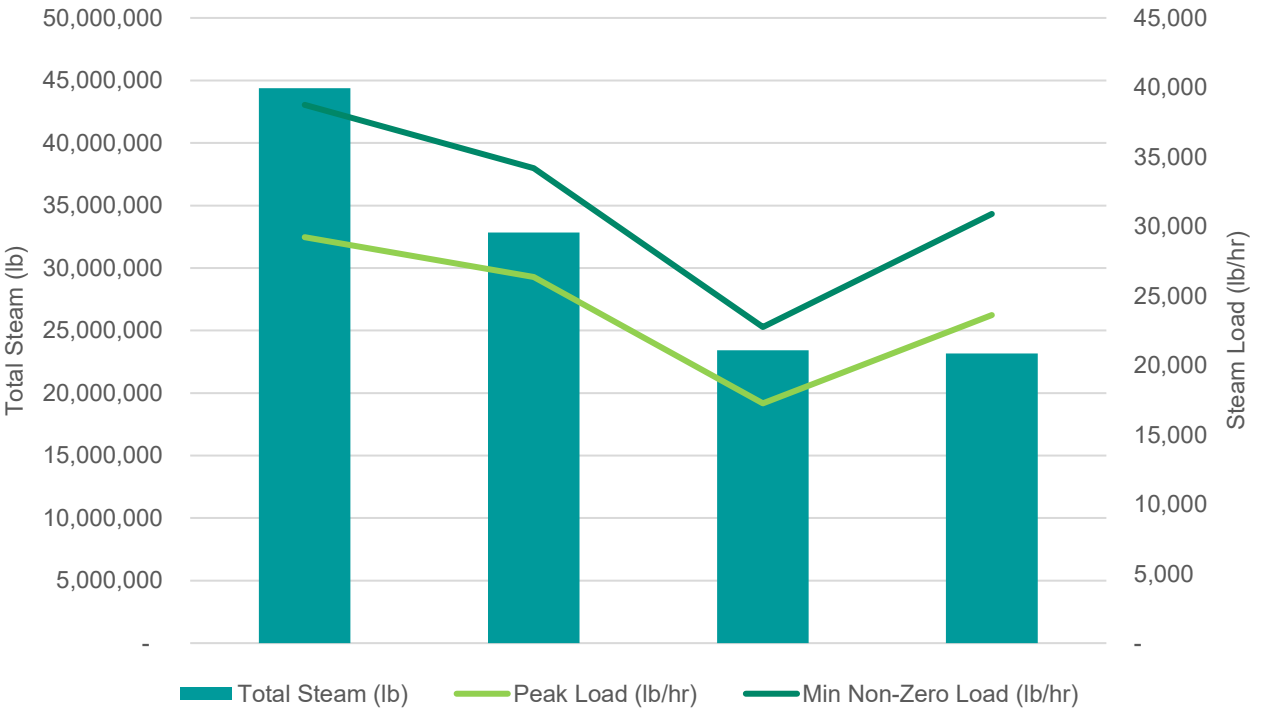

Figure 3 present the broader seasonal trends in total steam production and instantaneous operating capacity.

The seasonal totals reinforce the same pattern seen in the monthly data. During winter (December through February), the plant produced more than 44 million lb of steam, nearly double the 23 million lb generated in summer. Spring and fall act as transitional seasons, when outdoor temperatures fluctuate rapidly and boilers

must cycle to maintain indoor comfort across the course of a day. It should be noted that data for November 1 – 16 was missing from the trended data, which accounts for approximately 17% of the total recorded days, thus the Fall usage is expected to be higher than what is shown in the tables and figures below.

These results define the plant's operating range. The maximum recorded load—**29,219 lb/hr in December—marks the system's peak output**, while the lowest non-zero load—**5,494 lb/hr in July—represents its minimum operating condition**. The steam system must therefore be capable of running efficiently across a wide span of operating loads, from nearly 30,000 lb/hr at peak to below 6,000 lb/hr during the summer base load. In practice, this flexibility is achieved by taking individual boilers offline when demand drops. For example, during summer months the County typically operates only one of the four central boilers, while the others are placed in standby mode. Each boiler is designed to operate efficiently down to roughly **25–30% of its rated capacity**, below which combustion efficiency declines and short-cycling becomes more likely. Maintaining operation above this minimum load either by sequencing boilers on and off or by consolidating demand onto a smaller number of units is essential to sustaining stable pressure, efficient fuel use, and reliable system performance year-round.

Table 2. Seasonal Total, Peak, and Minimum Loads

Season	Total Steam (klb)	Peak Load (lb/hr)	Min Non-Zero Load (lb/hr)	Peak Month
Winter (Dec – Feb)	44,370	29,219	8,186	December
Spring (Mar – May)	32,838	26,350	7,836	March
Summer (Jun – Aug)	23,413	17,258	5,494	July
Fall (Sept – Nov)	23,165	23,611	7,274	October

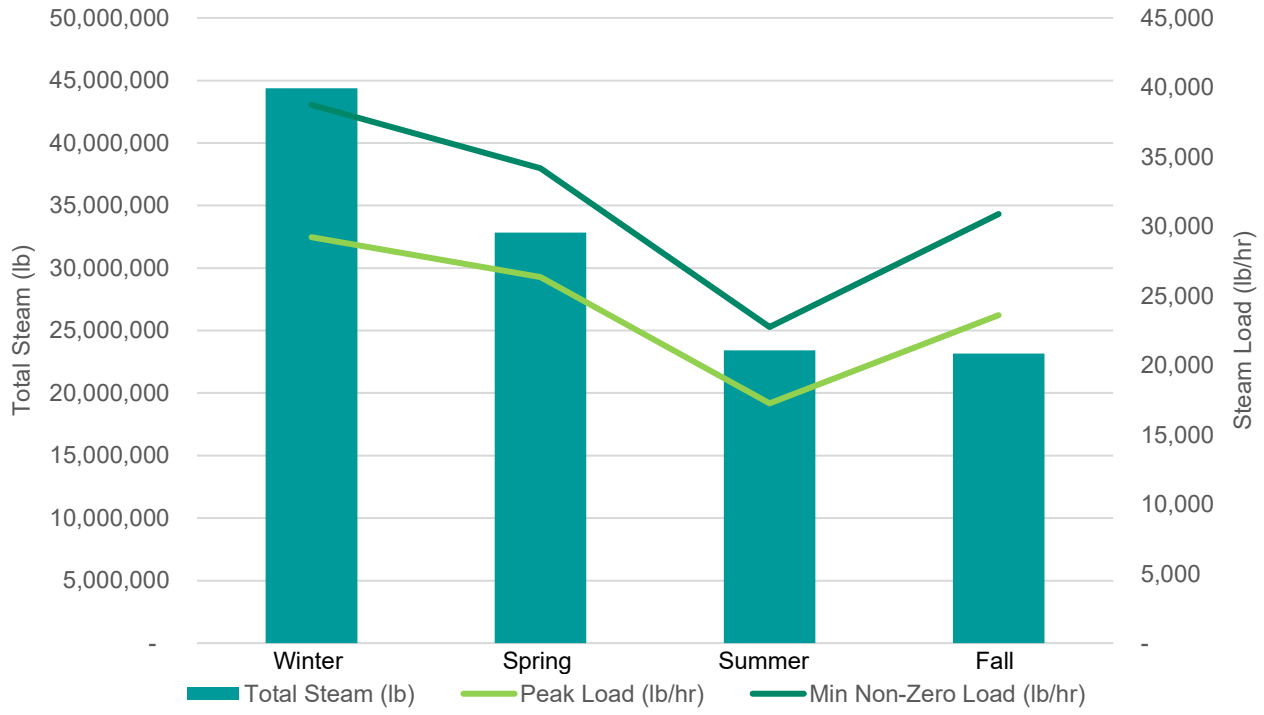

Figure 3. Seasonal Steam Production and Operating Range (showing total steam output by season and corresponding peak/minimum loads)

Taken together, the steam plant data provides the County with a clear picture of how the steam system performs across the year. It confirms that the system is heating-dominated, demonstrates the scale of variability between seasons, and establishes the numerical range of loads that future replacement systems must be designed to accommodate. The shift-level findings add another layer of insight, showing that future solutions must not only

meet seasonal peaks but also be responsive to short-duration spikes that occur overnight and during morning warm-up periods.

Building-Level Demand Disaggregation

While the plant-level data describes overall system performance, effective decommissioning planning requires understanding how that demand is distributed across individual buildings. To support this analysis, AECOM developed building-level demand profiles, which integrates a breakdown of steam end-uses and historic consumption records.

This modeling allowed the team to break down each facility's annual steam use into the following main categories:

- Space Heating – primary use for most facilities
- Domestic Hot Water (DHW) – a steady, year-round load
- Process Steam – negligible across most buildings
- Space Cooling – only used at the Sheriff Admin building

The analysis shown in **Table 3** confirmed that space heating accounts for roughly 85–95 percent of total steam use at nearly all facilities. Domestic hot water represents a smaller but continuous baseline, space cooling a minimal load while process steam was effectively zero for most users. This breakdown has important planning implications: once heating loads are electrified or replaced with alternative systems, the remaining steam demand is minimal and can be served by electrified and decentralized solutions.

Table 3. Steam End Use by Building

Steam End-Uses					Calculated Totals & Shares				
Building	Steam Space Heat (klb)	Steam Space Cool (klb)	Steam _DHW (klb)	Steam Process (klb)	Total Steam (klb) - Calculated	Space Heating (%)	DHW (%)	Process (%)	Total Annual Steam – Historical Trend (klb)
Admin Annex II	271	-	21	-	292	93%	7%	-	327
Central Garage	1,385	-	16	-	1,402	99%	1%	-	1,402
Central Services	377	-	47	-	424	89%	11%	-	472
Courthouse	50,048	-	2,656	-	53,114	95%	5%	-	53,114
Information Technology	3,613	-	215	-	3,828	94%	6%	-	3,828
Law Enforcement Complex	19,641	-	5,558	-	25,199	75%	25%	-	25,200
Little Oaks	1,817	-	10	-	1,827	98%	2%	-	1,827*
North Oakland Health Center	3,036		160		3,196	95%	5%	-	3,196*
North Office Building	9,174	-	-	-	9,174	100%	0%	-	9,174*
Pontiac Health Building	994				994	100%	0%	-	1,143*
Resources and Crisis Center	1,929	-	-	-	1,929	100%	0%	-	1,911*
Sheriff's Admin	10,217	4,064	255	-	14,536	66%	2%	-	14,536

The building-level analysis in Table 4**Table 3** revealed that a small number of large facilities dominate overall steam consumption. To understand not just annual consumption, but also peak consumption, peak heating load was estimated using annual steam consumption data and the total number of heating hours for the project location. Heating hours were defined as all weather-bin hours below 62°F in Michigan (5,822 hours), with a 75% load factor applied to account for unoccupied hours. Average load was calculated using annual consumption and heating hours, and this average load was then adjusted using a seasonal load factor of 0.5 to approximate the

building's peak heating demand. This information is outlined in **Table 4**. It should be noted that this information is the peak heating load at each individual building, and not the peak heating simultaneously on the central steam plant. The buildings connected to the steam plant do not peak simultaneously, thus the peak load on the steam boiler is significantly lower than the design peak at each building.

Table 4. Peak Heating and Steam Flow Building

Building	Peak Heating Load (MBH)	Peak Cooling Load (ton)	Peak Heating Steam Flow (lb/hr)	Peak Cooling Steam Flow (lb/hr)
Admin Annex II	179	-	172	
Central Garage	766	-	737	
Central Services	258	-	248	
Courthouse	29,048	-	27,944	
Information Technology	2,093	-	2,014	
Law Enforcement Complex	13,781	-	13,258	
Little Oaks	999	-	961	
North Oakland Health Center	2,947	-	2,835	
North Office Building	5,017	-	4,827	
Pontiac Health Building	625	-	602	
Resources and Crisis Center	1,045	-	1,005	
Sheriff's Admin	7,950	440	7,647	5,076
	64,709	**440**		

The Courthouse and Law Enforcement Complex together account for over half of total annual steam demand, consuming roughly 53 million and 25 million pounds, respectively. Both also have the highest peak heating loads, particularly the **Courthouse which requires approximately 28,000 lb/hr** and the **Law Enforcement Complex at 13,250 lb/hr** under peak design conditions.

Other major users include the Sheriff's Admin Building (peak of over 7,500 lb/hr), North Office Building (approximately 4,800 lb/hr peak), along with mid-sized buildings such as the IT and North Oakland Health Center, which consume 2,000-3,000 lb/hr peak.

In contrast, smaller peripheral facilities such as Admin Annex II, Central Garage, Pontiac Health Building, and the Resources & Crisis Center, consume less than 1.5 million pounds annually. Their peak loads are modest, generally ranging between a few hundred and 1,000 lb/hr. These buildings are located near the edges of the steam network and represent low overall demand, making them straightforward candidates for independent heating solutions in future planning.

While the system is primarily heating dominated, the Sheriff's Admin Building also uses steam for cooling through an absorption chiller. The building records an additional peak cooling steam flow of 5,076 lb/hr, on top of its 7,647 lb/hr peak heating load. A backup absorption chiller is also located at the Courthouse, which can draw additional steam capacity when in use, which is uncommon. Though cooling-related steam use is limited compared to heating, this dual use reinforces the need to consider seasonal overlap and year-round system operation when planning decommissioning.

Overall, this disaggregation provides a clear picture of how steam demand varies across the campus. It highlights which facilities are most dependent on the central plant and which can be feasibly transitioned first once detailed design and funding decisions are made.

4. Phasing Framework Development

Developing a phased decommissioning strategy required more than identifying which buildings were major "anchor" loads versus smaller "peripheral" users. It also required testing how removing different groups of buildings would affect the central steam plant's ability to maintain stable boiler performance across both high- and low-demand seasons, avoiding issues such as short-cycling or pressure instability when loads become too low. The purpose of this step was to define a transition plan that maintains reliable plant operation while allowing the County to gradually reduce its dependence on the central system.

AECOM approached this analysis by comparing building-level steam demand against the plant's technical minimum operating threshold, which was determined to be approximately 5,500 lb/hr. This value represents the lowest steam flow rate at which one boiler can function stably without excessive cycling, temperature fluctuations, or efficiency losses. If total system demand were to drop below this level during the transition, the boilers would begin to operate intermittently, causing reliability issues, uneven heating, and unnecessary fuel consumption.

To prevent these risks, AECOM developed a phasing analysis model that tested how the system would perform as groups of buildings are disconnected over time. This model examined the cumulative "relief" in demand after each phase and compared it to the plant's minimum threshold to ensure that the remaining connected load would always stay above 5,500 lb/hr. The analysis included both summer and winter operating conditions to capture the full range of seasonal variability.

A phased approach was recommended rather than a single, full-system shutdown to avoid several operational and financial risks. Disconnecting all buildings at once would leave critical facilities without reliable heat or hot water before replacement systems are ready, while also creating potential pressure instability within the remaining piping network. A phasing approach allows the County to sequence conversions alongside capital planning cycles, maintain continuous operation for occupied facilities and retire portions of the steam distribution system in a controlled manner.

Load Relief Testing

The load-testing process started with detailed calculations of seasonal peak and minimum loads for each building. These were separated into summer and winter conditions to reflect differences in heating intensity and base load requirements.

- **Peak loads** represent the highest hourly steam flow observed during periods of maximum demand, such as cold mornings or transitional weather events.
- **Minimum loads** capture the lowest sustained operation, representing steady-state conditions like domestic hot water use during mild weather.

The results in **Table 5** were used to verify that after each phase of disconnection; the remaining connected buildings would continue to maintain a load above the 5,500 lb/hr threshold. This threshold was determined from discussions during the site assessment and from analyzing the minimum trended loads at the plant. This approach ensured that at every step in the process, the plant could continue to operate safely and reliably without risk of under-loading the boilers.

Table 5. Building-Level Seasonal Load Relief by Phase

	Summer Relief (Peak lb/hr)	Summer Relief (Min lb/hr)	Winter Relief (Peak lb/hr)	Winter Relief (Min lb/hr)
Admin Annex II	69	20	175	69
Central Garage	295	87	739	295
Central Services	99	29	253	99
Courthouse	11,177	3,283	28,247	11,177
Information Technology	806	237	2,038	806
Law Enforcement Complex	5,303	1,558	13,892	5,303

Little Oaks	385	113	963	385
North Oakland Health Center	1,134	333	2,854	1,134
North Office Building	1,931	567	4,827	1,931
Pontiac Health Building	241	71	602	241
Resources & Crisis Center	402	118	1,005	402
Sheriff's Admin	8,135	2,675	7,677	3,059

The load-relief analysis provides the County with a clear understanding of how system demand changes under different operating scenarios.

- **During Winter Conditions:** The simultaneous peak load exceeds 62,000 lb/hr, while minimum loads remain above 24,000 lb/hr. This approach confirms that the system's boilers operate comfortably above the minimum threshold during heating season, even as loads are reduced in early phases. However, in reality the plant rarely operates at this capacity due to the buildings not peaking simultaneously

- **During Summer Conditions:** Total system demand is significantly lower but still remains above the minimum threshold, with a combined simultaneous minimum load of just over 9,000 lb/hr across all connected buildings. Because this value is near the plant's operational minimum, the summer condition becomes the most critical test case for sequencing. Early disconnections must therefore be limited to smaller buildings so the system remains stable during low-demand months.

- **Across All Seasons:** The data confirm that demand can be reduced gradually through multiple phases without under-loading the plant. In this analysis, the remaining load stays within range of the 5,500 lb/hr minimum threshold through, including after the removal of large anchor buildings. When the system falls below this, steam venting will be required, however this is only expected to occur during peak cooling times when the load on the plant is minimal. During standard operations, no venting should be required. The system only falls below minimum load in winter once the final buildings are intentionally disconnected at the end of the decommissioning sequence.

Application to Phasing

The results of this analysis form the foundation for the phasing strategy. They confirm that:

- The County can remove smaller, peripheral buildings first without operational risk.
- Mid-sized buildings can follow in later stages, provided the plant's minimum load is maintained.
- The large anchor buildings must remain connected until the end of the transition, as they sustain much of the base load that keeps the steam plant stable.

The following section, Phasing Scenarios, builds upon this framework to describe the defined phases of decommissioning, the buildings included in each, and how the sequence supports both technical and operational feasibility.

5. Phasing Scenarios

Building on the plant-level load analysis, building demand profiles, and the structured framework for decision-making, AECOM developed a phased decommissioning plan for Oakland County's central steam system. The intent of this plan is to reduce steam demand in a controlled sequence, maintaining system reliability while progressively retiring portions of the distribution network.

Definition of Phasing Scenarios

The phasing approach integrates both quantitative load analysis and spatial system layout. The phasing plan was informed by three primary factors:

1. **Load relief testing** against the plant's minimum operating threshold (5,500 lb/hr), ensuring that demand never falls below the level required for safe operation during the transition.
2. **Building-level demand profiles**, distinguishing between small peripheral users, mid-sized contributors, and large anchor loads.
3. **Steam distribution map review**, which highlighted opportunities to bundle buildings that share distribution piping, allowing entire segments of steam mains to be retired together.

Together, these criteria form five distinct **phasing scenarios** that follow both the physical layout of the distribution system and the load distribution across facilities.

- **Phase 1:** Peripheral buildings at the ends of distribution runs.
- **Phase 2:** Mid-sized buildings forming logical clusters along main branches.
- **Phase 3:** Buildings near the plant with moderate loads.
- **Phase 4:** Remaining support facilities located adjacent to the plant.
- **Phase 5:** Anchor buildings that sustain most of the base load (Courthouse and Law Enforcement Complex).

Figure 4. Steam Distribution Map



Building Assignments by Phase

Based on the load relief testing and steam distribution map review, AECOM organized each building into a logical sequence for decommissioning, The assignments reflect both operational role and physical location within the steam distribution network. Grouping buildings into phases allows the County to remove demand in manageable increments, maintain system stability above the 5,500 lb/hr threshold, and align conversions with capital planning timelines. The table below summarizes the recommended phasing order for all connected buildings.

Table 6. Building Decommissioning by Phase

Building Sequence	Phasing	Summer Relief (Peak lb/hr)	Summer Relief (Min lb/hr)	Winter Relief (Peak lb/hr)	Winter Relief (Min lb/hr)
Resources & Crisis Center	1	402	118	1,005	402
Sheriff's Admin	1	8,135	2,675	7,677	3,059
Central Services	1	99	29	253	99
Information Technology	2	806	237	2,038	806
North Oakland Health Center	2	1,134	333	2,854	1,134
Pontiac Health Building	2	241	71	602	241
Little Oaks	3	385	113	963	385
North Office Building	3	1,931	567	4,827	1,931
Admin Annex II	4	69	20	175	69
Central Garage	4	295	87	739	295
Courthouse	5	11,177	3,283	28,247	11,177
Law Enforcement Complex	5	5,303	1,558	13,892	5,303

Cumulative Load Relief Analysis

To confirm the feasibility of this sequencing, AECOM performed a cumulative load relief analysis using both summer and winter operating conditions (**Table 7** and **Table 8**). The analysis quantifies how much load is removed with each phase and how much remains on the system afterward. The key metric for validation was that the remaining load must stay above 5,500 lb/hr—the plant's minimum stable operating threshold. Under the phasing results, the remaining load stays well above this minimum threshold for during and winter conditions, and within 11% of this in summer conditions, indicating that the system can continue operating reliably with very minimal or no the need for steam venting to maintain stability throughout the vast majority of the year.

Table 7. Summer Relief Analysis

Phase	Relief Peak (lb/hr)	Relief Min (lb/hr)	Cumulative Relief Peak	Cumulative Relief Min	Remaining Peak After Phase	Remaining Min After Phase
1	8,636	2,822	8,636	2,822	21,340	6,269
2	2,180	640	10,817	3,463	19,159	5,628
3	2,315	680	13,132	4,143	16,844	4,948
4	364	107	13,495	4,250	16,481	4,841
5	16,481	5,429	29,976	9,091	-	-
6	-	-	29,976	9,091	-	-
Total			**29,976**	**9,091**		

Table 8. Winter Relief Analysis

Phase	Relief Peak (lb/hr)	Relief Min (lb/hr)	Cumulative Relief Peak	Cumulative Relief Min	Remaining Peak After Phase	Remaining Min After Phase
1	8,935	3,560	8,935	3,560	54,335	21,340
2	5,494	2,180	14,429	5,741	48,842	19,159
3	5,789	2,315	20,218	8,056	48,053	16,844
4	913	364	21,131	8,419	42,139	16,481
5	42,139	16,481	63,270	24,900	-	-
6	-	-	63,270	24,900	-	-
Total			**63,270**	**24,900**		

The results confirm that under both summer and winter conditions, the remaining system load remains safely above the 5,500 lb/hr threshold for the vast majority of the year:

- In **summer minimum** conditions, the load after Phase 4 remains **4,841 lb/hr** (i.e., <11% lower than the minimum threshold, thus any steam venting will be minimal and only on the peak cooling days).
- In **winter minimum** conditions, the load after Phase 4 remains **16,481 lb/hr** (i.e., 10,981 lb/hr above the minimum threshold).

This indicates that the steam system can continue operating reliably until all phases of conversion, as the remaining load stays within the range of the minimum threshold of 5,500 lb/hr throughout all phases. It is important to note that the Steam Plant phasing reflects when building conversions are anticipated to be completed, not necessarily when construction begins. Some major projects, particularly the **Courthouse** and **Law Enforcement Complex,** are expected to begin earlier in the overall schedule but will remain connected to the steam system until closer to the completion of Phase 5, when their new systems are fully commissioned.

The results of the cumulative load relief testing illustrate how the system can be safely stepped down over multiple years:

- **Phase 1** removes small and/or peripheral buildings such as the Resources and Crisis Center and Sheriff's Admin, along with the Central Services Building. Together, these provide about 8,636 lb/hr of summer peak relief and 2,822 lb/hr of summer minimum relief, leaving ample remaining load to sustain plant operation.
- **Phase 2** removes the Information Technology Building, Pontiac Health Building and North Oakland Health Center—mid-sized users that together add roughly 2,180 lb/hr of peak relief and 640 lb/hr of minimum relief.
- **Phases 3 and 4** remove smaller support facilities and buildings near the plant, continuing to reduce steam demand while keeping the system above minimum thresholds. Phase 3 removes smaller facilities such as Little Oaks and North Office Building, providing another 2,315 lb/hr of summer peak relief and 680 lb/hr of summer minimum relief, further reducing the remaining summer minimum load to 4,948 lb/hr. Phase 4 includes Admin Annex II and Central Garage, adding 364 lb/hr of peak relief and 107 lb/hr of minimum relief, resulting in a remaining summer minimum load of 4,841 lb/hr, which is slightly below the nominal 5,500 lb/hr minimum operating threshold.
- **Phase 5** is reserved for the Courthouse, and Law Enforcement Complex. Their removal provides the single largest relief, with approximately 16,481 lb/hr of summer peak relief and 5,429 lb/hr of summer minimum relief, and can only occur once replacement systems are installed, as these facilities currently sustain most of the base load.

The specific timing of each phase will be determined through the forthcoming Electrification Plan, which will align building conversions with capital budgeting cycles, funding availability, and system design readiness.

This five-phase approach ensures a smooth and technically feasible transition:

- Early phases remove small, low-risk loads at system edges.
- Middle phases address moderate users and retire full distribution branches.
- Final phases handle the anchor buildings that maintain system stability until the end.

By structuring the transition this way, Oakland County can decommission the central steam plant safely, cost-effectively, and without operational disruption.

6. Operational Recommendations

This report outlines a prioritized approach for decentralizing building heating equipment, which systematically reduces the demand on the existing heating equipment. Although the timeline for decommissioning is aggressive, the best-case scenarios for full decommissioning of the steam plant are likely to extend plant operation to 2035 or later. Short-term recommendations to improve steam generation efficiency, reduce distribution losses, and optimize plant operation have been developed as part of this report for Oakland County to consider as temporary cost saving opportunities that will also help to extend the useful life of the existing equipment. Recommendations included in this section are intended to be low-cost, rapid payback opportunities that will recover implementation costs through energy savings in less than 5 years. This report identifies six measures to be considered for immediate and short-term implementation while additional steam plant decommissioning planning is being completed. The measures are presented in Table 9, followed by brief summaries for each measure.

Table 9. Recommended Energy Conservation Measures for Steam Plant Equipment

Energy Conservation Measures										
ECM #	**ECM Description**	**Priority**	**Year -1 Electricity Savings**	**Demand Reduction (kW)***	**Year -1 Gas Savings**	**Total Energy Saved**	**O&M Savings**	**Year - 1 Cost Savings**	**Project Cost (Est)**	**Simple Payback Period**
No	Description	High, Med, Low	kWh/yr		MCF/yr	MMBTU	$/yr	$/yr	$	Years
ECM 1	Install Energy Metering and Burner Performance Monitors	HIGH	0	0	0	0	-$2,500	-$2,500	$20,000	NA
ECM 2	Ongoing Boiler Tuning and Burner Optimization	HIGH	0	0	4,514	4,681	-$4,000	$18,467	$12,000	0.6
ECM 3	Steam Trap and Piping Leak Repairs	HIGH	5,258	0	11,284	11,719	-$22,500	$34,245	$120,000	3.5
ECM 4	Install VFDs on Boiler Motors	MED	16,785	0	2,821	2,983	$0	$15,888	$72,000	4.5
ECM 5	Building Lighting Retrofits	LOW	8,491	2	0	29	$384	$1,318	$4,800	3.6
ECM 6	Upgrade Pneumatic to DDC Controls, Decommissioning Air Compressors	LOW	6,535	0	0	22	$3,500	$4,219	$28,000	6.6
		Sum	**37,069**	**2**	**18,618**	**19,434**	**-$25,116**	**$71,636**	**$256,800**	**3.6**

ECM 1: Install Metering Equipment and Burner Performance Monitors: The goal of this measure is to improve visibility into the current boiler performance, allowing for improved maintenance, optimized controls, and other boiler performance such as sequencing, pressure controls, and resets. This measure also suggests metering the condensate return and make-up water flow and quality, which can help indicate additional improvements for ECMs 2 and 3. Additionally, improving metering on the steam system, specifically at the building levels, will inform electrification designs and create value through downsizing of capital equipment and improved building efficiency. The implementation of this measure assumes meter installation on existing boiler controls, and tie-in to the existing Building Automation System. Additional costs may be incurred if controls upgrades are required to read the operational data.

ECM 2: Ongoing Boiler Tuning and Burner Optimization: Following the implementation of performance meters, the boilers should be regularly tuned to maintain maximum combustion efficiency at variable load conditions, This measure assumes an initial upgrade, followed by annual inspections (in addition to existing inspections) of boiler performance as the measured efficiency drifts below optimum.

ECM 3: Steam Trap and Piping Leak Repairs: Manual logs of make-up water supply suggest a potential steam loss of at least 15% of the mass of steam distributed from the plant. These losses are from failed steam traps, leaks in the distribution piping, and in some cases process use that can't be recovered. This measure recommends a systematic inspection and repair of the existing steam distribution system between the Central Heating Building and the steam entrances to the buildings served by the system.

ECM 4: Install VFDs on Boiler Motors: Installing VFDs on the boiler blower and new O2 sensors can improve the overall efficiency of the systems, and allow for more precise modulation of the system if controlled correctly. This measure suggests integrating VFDs into the boiler controls so that systems can be optimized based on airflow and pressurization requirements. The implementation assumes installation to the VFDs and upgrades to the boiler controls, with integration to the BAS required to fully realize savings.

ECM 5: Building Lighting Upgrades: Approximately 54 fluorescent fixtures with 154 lamps were counted in the building. This measure suggests replacing existing lamps with insta-fit LED tube lighting to reduce overall power consumption of the lighting systems in the building. Additional controls or fixture changes are not recommended in this building due to the uncertain future of the space.

ECM 6: Upgrade Pneumatic to DDC Controls: This measure aims to reduce the use of compressed air around the facility and improve the overall visibility into the operation of the systems. Many aspects of this measure should be implemented as part of ECMs 1 and 4, with ECM 6 focusing on the remaining equipment controlled with the compressed air system (HX, DHW, and AHUs 1 and 2). Converting the remaining systems to DDC control will allow the control air compressor to be decommissioned, eliminating the run time of the system. This measure would utilize the existing Niagara controls system, and controllers. Costs include actuator replacements for the heat exchangers and AHUs, and programming to integrate systems into the BAS.

7. Recommendations and Next Steps

This Plan provides Oakland County with a high-level assessment of its central steam system and a recommended framework for phased decommissioning. By combining plant-level load analysis, building-level demand profiles, and distribution mapping, AECOM identified a rational sequence that begins with small peripheral facilities and concludes with the County's anchor buildings. This phased approach balances reliability, cost-effectiveness, and long-term sustainability.

It is important to note that implementation of this framework will occur over many years and must be coordinated with the County's capital improvement planning and annual budgeting process. The timing of each phase will depend on available funding, equipment lifecycles, and broader County priorities. In practice, each phase would advance only after all buildings within that group have received and commissioned their new heating systems, at which point the corresponding steam lines could be safely disconnected. Cooling equipment connected to the steam system would likely be addressed at the same time to minimize downtime and construction overlap. Operationally, this transition will require careful planning—steam plant maintenance personnel will play a critical role in managing the phased changeover and may see their focus shift gradually from central plant operations to distributed equipment maintenance over time. The recommendations outlined in this Plan are therefore intended to guide decision-making and help the County prepare for strategic investments, rather than prescribe an immediate set of construction projects.

By adopting this phased strategy, Oakland County positions itself to retire aging steam infrastructure in a controlled, cost-effective manner while making steady progress toward its long-term decarbonization goals. Future implementation will require integration of this framework into capital planning cycles, alignment with grant and incentive opportunities, and prioritization of anchor facility conversions as major capital projects. While this plan focuses on sequencing and load management, future planning efforts are expected to pair this strategy with building-level electrification solutions, such as a centralized system serving the Courthouse and Law Enforcement Complex and decentralized systems for other facilities, to provide efficient, low-carbon replacements for existing steam service.



AECOM

Electrification Implementation Plan

Oakland County

March 6, 2026

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1 Background

The Electrification Implementation Plan (Deliverable 5) is the final stage of the Oakland County Energy and Electrification Study. This document consolidates the results of prior deliverables and establishes a structured implementation framework for transitioning County facilities to low-carbon, fully electrified operations.

Baseline conditions were documented in the Initial Study Findings Memo and Load and Capacity Reports, while short-term operational measures were identified in the Immediate Future Needs Report. Energy audits performed in accordance with ASHRAE Standard 211 characterized efficiency opportunities and electrification readiness. The Steam Plant Decommissioning Memo and Renewables Opportunities Memo provided the foundation for long-term system transitions.

The plan integrates these findings into an actionable framework that defines a prioritization methodology, sequencing of projects, and an implementation timeline that aligns with available electrical capacity, projected system needs, and the County's long-term decarbonization targets.

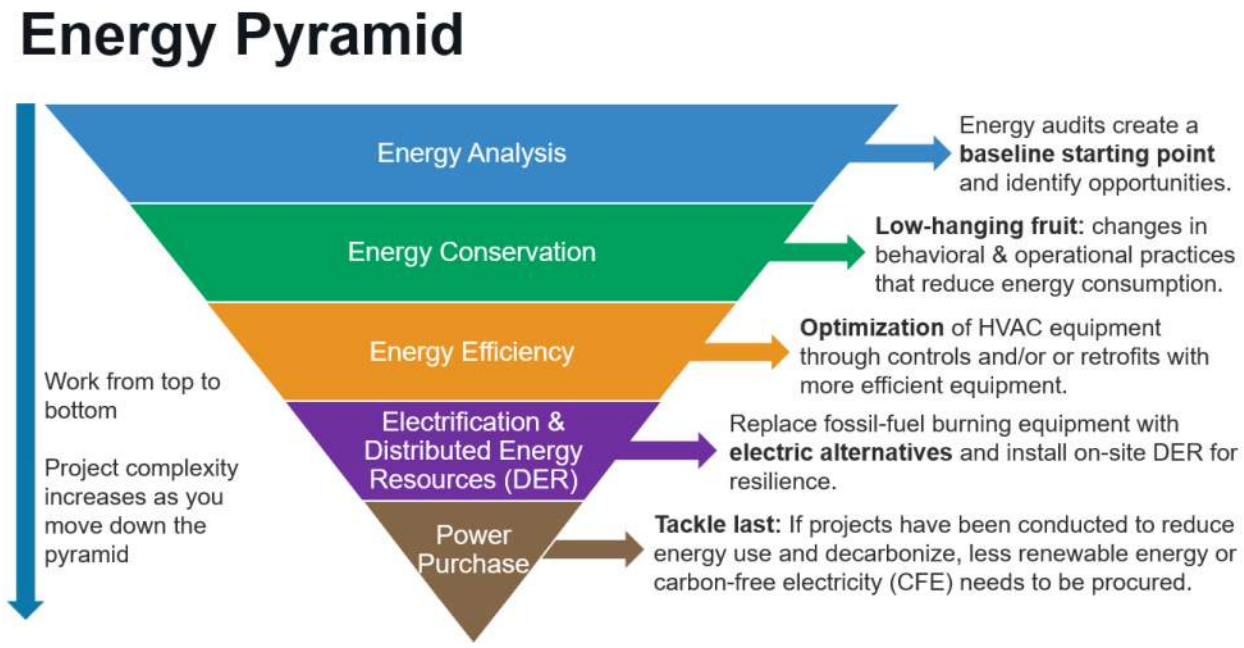


Figure 1: The Energy Pyramid

Figure 1 illustrates the sequencing approach applied in this plan. The County's path to electrification follows this methodology: establish the baseline energy use; evaluate energy conservation measures and operational improvements; implement energy efficiency upgrades; then transition fossil-fuel end uses to electric alternatives while integrating distributed energy resources; and finally, address any residual energy needs through power purchase agreements or clean energy procurement. This structured approach provides the County with a technical pathway to phased electrification that aligned with operational requirements, system reliability, and financial constraints.

2 Existing Conditions

The Oakland County Service Center building portfolio consists of 36 facilities totaling approximately 4.4 million square feet (sf). Current operations are supported by a combination of electric and central steam infrastructure, with the majority of space heating and domestic hot water loads served by the central steam plant (Building 22E).

Baseline demand conditions were established through analysis of 2024 utility billing data and submetered consumption profiles. In 2024, total campus-wide utility consumption was approximately 436 million kBtu. Electricity usage accounted for approximately 81 million kBtu and natural gas use totaled approximately 355 million kBtu, which is converted to steam at the central steam plant. These figures represent the combined energy use across all metered buildings within the project scope included in the utility dataset. Buildings connected to the steam plant exhibit the highest carbon intensities due to distribution losses and reliance on natural gas combustion for steam generation.

2.1 Electrical Infrastructure Capacity

Building-level electrical service sizes and remaining capacity were documented in the Load and Capacity Reports. Table 1 summarizes transformer ratings, switchgear capacities, peak demands, and remaining electrical headroom across the portfolio. This information forms the basis for evaluating where building-level service upgrades may be required to support electrification.

Table 1: Electric Capacity By Building

Building Name & ID	Building Transformer Capacity (kW)	Switchgear Capacity (kW)	Estimated Peak Demand (kW)	Remaining Capacity (kW)
Admin Annex I (47 West)	Unknown	860 (combined)	112	**748**
Admin Annex II (18 East)	500	600	31	**469**
Animal Control (42 East)	750	831	470	**281**
Central Garage (16 East)	150	144	42	**108**
Central Heating (22 East)	300	360	14	**286**
Central Services (20 East)	150	96	41 (meter)	**55**
Children's Village A Building (65 West)	300	430	28	**272**
Children's Village B Building (71 West)	150	216	49	**101**
Children's Village C Building (73 West)	150	216	49	**101**
Children's Village D Building (77 West)	150	288	19.8	**130**
Children's Village G Building (81 West)	150	216	21	**129**
Children's Village H Building (83 West)	150	N/A	59	**91**
Children's Village J Building (63 West)	750	900	88	**667**
Children's Village Kitchen (85 West)	225	300	48	**177**

Building Name & ID	Building Transformer Capacity (kW)	Switchgear Capacity (kW)	Estimated Peak Demand (kW)	Remaining Capacity (kW)
Children's Village School (87 West)	300	216	37.6	**180**
Courthouse (12 East)	Chiller Sub: 1500 kW Tower: 750 kW West: 300 kW West Extension: 1000 kW	N/A	753	**>1000**
East Annex (8 East)	750	1000	221	**529**
Executive Office Building (41 West)	1000	1328	280	**1048**
Information Technology (49 West)	1000	1333	465	**868**
Law Enforcement Complex (10 East)	750	900	590	**160**
Little Oaks (30 East)	150	216	38	**112**
Resource & Crisis Center (32 East)	1500	1330	680	**650**
Sheriffs Admin (38 East)	750	1000	240	**510**
Pontiac Health Building (36 East)	750	900	88	**667**
Children's Village Counseling Center (75 West)	150	288	19.8	**130**
Medical Examiners Facility (28 East)	1500	1660	246	**1254**
North Oakland Health Center (34 East)	750	1000	195	**555**
North Office Building (26 East)	500	665	77	**423**
Materials Management (Pontiac)	300	320	100	**200**
Patrol Services (57 West)	225	216	22	**198**
Public Works Building (95 West)	750	498	289	**212**
Farmer's Market (43 West)	150	144	7.7	**137**
Credit Union (51 West)	500	210	18	**202**
Road Commission Complex (59 West)	500	576	118	**382**

Facilities such as the Executive Office Building, Medical Examiners Facility, and Information Technology Center show substantial available capacity (>800 kW headroom). By contrast, smaller facilities such as Central Garage, Farmer's Market, and Little Oaks have limited remaining capacity (<150 kW), which will influence sequencing of electrification projects.

In summary, the County's electrical infrastructure is generally positioned to accommodate phased electrification. Key constraints are isolated to a small subset of buildings and can be addressed through targeted service upgrades. The predominance of steam-dependent heating loads remains the most significant barrier to decarbonization, underscoring the importance of the Steam Plant Decommissioning Plan and associated transition strategies.

3 Building Project Sheets

The building-level project sheets compile all recommended actions for each facility into a single reference format. Each sheet includes a summary of the building's primary characteristics, identified opportunities, and proposed projects required to transition the facility toward electrification and decarbonization.

Admin Annex I

47 West

This building is served by a natural gas boiler that can be replaced an ASHP system. The hot water piping will be upgraded as required in the Hot Water Piping Study / Design Specification Development.



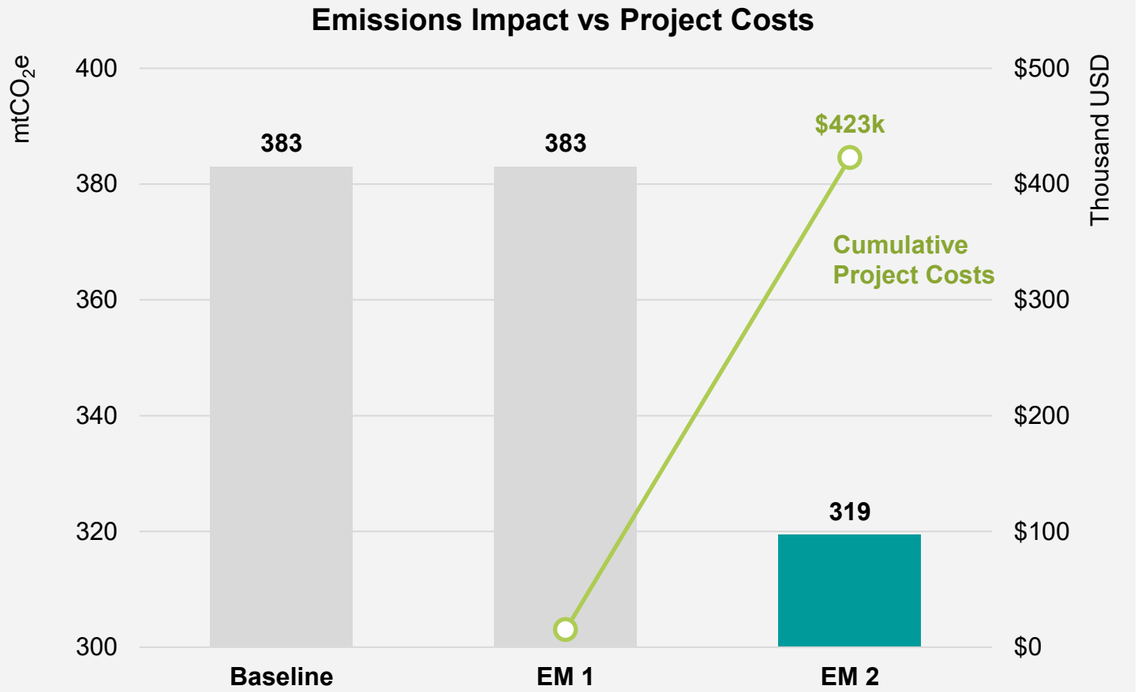


Building Implementation Plan

- ✓ Perform retro-commissioning and HW piping study
- ✓ Optimize air systems, remove dual duct controls, remove pneumatic controls, and zone air dampers if possible
- ✓ Evaluate new heating system
- ✓ Electrify heating system
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	Unknown
Switchgear Capacity	860 kW
Est. Peak Demand	112 kW
Remaining Capacity	748 kW
Required Capacity	213 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority	Electrification Measure (EM)	1st Year Project Costs	1st Year Steam Savings	1st Year Electricity Savings	1st Year Demand Savings	1st Year Gas Savings	1st Year Utility Cost Savings	1st Year Emissions Savings
No.	**Name**	**$**	**klbs**	**kWh**	**kW**	**MCF**	**$**	**$mtCO_2e$**
1	Hot Water Piping Study/Design Spec Development	$15,000	0	0	0	0	$0	0
2	Replace Boiler with ASHP	$407,762	0	-191,109	-213	2,698	-$7,588	64
	Total	**$422,762**	**$0**	**-$191,109**	**-$213**	**2,698**	**-$7,588**	**64**

Admin Annex II

18 East

This building has HVAC systems that can be replaced with high efficiency heat pump systems. There is an option to replace the steam with a HHW system with an ASHP that utilizes the existing hot water system, or to upgrade the HVAC and controls while installing a GSHP for the baseboard heating system. For this building, electrical capacity could be a concern such that if the electrical service needs to be upgraded, a GSHP may become the more economical option than the service upgrade.



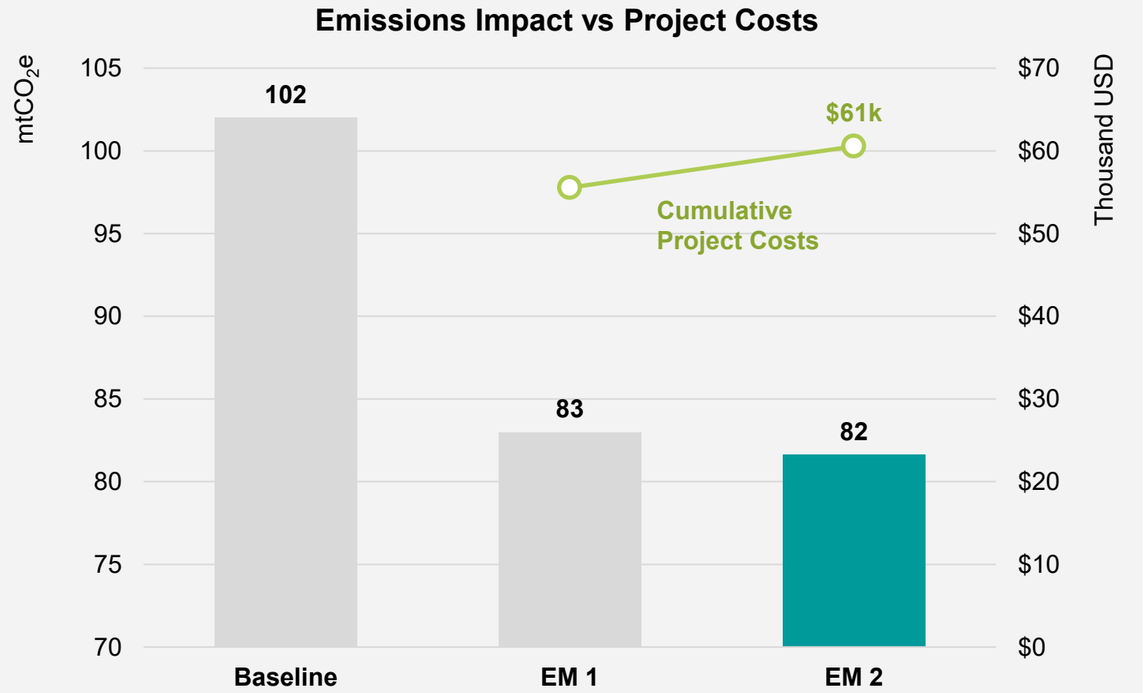


Building Implementation Plan

- ✓ Analyze and upgrade HVAC systems
- ✓ Decommission steam connection
- ✓ Upgrade building envelope
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	500 kW
Switchgear Capacity	600 kW
Est. Peak Demand	31 kW
Remaining Capacity	469 kW
Required Capacity	35 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority	Electrification Measure (EM)	1st Year Project Costs	1st Year Steam Savings	1st Year Electricity Savings	1st Year Demand Savings	1st Year Gas Savings	1st Year Utility Cost Savings	1st Year Emissions Savings
No.	**Name**	**$**	**klbs**	**kWh**	**kW**	**MCF**	**$**	**$mtCO_2e$**
1	Replace with Packaged Heat Pump Forced Air Heating	$55,547	269	-29,459	-33	0	-$547	19
2	Domestic Hot Water Electrification	$5,000	21	-2,662	-2	0	-$80	1
	Total	**$60,547**	**291**	**-32,121**	**-35**	**0**	**-$626**	**20**

Animal Control

42 East

This building has HVAC and hot water systems that can be replaced with high-efficiency heat pump technologies. The primary option is to replace the existing hot water boilers with a central ASHP system while converting the natural gas RTUs and ERUs to equivalent heat pump units.
The hot water piping will be upgraded as required in the Hot Water Piping Study / Design Specification Development.
Installing demand meters on the electrical system will help confirm remaining capacity and inform the feasibility of implementing the full electrification package.

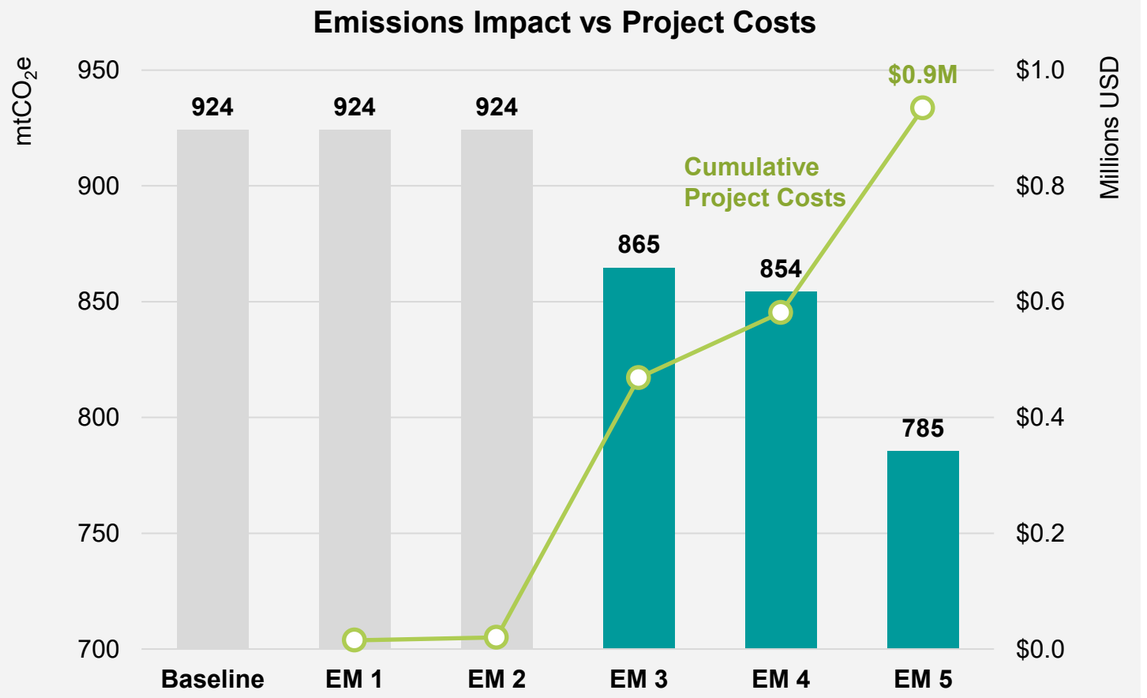


Building Implementation Plan

- ✓ Analyze and upgrade HVAC systems
- ✓ Install submeters and review electrical capacity
- ✓ Upgrade building envelope
- ✓ Implement electrification technologies
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	750 kW
Switchgear Capacity	831 kW
Est. Peak Demand	470 kW
Remaining Capacity	281 kW
Required Capacity	488 kW



Required capacity exceeds remaining capacity. Investigate electrical capacity at the building.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Hot Water Piping Study/Design Spec Development	$15,000	0	0	0	0	$0	0
2	Install demand meters on electrical system to better understand remaining capacity	$5,000	0	0	0	0	$0	0
3	Replace Boiler with ASHP	$448,499	0	-375,760	-235	4,110	-$20,867	59
4	Replace DHW with ASHP	$112,636	0	-123,936	-69	1,189	-$7,714	10
5	Replace Natural Gas RTUs and ERUs with Equivalent Heat Pump RTUs	$353,244	0	-246,199	-185	3,237	-$10,962	69
	Total	**$934,379**	**0**	**-745,895**	**-488**	**8,535**	**-$39,543**	**139**

Central Garage

16 East

This building has outdated HVAC systems that can be replaced with high efficiency heat pump systems. There is an option to replace the hot water heating system with forced air heating from packaged air handling equipment, or to upgrade the HVAC and controls while installing a GSHP for the baseboard heating system.

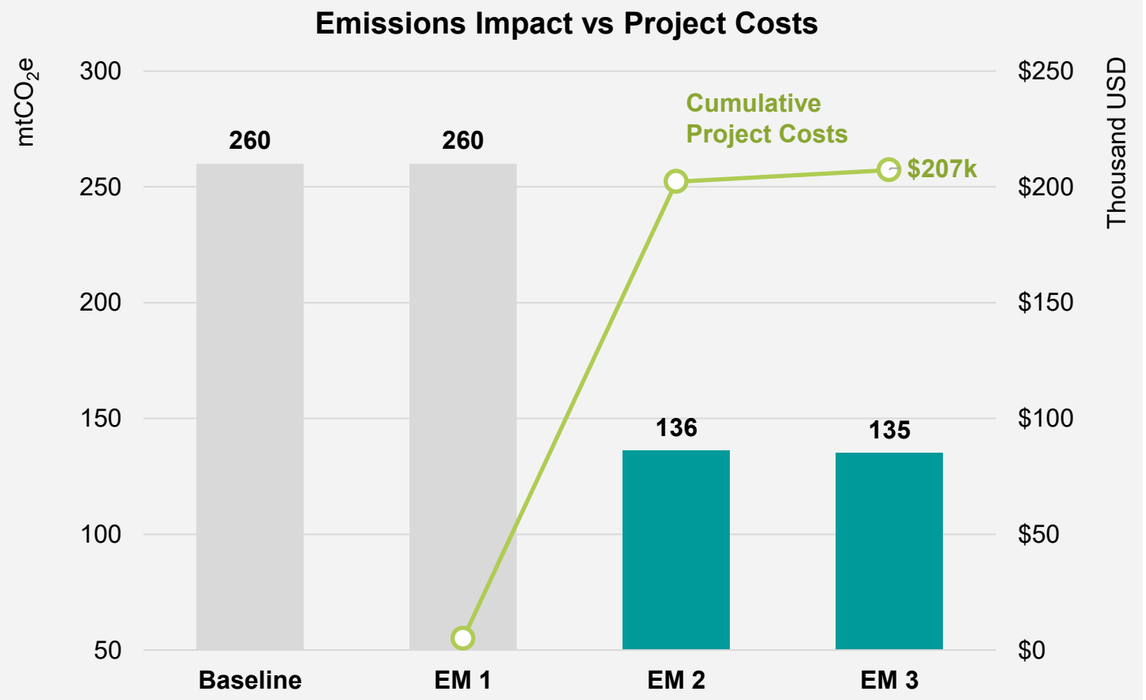


Building Implementation Plan

- ✓ Install submeters on electric system to monitor electric capacity
- ✓ Upgrade building HVAC
- ✓ Decommission steam system
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	150 kW
Switchgear Capacity	144 kW
Est. Peak Demand	42 kW
Remaining Capacity	108 kW
Required Capacity	105 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority	Electrification Measure (EM)	1st Year Project Costs	1st Year Steam Savings	1st Year Electricity Savings	1st Year Demand Savings	1st Year Gas Savings	1st Year Utility Cost Savings	1st Year Emissions Savings
No.	**Name**	**$**	**klbs**	**kWh**	**kW**	**MCF**	**$**	**$mtCO_2e$**
1	Install Submeters on Electric System	$5,000	0	0	0	0	$0	0
2	Replace AHU and RTU with Packaged Heat Pump Units	$197,262	1,385	-92,453	-103	0	$3,683	124
3	Domestic Hot Water Electrification	$5,000	16	-2,058	-2	0	-$66	1
4								
5								
	Total	**$207,262**	**1,401**	**-94,511**	**-105**	**0**	**$3,617**	**125**

Children's Village A

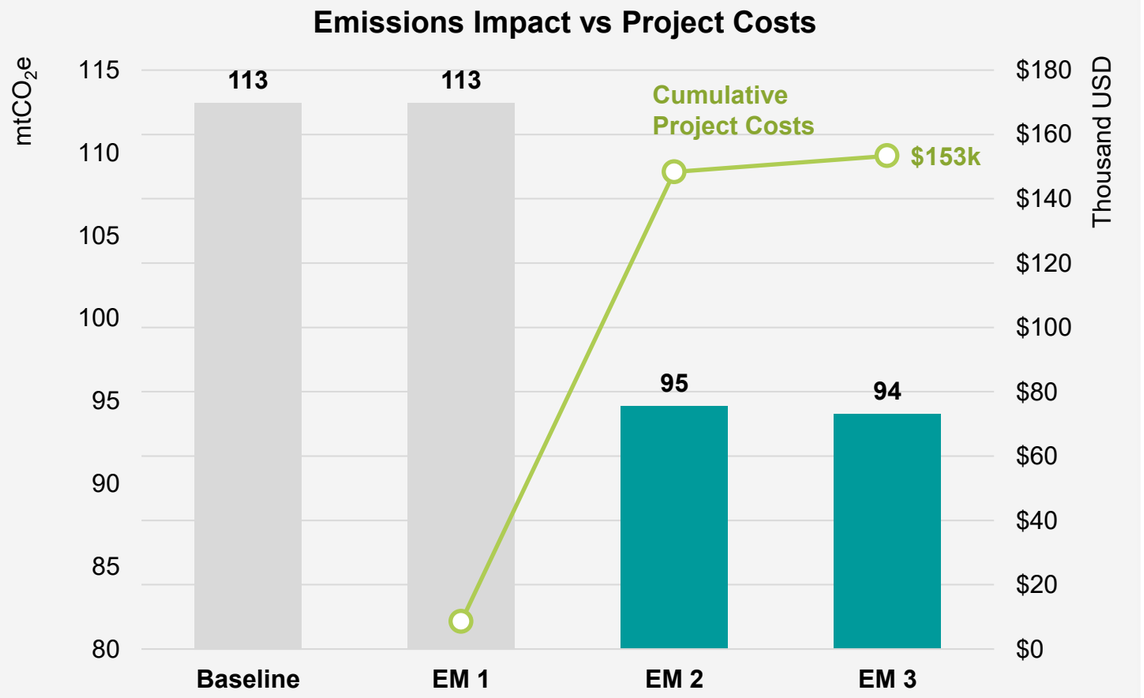
65 West

This building has an uncertain future and may be demolished. If the building is retrofitted, additional work will be required to determine the optimum design. This report assumes replacing the existing AHUs and boiler with packaged roof top heat pump units.



Building Implementation Plan
✓ Determine future use of building
✓ Determine final design of HVAC system
✓ Implement electrified design
✓ Upgrade building envelope and controls
✓ Perform other efficiency measures

Building Electrical Capacity	
Bldg. TX Capacity	Unknown
Switchgear Capacity	Unknown
Est. Peak Demand	Unknown
Remaining Capacity	250 kW
Required Capacity	73 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Future Building Usage Analysis	$8,500	0	0	0	0	$0	0
2	Replace Boiler and AHUs with Packaged Heat Pump Systems	$139,824	0	-65,532	-73	862	-$2,916	18
3	Domestic Hot Water Electrification	$5,000	0	-3,100	-2	34	-$174	1
	Total	**$153,324**	**0**	**-68,633**	**-75**	**895**	**-$3,090**	**19**

Children's Village B

71 West

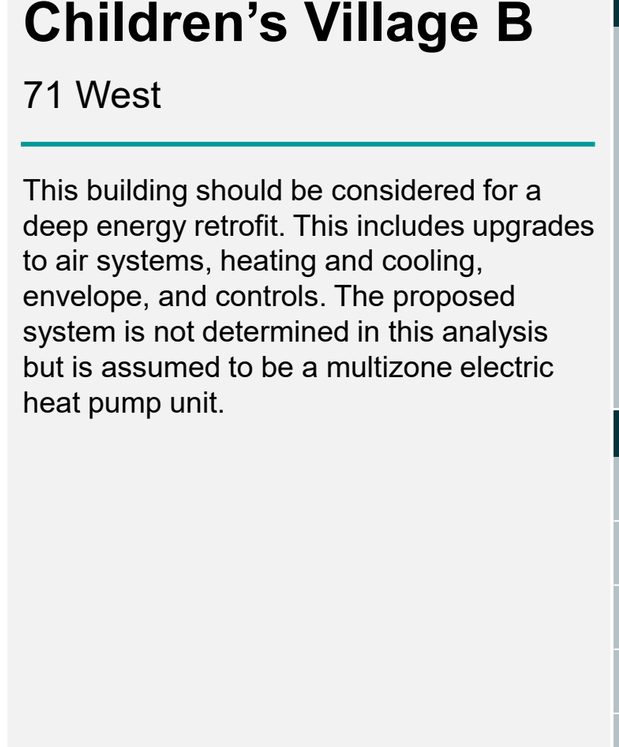
This building should be considered for a deep energy retrofit. This includes upgrades to air systems, heating and cooling, envelope, and controls. The proposed system is not determined in this analysis but is assumed to be a multizone electric heat pump unit.

Building Implementation Plan

- ✓ Determine final design of HVAC system
- ✓ Implement electrified design
- ✓ Upgrade building envelope and controls
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	150 kW
Switchgear Capacity	216 kW
Est. Peak Demand	49 kW
Remaining Capacity	101 kW
Required Capacity	44 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.



Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	HVAC Upgrades (VAV AHU, HP, Controls & Retrocommissioning)	$104,037	0	-36,552	-41	582	-$1,122	16
2	Install Heat Pump Hot Water Heater	$6,985	0	-5,245	-3	60	-$276	1
	Total	**$111,022**	**0**	**-41,797**	**-44**	**642**	**-$1,399**	**17**

Children’s Village C

73 West

This building should be considered for a deep energy retrofit. This includes upgrades to air systems, heating and cooling, envelope, and controls. The proposed system is not determined in this analysis but is assumed to be a multizone electric heat pump unit.

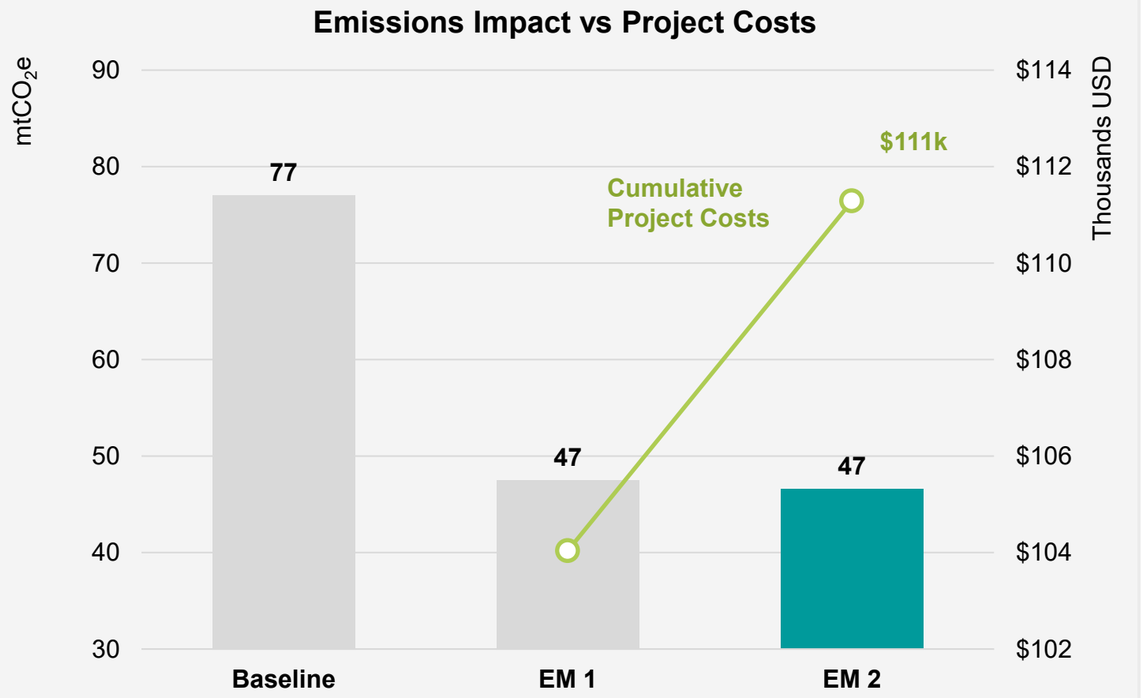


Building Implementation Plan

- ✓ Determine final design of HVAC system
- ✓ Implement electrified design
- ✓ Upgrade building envelope and controls
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	150 kW
Switchgear Capacity	216 kW
Est. Peak Demand	49 kW
Remaining Capacity	101 kW
Required Capacity	44 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	HVAC Upgrades (VAV AHU, HP, Controls & Retrocommissioning)	$104,037	0	-5,545	-41	582	$2,288	30
2	Install Heat Pump Hot Water Heater	$7,247	0	-5,442	-3	60	-$298	1
	Total	**$111,284**	**0**	**-10,987**	**-44**	**642**	**$1,990**	**30**

Children's Village Counseling Center

75 West

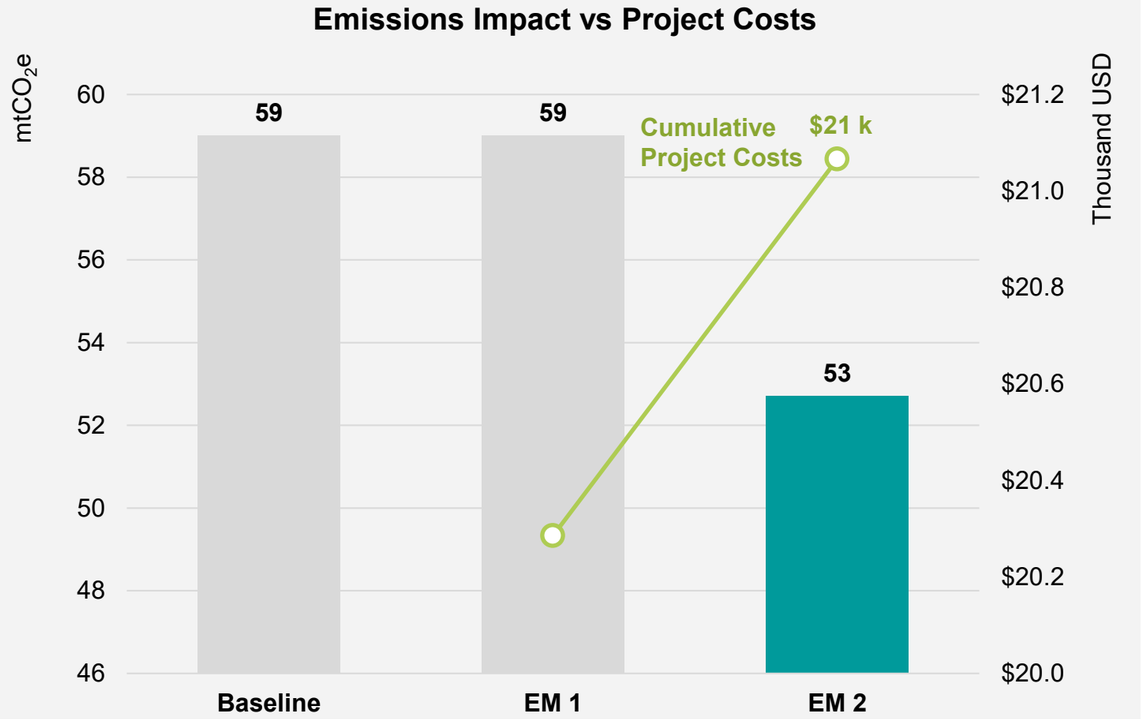
This building is served by two AHUs with natural gas furnaces that can be replaced with equivalent heat pump RTUs for each zone. The existing natural gas domestic hot water heaters can be replaced with Air Source Heat Pump (ASHP) units.

Building Implementation Plan

- ✓ Analyze and upgrade HVAC systems
- ✓ Install submeters and review electrical capacity
- ✓ Implement electrification technologies
- ✓ Upgrade building envelope
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	150 kW
Switchgear Capacity	288 kW
Est. Peak Demand	19.8 kW
Remaining Capacity	130 kW
Required Capacity	11 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Replace Natural Gas AHUs with Equivalent Heat Pump RTUs	$20,286	0	-9,507	-11	125	-$423	3
2	Replace DHW with ASHP	$780	0	-715	0	8	-$38	0
	Total	**$21,066**	**0**	**-10,223**	**-11**	**133**	**-$461**	**3**

Children's Village D

77 West

The existing natural gas domestic hot water heater and natural gas boiler can be replaced with an Air Source Heat Pump (ASHP) system. The hot water piping will be upgraded as required in the Hot Water Piping Study / Design Specification Development.

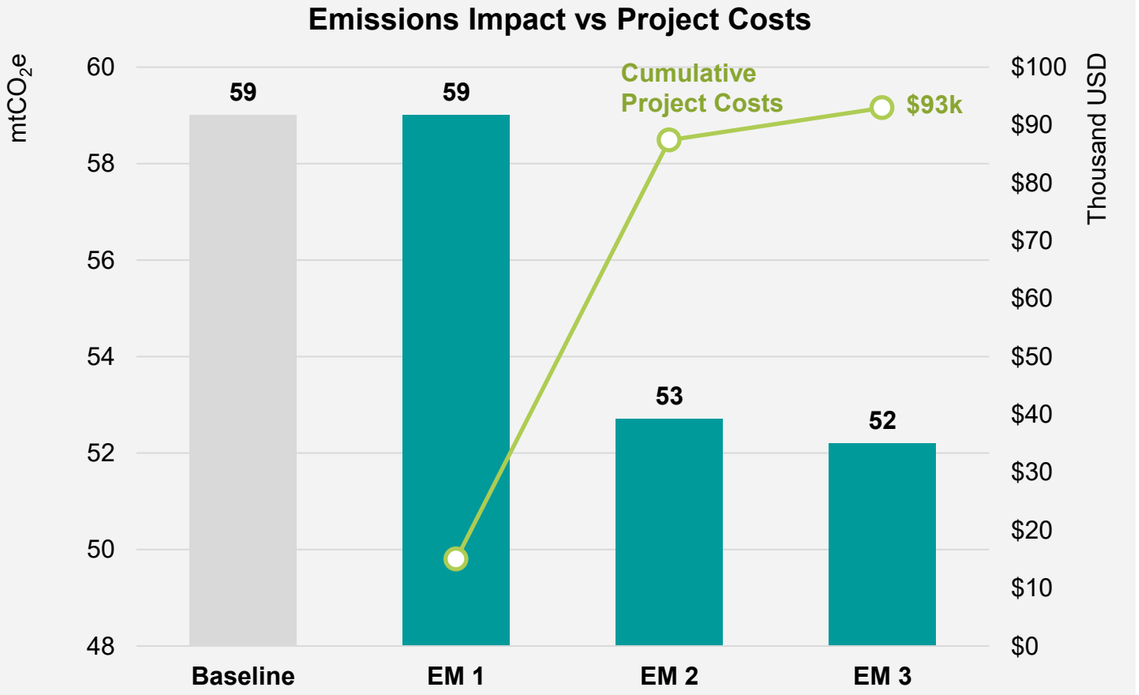


Building Implementation Plan

- ✓ Analyze and upgrade HVAC systems
- ✓ Install submeters and review electrical capacity
- ✓ Implement electrification technologies
- ✓ Upgrade building envelope
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	150 kW
Switchgear Capacity	288 kW
Est. Peak Demand	19.8 kW
Remaining Capacity	130 kW
Required Capacity	41 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Hot Water Piping Study/Design Spec Development	$15,000	0	0	0	0	$0	0
2	Replace Boiler with ASHP	$72,386	0	-33,926	-38	388	-$1,800	6
3	Replace DHW with ASHP	$5,572	0	-6,131	-3	59	-$382	1
	Total	**$92,958**	**0**	**-40,057**	**-41**	**447**	**-$2,181**	**7**

Children's Village G

81 West

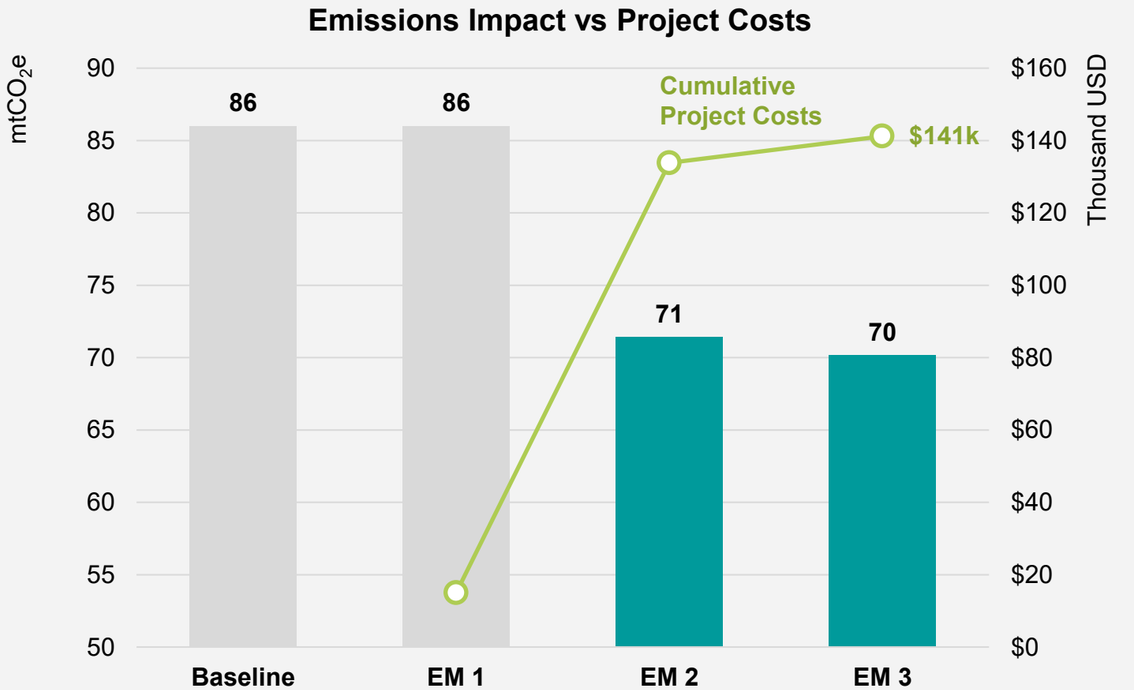
The existing natural gas domestic hot water heater and natural gas boiler can be replaced with an Air Source Heat Pump (ASHP) system. The hot water piping will be upgraded as required in the Hot Water Piping Study / Design Specification Development.





Building Implementation Plan
✓ Analyze and upgrade HVAC systems
✓ Install submeters and review electrical capacity
✓ Implement electrification technologies
✓ Upgrade building envelope
✓ Perform other efficiency measures

Building Electrical Capacity	
Bldg. TX Capacity	150 kW
Switchgear Capacity	216 kW
Est. Peak Demand	21 kW
Remaining Capacity	129 kW
Required Capacity	67 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Hot Water Piping Study/Design Spec Development	$15,000	0	0	0	0	$0	0
2	Replace Boiler with ASHP	$118,799	0	-55,679	-62	714	-$2,567	15
3	Replace DHW with ASHP	$7,363	0	-6,752	-4	78	-$356	1
	Total	**$141,162**	**0**	**-62,430**	**-67**	**792**	**-$2,923**	**16**

Children's Village H

83 West

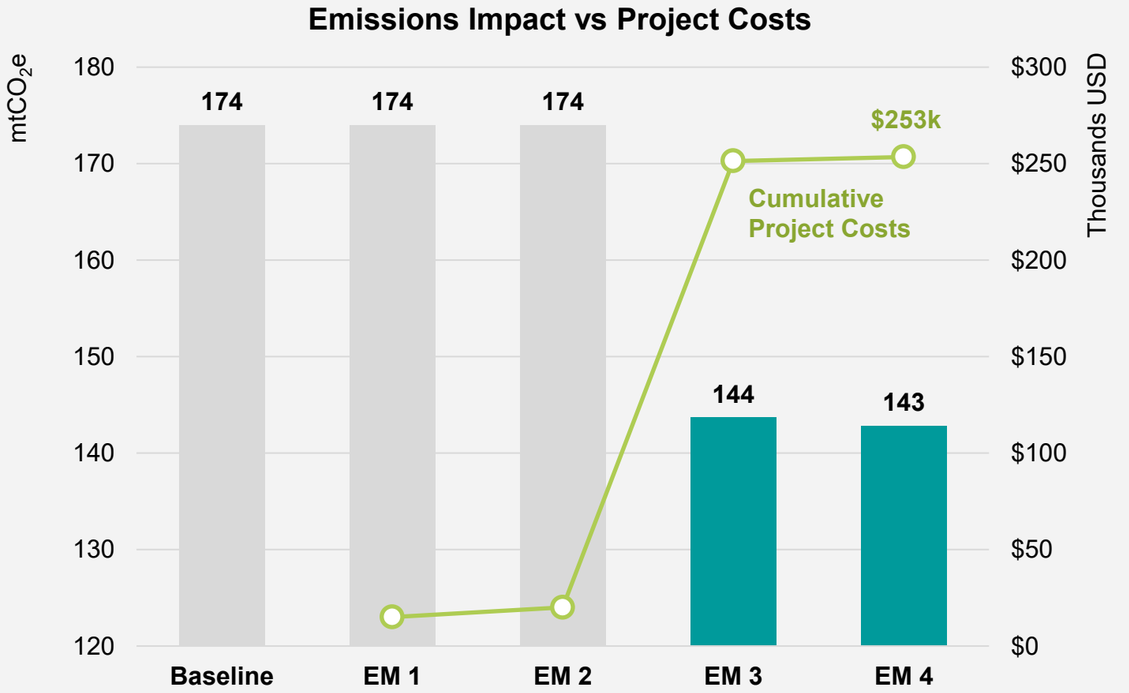
The existing natural gas domestic hot water heater and natural gas boiler can be replaced with an Air Source Heat Pump (ASHP) system. The hot water piping will be upgraded as required in the Hot Water Piping Study / Design Specification Development. Installing demand meters on the electrical system will help confirm remaining capacity and inform the feasibility of implementing the full electrification package.

Building Implementation Plan

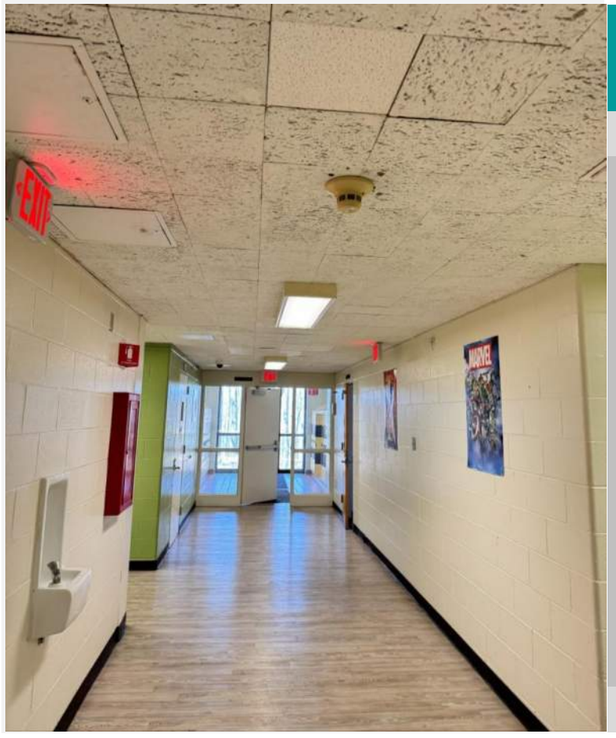
- ✓ Analyze and upgrade HVAC systems
- ✓ Install submeters and review electrical capacity
- ✓ Implement electrification technologies
- ✓ Upgrade building envelope
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	150 kW
Switchgear Capacity	Not Applicable
Est. Peak Demand	59 kW
Remaining Capacity	91 kW
Required Capacity	121 kW



Required capacity exceeds remaining capacity. Investigate electrical capacity at the building.

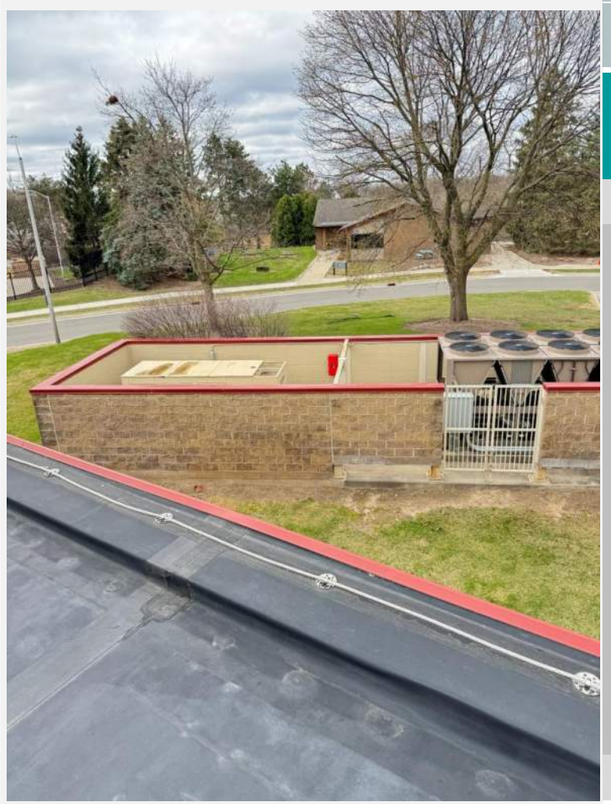


Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Hot Water Piping Study/Design Spec Development	$15,000	0	0	0	0	$0	0
2	Install Demand Meters on Electrical System to Better Understand Remaining Capacity	$5,000	0	0	0	0	$0	0
3	Replace Boiler with ASHP	$231,331	0	-108,420	-121	1,426	-$4,825	30
4	Replace DHW with ASHP	$2,093	0	-4,500	0	52	-$237	1
	Total	**$253,424**	**0**	**-112,920**	**-121**	**1,478**	**-$5,062**	**31**

Children's Village J

63 West

This building has hot water and ventilation systems that can be replaced with high-efficiency heat pump technologies. The two existing hot water boilers can be replaced with a central heat pump system, while the natural-gas unit heater can be converted to a split-system heat pump. The hot water piping will be upgraded as required in the Hot Water Piping Study / Design Specification Development to support the new ASHP system.

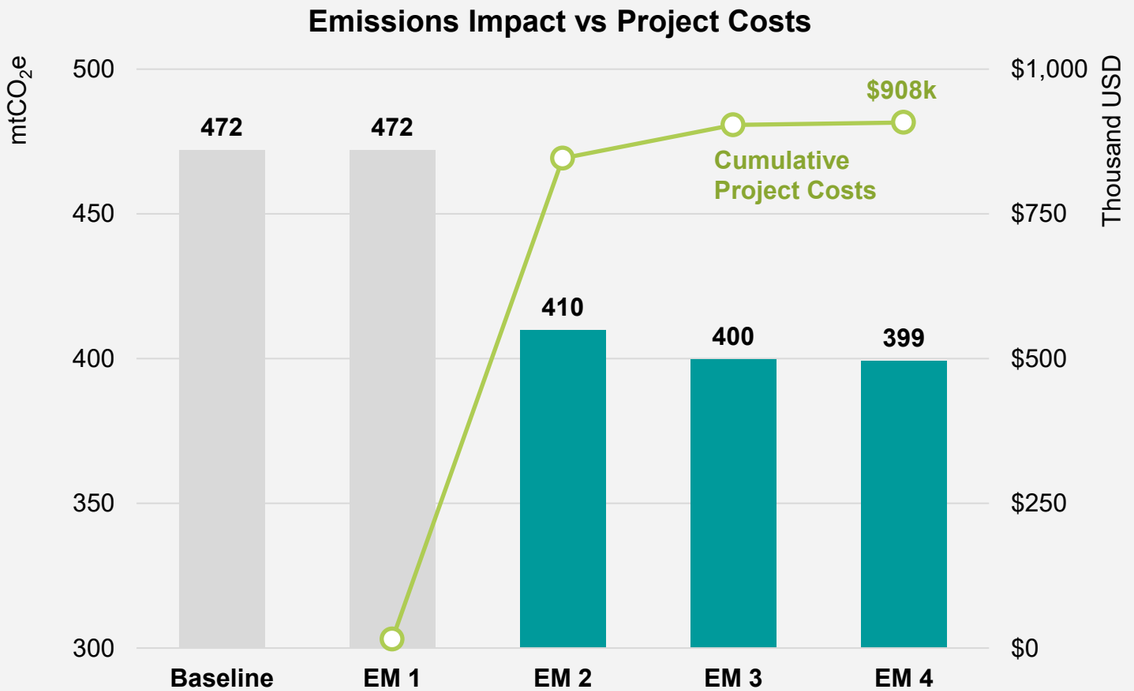


Building Implementation Plan

- ✓ Analyze and upgrade HVAC systems
- ✓ Install submeters and review electrical capacity
- ✓ Implement electrification technologies
- ✓ Upgrade building envelope
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	750 kW
Switchgear Capacity	900 kW
Est. Peak Demand	88 kW
Remaining Capacity	667 kW
Required Capacity	472 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Hot Water Piping Study/Design Spec Development	$15,000	0	0	0	0	$0	0
2	Replace Boiler with ASHP	$830,946	0	-391,472	-435	4,291	-$21,695	62
3	Replace DHW with ASHP	$57,512	0	-52,735	-35	607	-$2,779	10
4	Replace Unit Heater with Split System	$4,321	0	-1,697	-2	22	-$76	1
	Total	**$907,779**	**0**	**-445,903**	**-472**	**4,920**	**-$24,549**	**73**

Children's Village Kitchen

85 West

This building has natural gas systems that can be replaced with high-efficiency electric alternatives. The two natural gas RTUs can be converted to equivalent heat pump RTUs for each zone, and the gas-fired unit heater can be replaced with a split-system heat pump. Gas kitchen appliances can also be replaced with electric equivalents.



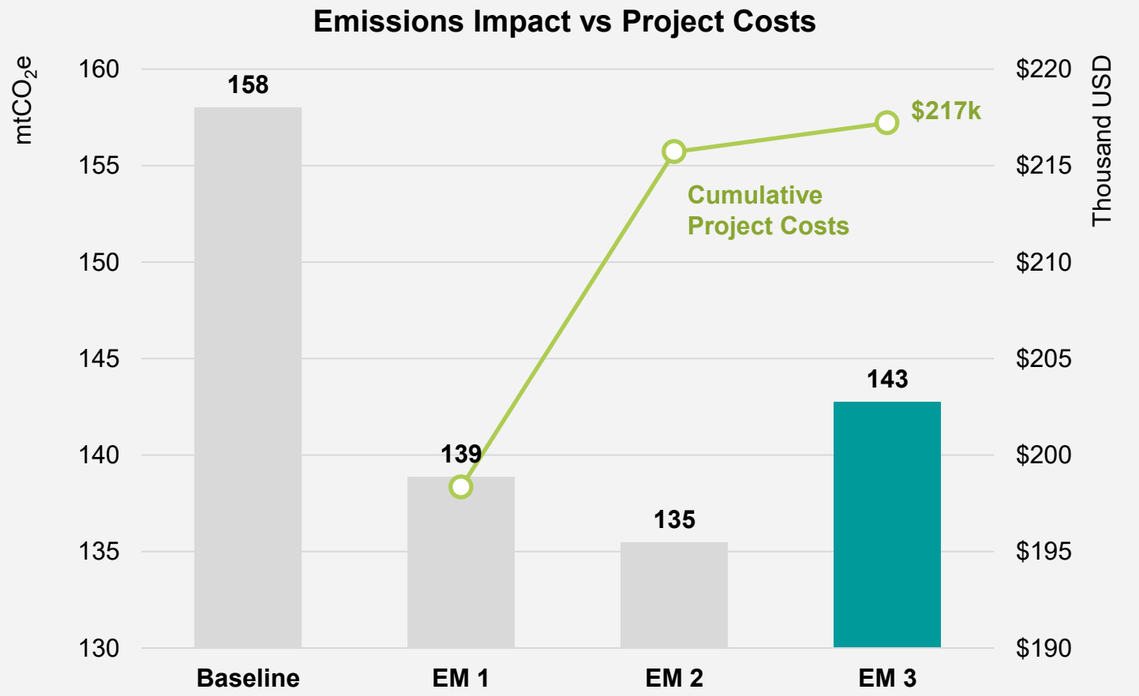


Building Implementation Plan

- ✓ Analyze and upgrade HVAC systems
- ✓ Install submeters and review electrical capacity
- ✓ Implement electrification technologies
- ✓ Upgrade building envelope
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	225 kW
Switchgear Capacity	300 kW
Est. Peak Demand	48 kW
Remaining Capacity	177 kW
Required Capacity	120 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority	Electrification Measure (EM)	1st Year Project Costs	1st Year Steam Savings	1st Year Electricity Savings	1st Year Demand Savings	1st Year Gas Savings	1st Year Utility Cost Savings	1st Year Emissions Savings
No.	**Name**	**$**	**klbs**	**kWh**	**kW**	**MCF**	**$**	**$mtCO_2e$**
1	Replace Natural Gas RTUs with Equivalent Heat Pump RTUs	$198,333	0	-92,954	-104	1,098	-$4,758	19
2	Replace Unit Heater with Split System	$17,378	0	-7,835	-9	125	-$241	3
3	Kitchen Electrification	$1,500	0	-35,941	-7	158	-$3,169	-7
	Total	**$217,211**	**0**	**-136,731**	**-120**	**1,380**	**-$8,168**	**15**

Children's Village School

87 West

This building has a hot water heating system that can be replaced with a high-efficiency heat pump system. The two existing hot water boilers can be replaced with an ASHP system, and the domestic hot water system can also be electrified with a dedicated heat pump water heater. The hot water piping will be upgraded as required in the Hot Water Piping Study / Design Specification Development to support the new system.

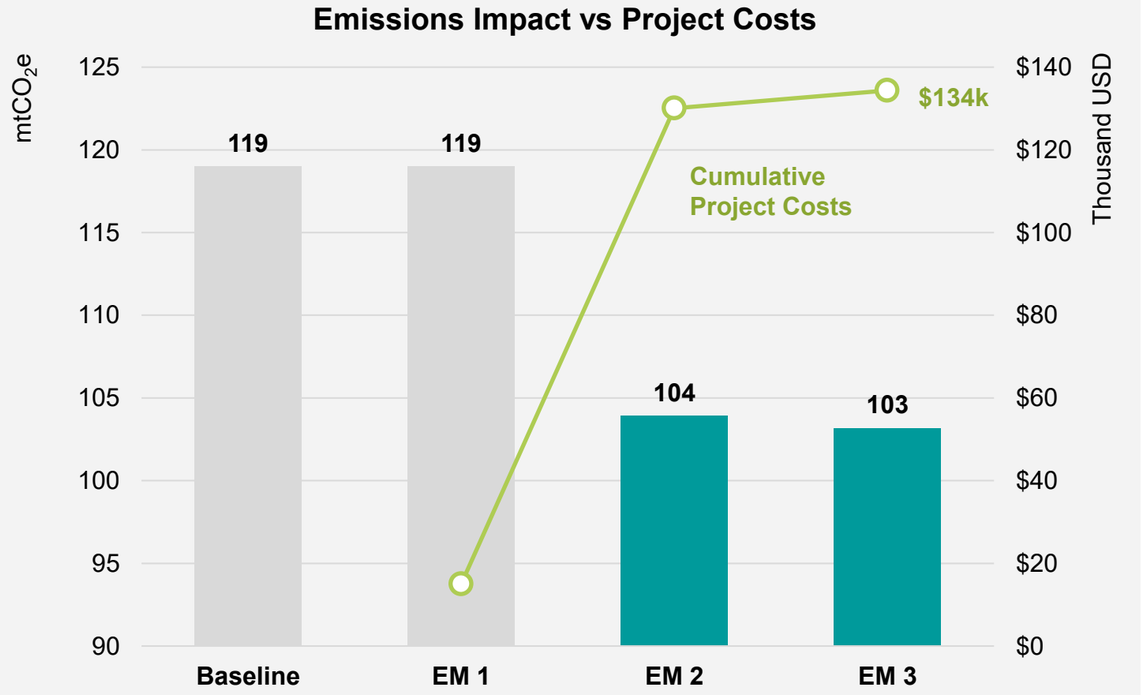


Building Implementation Plan

- ✓ Analyze and upgrade HVAC systems
- ✓ Install submeters and review electrical capacity
- ✓ Implement electrification technologies
- ✓ Upgrade building envelope
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	300 kW
Switchgear Capacity	216 kW
Est. Peak Demand	37.6 kW
Remaining Capacity	180 kW
Required Capacity	63 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority	Electrification Measure (EM)	1st Year Project Costs	1st Year Steam Savings	1st Year Electricity Savings	1st Year Demand Savings	1st Year Gas Savings	1st Year Utility Cost Savings	1st Year Emissions Savings
No.	**Name**	**$**	**klbs**	**kWh**	**kW**	**MCF**	**$**	**$mtCO_2e$**
1	Hot Water Piping Study/Design Spec Development	$15,000	0	0	0	0	$0	0
2	Replace Boiler with ASHP	$115,067	0	-53,930	-60	709	-$2,400	15
3	Replace DHW with ASHP	$4,295	0	-3,938	-3	45	-$207	1
	Total	**$134,362**	**0**	**-57,868**	**-63**	**755**	**-$2,607**	**16**

Courthouse

12 East

This building is the most complex on campus from an electrification perspective, requiring extensive upgrades to prepare for the transition to all-electric systems. Key steps include modernizing the HVAC infrastructure by updating dual-duct systems, replacing pneumatic controls with variable volume controls, and addressing hot water heating systems. Prior to designing the electric heating plant, detailed analysis of heating loads, electrical demands, and hot water system capacity is recommended to ensure optimal system performance. For this building, a new district heating system is proposed to connect the Courthouse and Law Enforcement Complex, powered by a central plant utilizing air-source and/or ground-source heat pumps as the primary heating source. The system will be constructed while steam remains the primary heating source, allowing building upgrades to align with the eventual changeover to the new hot water system. Electrical upgrades may be required, though peak heating loads could potentially be supplied via a new service at the central plant, minimizing the need for extensive electrical modifications.

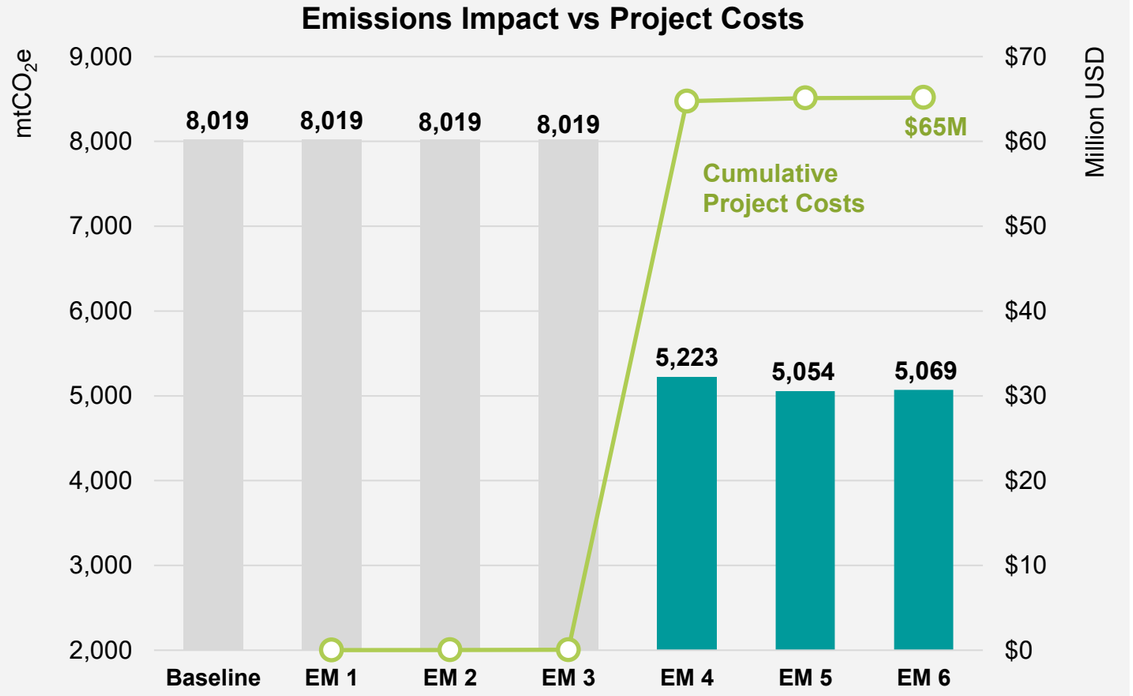


Building Implementation Plan

- ✓ Improve metering of steam and electricity
- ✓ Analyze capabilities of existing HW system
- ✓ Upgrade HVAC systems and prepare the building to be serviced by HHW at a low temperature of < 150°F
- ✓ Begin construction of new district heating plant
- ✓ Provide connection from building HHW system to new central plant
- ✓ Coordinate changeover from steam as the primary heating source to the new HW plant with the steam system decommissioning
- ✓ Implement DHW and Kitchen Electrification

Building Electrical Capacity

Bldg. TX Capacity	1,500 kW (Chiller Sub.) 750 kW (Tower) 300 kW (West) 1,000 kW (West Ext.)
Switchgear Capacity	Not Applicable
Est. Peak Demand	753 kW
Remaining Capacity	1,500 kW
Required Capacity	1,434 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority	Electrification Measure (EM)	1st Year Project Costs	1st Year Steam Savings	1st Year Electricity Savings	1st Year Demand Savings	1st Year Gas Savings	1st Year Utility Cost Savings	1st Year Emissions Savings
No.	**Name**	**$**	**klbs**	**kWh**	**kW**	**MCF**	**$**	**$mtCO_2e$**
1	Install Submeters on Electric System	$15,000	0	0	0	0	$0	0
2	Calibrate Steam Meter and Track Usage	$10,000	0	0	0	0	$0	0
3	HW System Piping Capacity Study	$25,000	0	0	0	0	$0	0
4	Implement District Hot Water Heating System with GSHP Central Plant	$64,688,809	30,780	-1,958,367	-1,445	0	$92,380	2,796
5	Domestic Hot Water Electrification	$265,222	2,656	-331,906	-177	0	-$9,950	169
6	Kitchen Electrification	$46,000	0	-72,276	-24	317	-$6,372	-1
	Total	**$65,050,031**	**33,436**	**-2,362,549**	**-1,646**	**317**	**$76,058**	**2,950**

East Annex

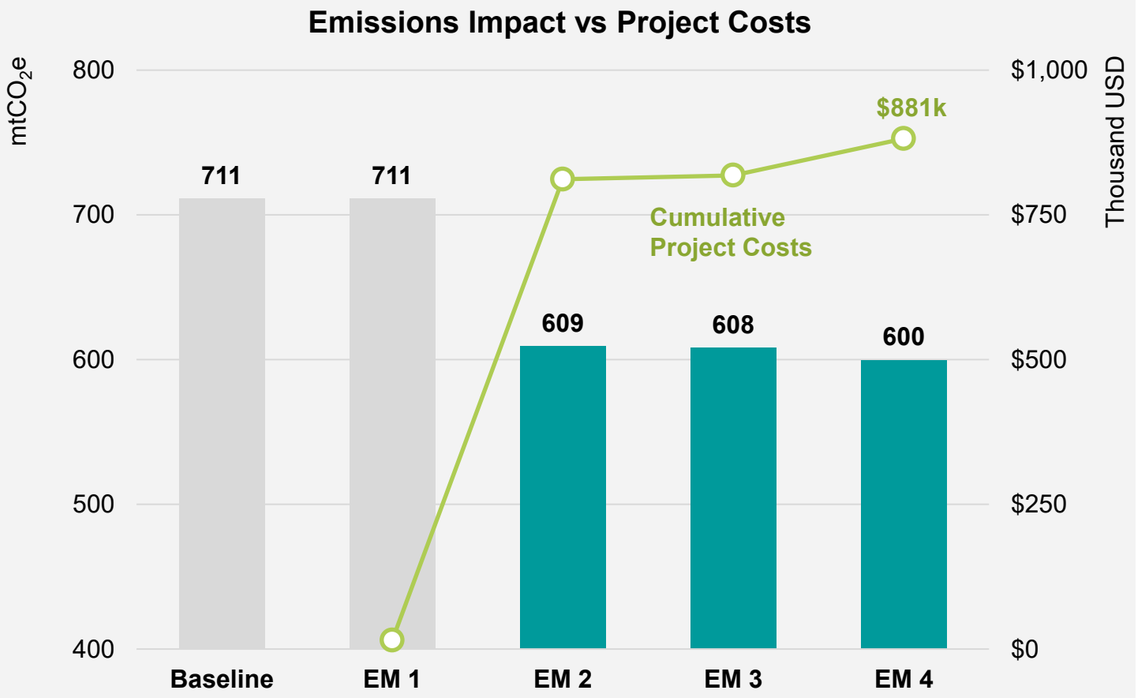
8 East

This building has hot water and ventilation systems that can be replaced with high-efficiency heat pump technologies. The two existing hot water boilers can be replaced with a central heat pump system, and the cabinet and unit heaters can be converted to split-system heat pumps to fully electrify the heating load. The hot water piping will be upgraded as required in the Hot Water Piping Study / Design Specification Development to support the new ASHP system.



Building Implementation Plan
✓ Analyze and upgrade HVAC systems
✓ Install submeters and review electrical capacity
✓ Implement electrification technologies
✓ Upgrade building envelope
✓ Perform other efficiency measures

Building Electrical Capacity	
Bldg. TX Capacity	750 kW
Switchgear Capacity	1,000 kW
Est. Peak Demand	221 kW
Remaining Capacity	529 kW
Required Capacity	454 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Hot Water Piping Study/Design Spec Development	$15,000	0	0	0	0	$0	0
2	Replace Boiler with ASHP	$796,425	0	-402,956	-417	5,100	-$18,926	102
3	Replace DHW with ASHP	$6,882	0	-6,705	-4	73	-$376	1
4	Replace Unit Heaters (CUH and UH) with Split Systems	$63,346	0	-30,855	-33	406	-$1,374	8
	Total	**$881,653**	**0**	**-440,516**	**-454**	**5,579**	**-$20,675**	**111**

Executive Office Building

41 West

This building has a centralized hot water system that can be replaced with high-efficiency heat pump technologies. The three existing hot water boilers can be replaced with a central ASHP system, and the domestic hot water system can also be electrified with a dedicated heat pump water heater. The hot water piping will be upgraded as required in the Hot Water Piping Study / Design Specification Development to support the new system.

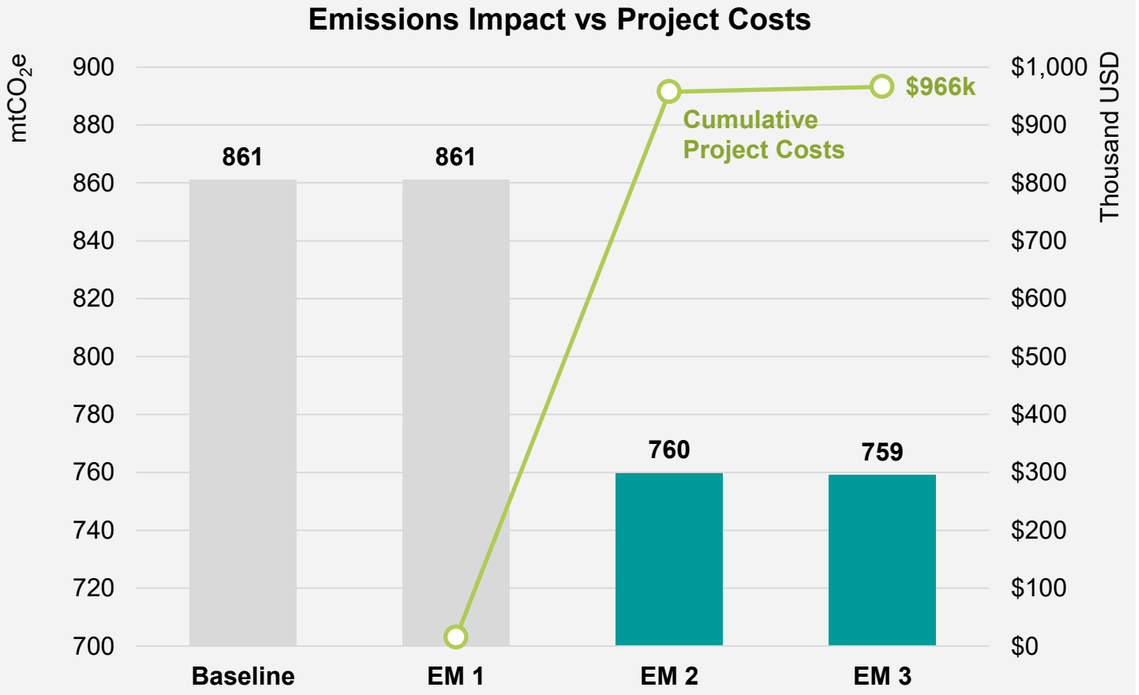


Building Implementation Plan

- ✓ Analyze and upgrade HVAC systems
- ✓ Install submeters and review electrical capacity
- ✓ Implement electrification technologies
- ✓ Upgrade building envelope
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	1,000 kW
Switchgear Capacity	1,328 kW
Est. Peak Demand	280 kW
Remaining Capacity	720 kW
Required Capacity	498 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Hot Water Piping Study/Design Spec Development	$15,000	0	0	0	0	$0	0
2	Replace Boiler with ASHP	$942,426	0	-441,695	-493	5,404	-$21,675	101
3	Replace DHW with ASHP	$8,615	0	-9,480	-5	91	-$590	1
	Total	**$966,042**	**0**	**-451,175**	**-498**	**5,495**	**-$22,265**	**102**

Information Technology

49 West

This building has HVAC systems that can be replaced with high efficiency heat pump systems. There is an option to replace the steam to hot water heating system with a central ASHP system, or to upgrade the HVAC and controls while installing a GSHP for the baseboard heating system. Additionally, waste heat from IT loads could be used to offset nearly 50% of the building heating load. This could be achieved through a hybrid air source or ground source system paired with a heat recovery chiller. Efficiency for this system would exceed the GSHP performance. However, this system would add additional complexity to the HVAC system and potentially not be available at all times if IT electrical load is 100% utilized.

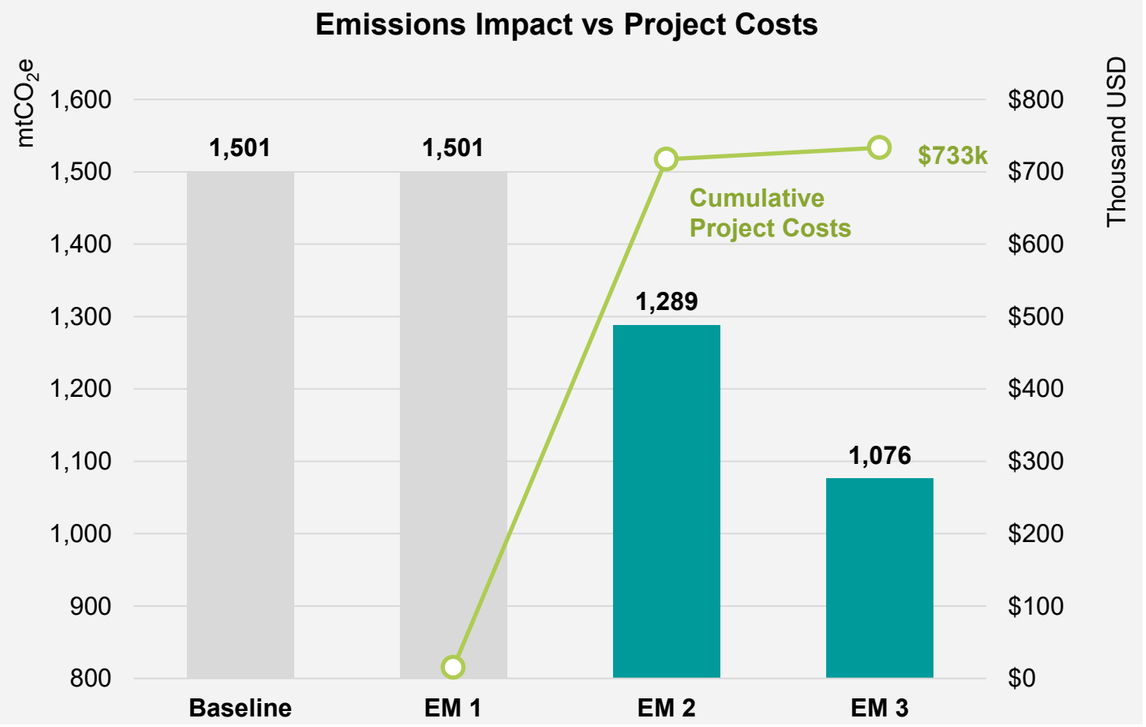


Building Implementation Plan

- ✓ Perform hot water heating study and implement upgrades as needed
- ✓ Finalize design for heating system and waste heat recovery potential
- ✓ Implement electrification technologies
- ✓ Perform efficiency measures
- ✓ Decommission steam connection

Building Electrical Capacity

Bldg. TX Capacity	1,000 kW
Switchgear Capacity	1,333 kW
Est. Peak Demand	465 kW
Remaining Capacity	535 kW
Required Capacity	385 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority	Electrification Measure (EM)	1st Year Project Costs	1st Year Steam Savings	1st Year Electricity Savings	1st Year Demand Savings	1st Year Gas Savings	1st Year Utility Cost Savings	1st Year Emissions Savings
No.	**Name**	**$**	**klbs**	**kWh**	**kW**	**MCF**	**$**	**$mtCO_2e$**
1	Hot Water Piping Study/Design Spec Development	$15,000	0	0	0	0	$0	0
2	Replace Steam Hot Water System with Packaged Heat Pump Forced Air Heating	$702,334	3,010	-329,169	-368	0	-$6,108	212
3	Domestic Hot Water Electrification	$16,000	215	-26,887	-17	0	-$806	14
	Total	**$733,344**	**$3,225**	**-$356,056**	**-$385**	**$0**	**-$6,914**	**226**

Little Oaks

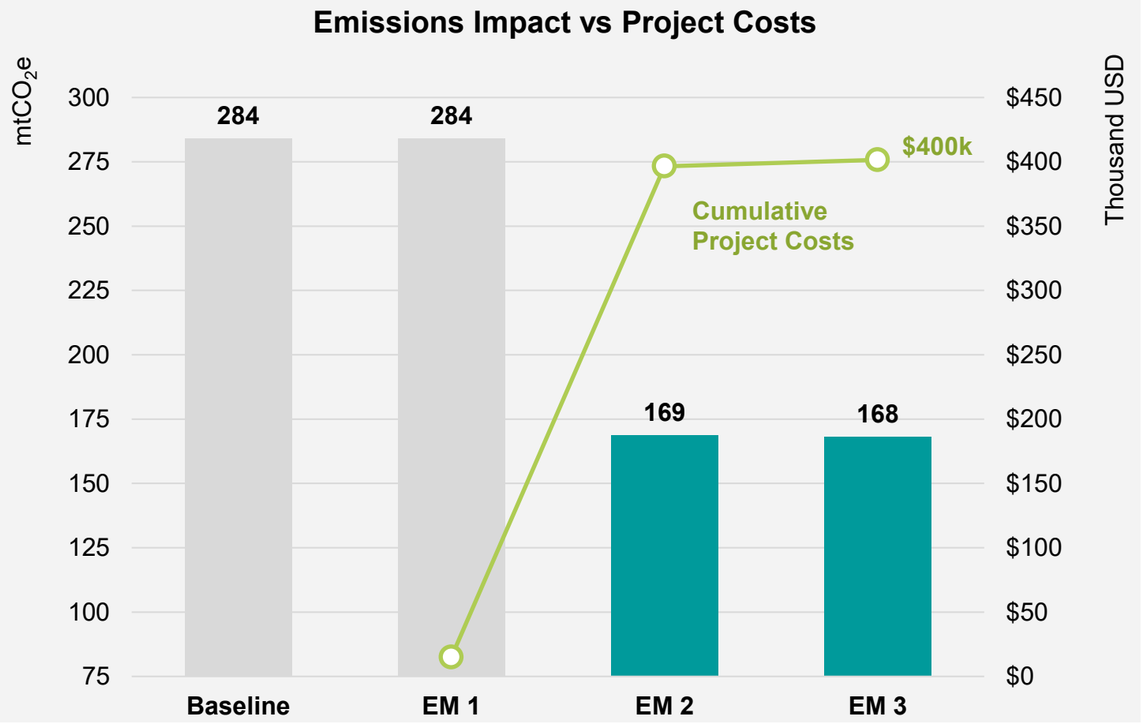
30 East

This building has HVAC systems that can be replaced with high efficiency heat pump systems. There is an option to replace the steam to hot water heating system with a central ASHP system, or to upgrade the HVAC and controls while installing a GSHP for the baseboard heating system.



Building Implementation Plan
✓ Perform HHW study
✓ Implement electrification technologies
✓ Perform HVAC efficiency measures
✓ Decommission steam connection

Building Electrical Capacity	
Bldg. TX Capacity	150 kW
Switchgear Capacity	216 kW
Est. Peak Demand	38 kW
Remaining Capacity	112 kW
Required Capacity	202 kW



Required capacity exceeds remaining capacity. Investigate electrical capacity at the building.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Hot Water Piping Study/Design Spec Development	$15,000	0	0	0	0	$0	0
2	Replace Steam Hot Water System with Packaged Heat Pump Forced Air Heating	$381,531	1,635	-178,815	-200	0	-$3,320	115
3	Domestic Hot Water Electrification	$5,000	10	-1,310	-2	0	-$44	0.6
	Total	**$401,531**	**1,645**	**-180,125**	**-202**	**0**	**-$3,364**	**116**

Resource & Crisis Center

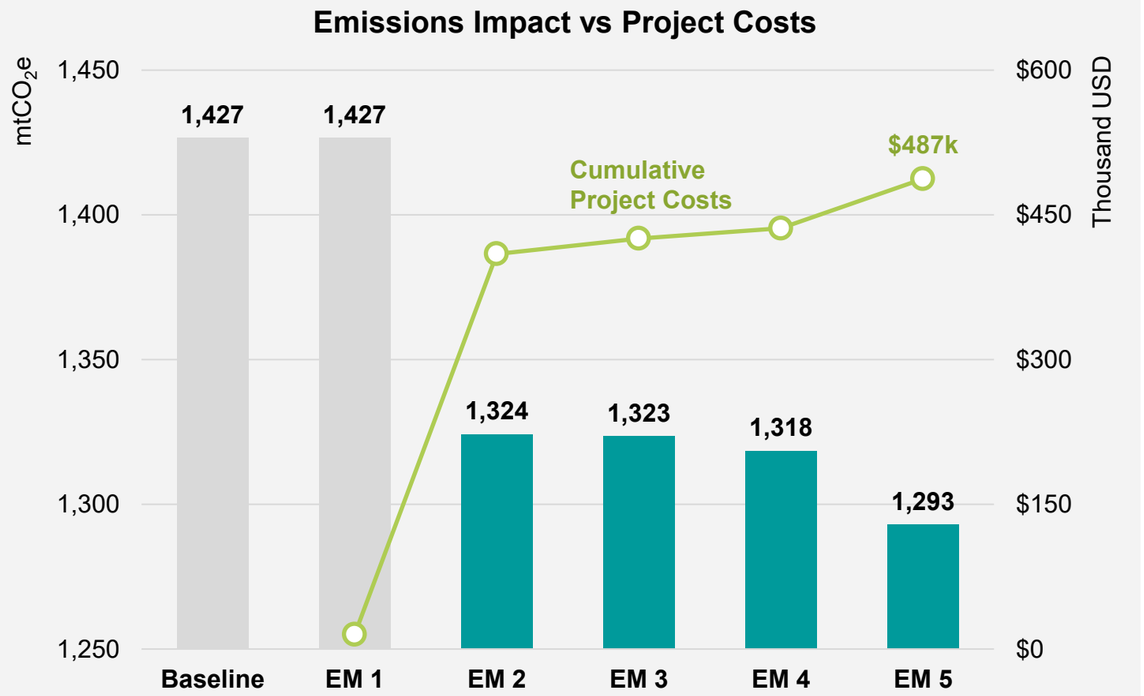
32 East

The building's HVAC systems can be modernized with high-efficiency heat pump solutions to improve energy performance and reduce emissions. Options include replacing the HHW system with a central ASHP or upgrading HVAC equipment and controls while installing a GSHP for baseboard heating. Unit and cabinet heaters should be replaced with split-system heat pumps as they reach end-of-life. With the lab relocating in Fall 2025, the future use of the space should be assessed to determine whether HVAC replacement is necessary or if the existing unit can be decommissioned. Steam usage should be monitored regularly to identify the right time to disconnect the steam connection, reducing costs and improving efficiency. This phased approach ensures a seamless transition to modern systems while supporting long-term sustainability goals.



Building Implementation Plan
✓ Perform HHW study
✓ Determine future use of lab space
✓ Perform HVAC efficiency measures
✓ Implement electrification technologies
✓ Decommission steam connection

Building Electrical Capacity	
Bldg. TX Capacity	1,500 kW
Switchgear Capacity	1,330 kW
Est. Peak Demand	680 kW
Remaining Capacity	650 kW
Required Capacity	244 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority	Electrification Measure (EM)	1st Year Project Costs	1st Year Steam Savings	1st Year Electricity Savings	1st Year Demand Savings	1st Year Gas Savings	1st Year Utility Cost Savings	1st Year Emissions Savings
No.	**Name**	**$**	**klbs**	**kWh**	**kW**	**MCF**	**$**	**$mtCO_2e$**
1	HW Piping Study/Design Spec Development	$15,000	0	0	0	0	$0	0
2	Replace Steam Hot Water System with Air-Source Heat Pump	$394,518	1,452	-158,786	-206	0	-$2,946	102
3	Domestic Hot Water Electrification	$16,000	0	-3,838	-5	44	-$202	1
4	Replace Natural Gas RTU with Equivalent Heat Pump RTU	$10,534	0	-17,709	-6	233	-$786	5
5	Replace Steam Cabinet & Unit Heaters with Split Systems	$51,266	220	-1,604	-27	0	$2,024	25
	Total	**$487,319**	**1,672**	**-181,938**	**-244**	**277**	**-$1,911**	**134**

Sheriff's Admin

38 East

This building has inefficient HVAC systems that can be replaced with high efficiency heat pump systems. There is an option to replace the hot water heating system with a central ASHP system, or to upgrade the HVAC and controls while installing a GSHP for the baseboard heating system. Under current assumptions, this building would not require an electric service upgrade. It is recommended to replace the steam absorption chiller with a centrifugal chiller to reduce steam cooling use. The new electric chiller will only operate in cooling months while the GSHP system will operate in the heating months. For this reason, the higher demand was used in the electrical system capacity check.

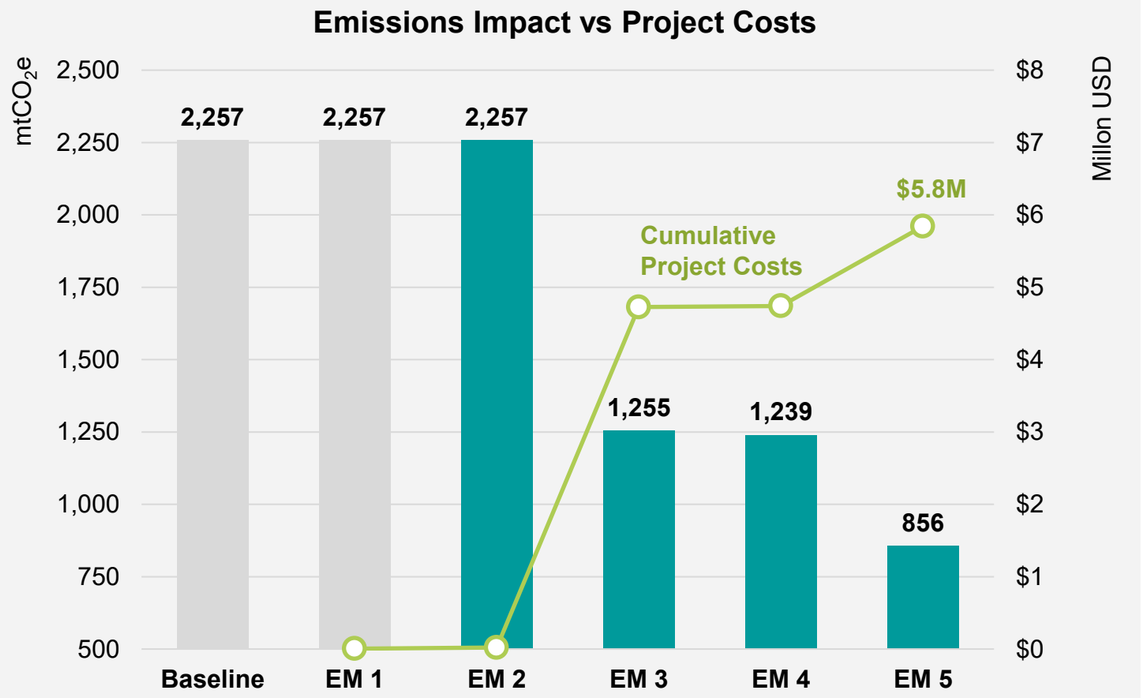


Building Implementation Plan

- ✓ Install submeters and review electrical capacity
- ✓ Perform hot water heating study and implement upgrades as needed
- ✓ Perform HVAC efficiency measures
- ✓ Decommission steam connection

Building Electrical Capacity

Bldg. TX Capacity	750 kW
Switchgear Capacity	1,000 kW
Est. Peak Demand	240 kW
Remaining Capacity	510 kW
Required Capacity	453 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Install Demand Meters on Electrical System to Better Understand Remaining Capacity	$5,000	0	0	0	0	$0	0
2	Hot Water Piping Study/Design Specification Development	$15,000	0	0	0	0	$0	0
3	GSHP Heating Hot Water & Controls	$4,706,044	10,217	-483,114	-433	0	$49,027	1,002
4	Domestic Hot Water Electrification	$16,000	255	-31,890	-20	0	-$956	16
5	Replace Absorption Chiller with Centrifugal Chiller	$1,100,000	4,064	-227,532	-309	0	$15,609	383
	Total	**$5,842,044**	**14,536**	**-742,536**	**-763**	**0**	**$63,680**	**1,401**

Pontiac Health Building

36 East

This building has outdated HVAC systems that can be replaced with high efficiency heat pump systems. There is an option to replace the hot water heating system with a central ASHP system, or to upgrade the HVAC and controls while installing a GSHP for the baseboard heating system.

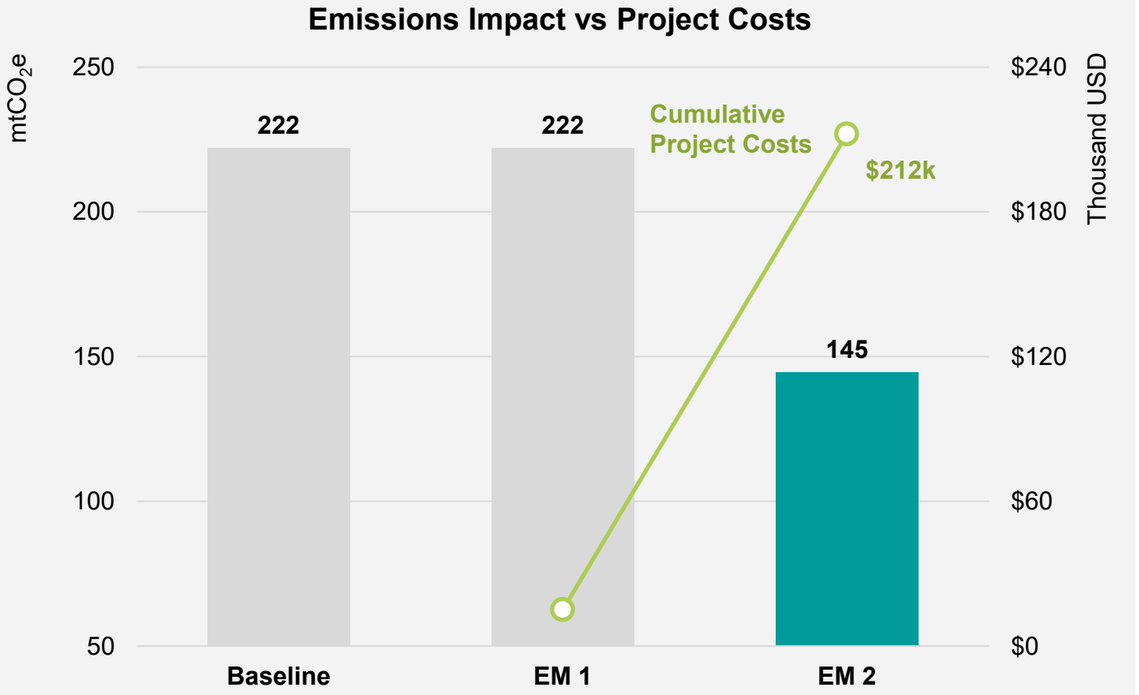


Building Implementation Plan

- ✓ Perform HW heating study and implement upgrades as needed
- ✓ Perform HVAC efficiency measures
- ✓ Implement electrification technologies
- ✓ Decommission steam connection

Building Electrical Capacity

Bldg. TX Capacity	750 kW
Switchgear Capacity	900 kW
Est. Peak Demand	88 kW
Remaining Capacity	667 kW
Required Capacity	103 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Hot Water Piping Study/Design Spec Development	$15,000	0	0	0	0	$0	0
2	Replace Steam Hot Water System with Packaged Heat Pump Forced Air Heating	$197,206	994	-92,426	-103	0	-$224	77
	Total	**$212,206**	**994**	**-92,426**	**-103**	**0**	**-$224**	**77**

Public Works

1 Public Works Drive

This building has inefficient dual duct HVAC systems. These systems should be converted to variable air volume systems before additional heating upgrades are completed. Once HVAC is optimized, reevaluate the gas heating load required to heat the building and size heat pumps accordingly. The electrical capacity of this building is very close to maximized with the use of ASHP heating but is well within acceptable range if GSHP is used. Replace RTUs with heat pump units at end of useful life.

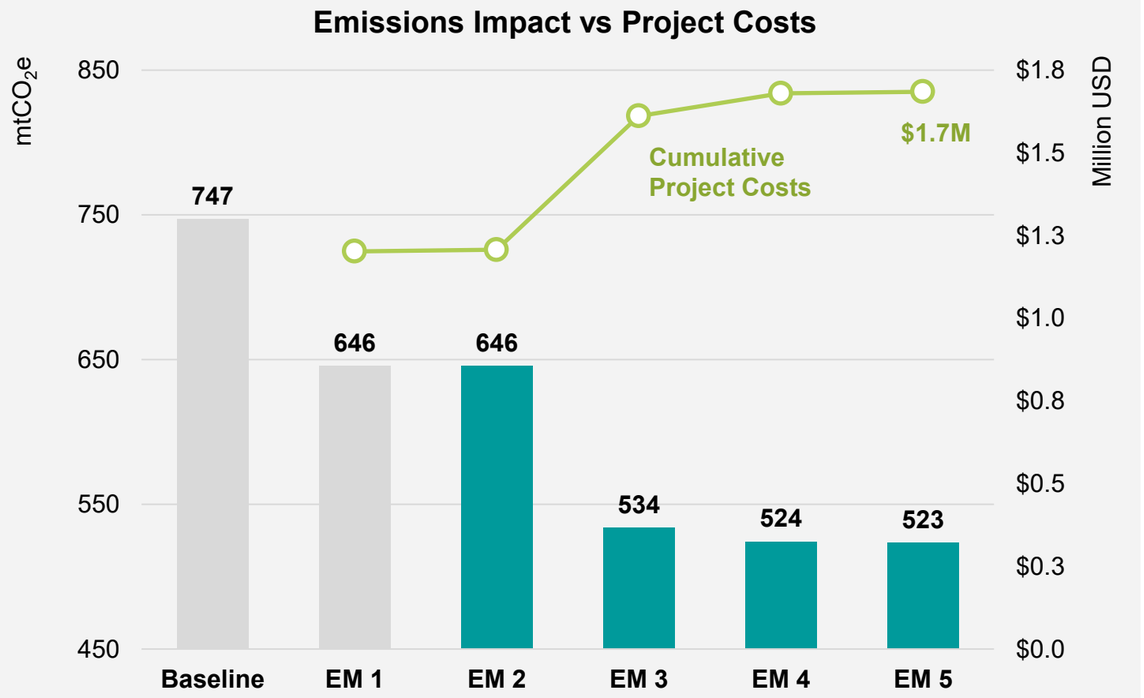


Building Implementation Plan

- ✓ Analyze and upgrade HVAC systems
- ✓ Install submeters and review electrical capacity
- ✓ Implement electrification technologies
- ✓ Upgrade building envelope
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	750 kW
Switchgear Capacity	498 kW
Est. Peak Demand	289 kW
Remaining Capacity	212 kW
Required Capacity	252 kW



Required capacity exceeds remaining capacity. Investigate electrical capacity at the building.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Upgrade/Optimize HVAC Systems, replace Dual Duct AHUs with VAV	$1,202,000	0	102,894	0	1,017	$16,384	101
2	Install Demand Meters on Electrical System to Better Understand Remaining Capacity	$5,000	0	0	0	0	$0	0
3	Replace Boiler with ASHP	$404,288	0	-189,481	-212	3,560	-$3,114	112
4	Replace RTUs with HP Packaged Units	$68,337	0	-34,803	-39	458	-$1,549	10
5	Domestic Hot Water Electrification	$5,000	0	-4,901	-2	53	-$275	1
	Total	**$1,684,625**	**0**	**-126,291**	**-252**	**5,088**	**$11,447**	**224**

Farmers Market

1 Public Works Drive

This building has natural gas heating systems that can be replaced with high-efficiency heat pump technologies. The two existing duct furnaces can be converted to equivalent heat pump RTUs for each zone, and the domestic hot water system can be electrified with a heat pump water heater.

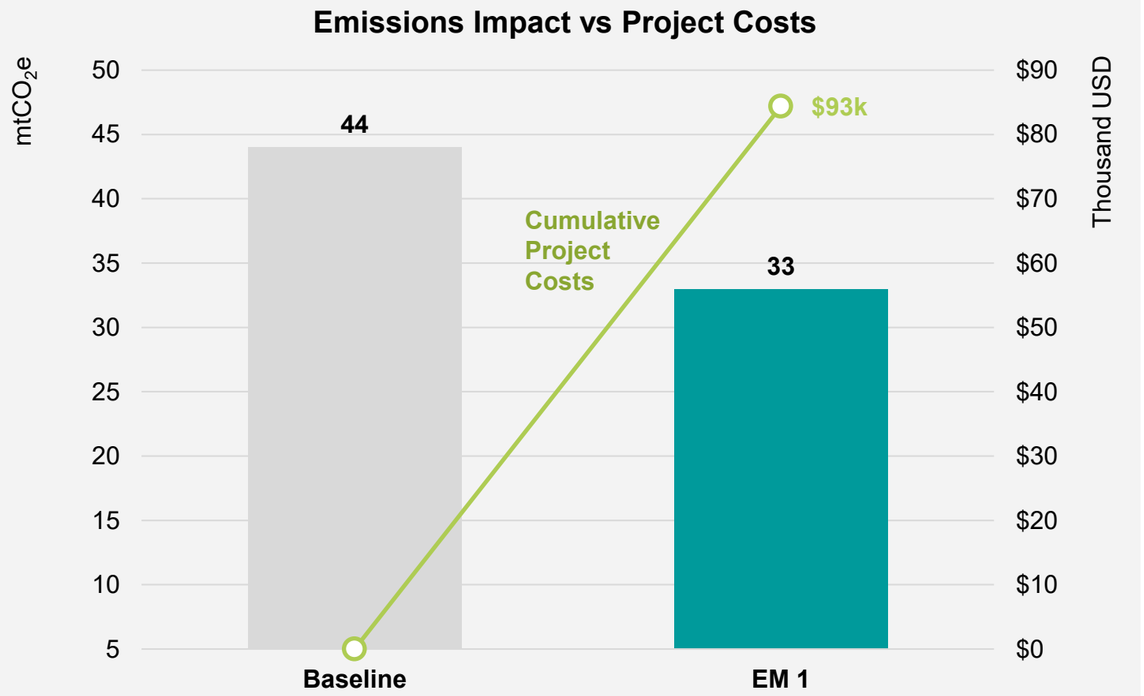


Building Implementation Plan

- ✓ Analyze and upgrade HVAC systems
- ✓ Install submeters and review electrical capacity
- ✓ Implement electrification technologies
- ✓ Update building envelope

Building Electrical Capacity

Bldg. TX Capacity	150 kW
Switchgear Capacity	144 kW
Est. Peak Demand	7.7 kW
Remaining Capacity	137 kW
Required Capacity	45 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Replace Natural Gas RTUs with Equivalent Heat Pump RTUs	$84,363	0	-39,539	-44	520	-$1,760	11
2								
3								
4								
5								
	Total	**$84,363**	**0**	**-39,539**	**-44**	**520**	**-$1,760**	**11**

Materials Management

1155 Oakland Ave

This building has natural gas heating and ventilation systems that can be replaced with high-efficiency heat pump technologies. The existing boiler can be replaced with an ASHP system, while the six natural gas RTUs and gas-fired unit heaters can be converted to equivalent heat pump RTUs or split-system heat pumps for each zone. The hot water piping will be upgraded as required in the Hot Water Piping Study / Design Specification Development to support the new system, and the domestic hot water load can be electrified with a heat pump water heater.

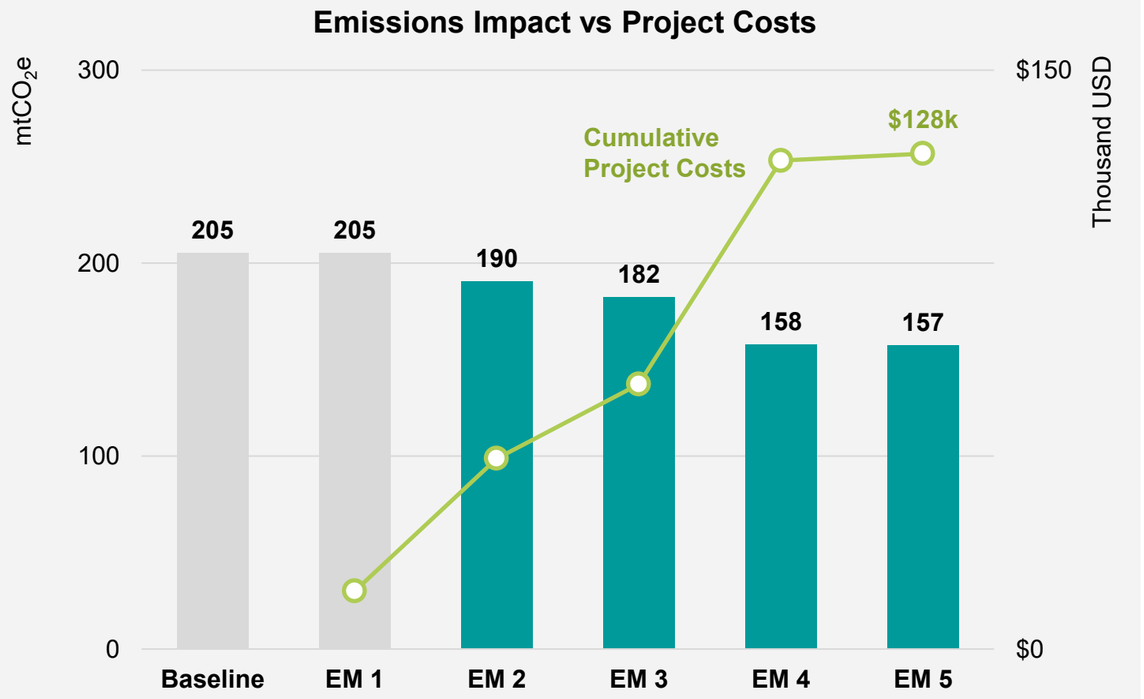


Building Implementation Plan

- ✓ Analyze and upgrade HVAC systems
- ✓ Install submeters and review electrical capacity
- ✓ Implement electrification technologies
- ✓ Upgrade building envelope
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	300 kW
Switchgear Capacity	320 kW
Est. Peak Demand	100 kW
Remaining Capacity	200 kW
Required Capacity	59 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Hot Water Piping Study/Design Spec Development	$15,000	0	0	0	0	$0	0
2	Replace Boiler with ASHP	$34,364	0	-52,279	-18	687	-$2,328	15
3	Replace Natural Gas RTUs with Equivalent Heat Pump RTUs	$19,244	0	-29,276	-10	385	-$1,304	8
4	Replace Gas Unit Heaters with Split Systems	$57,937	0	-88,142	-30	1,159	-$3,924	25
5	Replace DHW with ASHP	$1,804	0	-1,654	-1	19	-$87	0
	Total	**$128,349**	**0**	**-171,351**	**-59**	**2,250**	**-$7,643**	**48**

North Oakland Health Center

34 East

This building has HVAC systems that can be replaced with high efficiency heat pump systems. There is an option to replace the steam to hot water heating system with an air source heat pump that utilizes the existing hot water system, or to upgrade the HVAC and controls while installing a GSHP for the baseboard heating system. For this building, electrical capacity could be a concern such that if the electrical service needs to be upgraded, a GSHP may become the more economical option than the service upgrade.

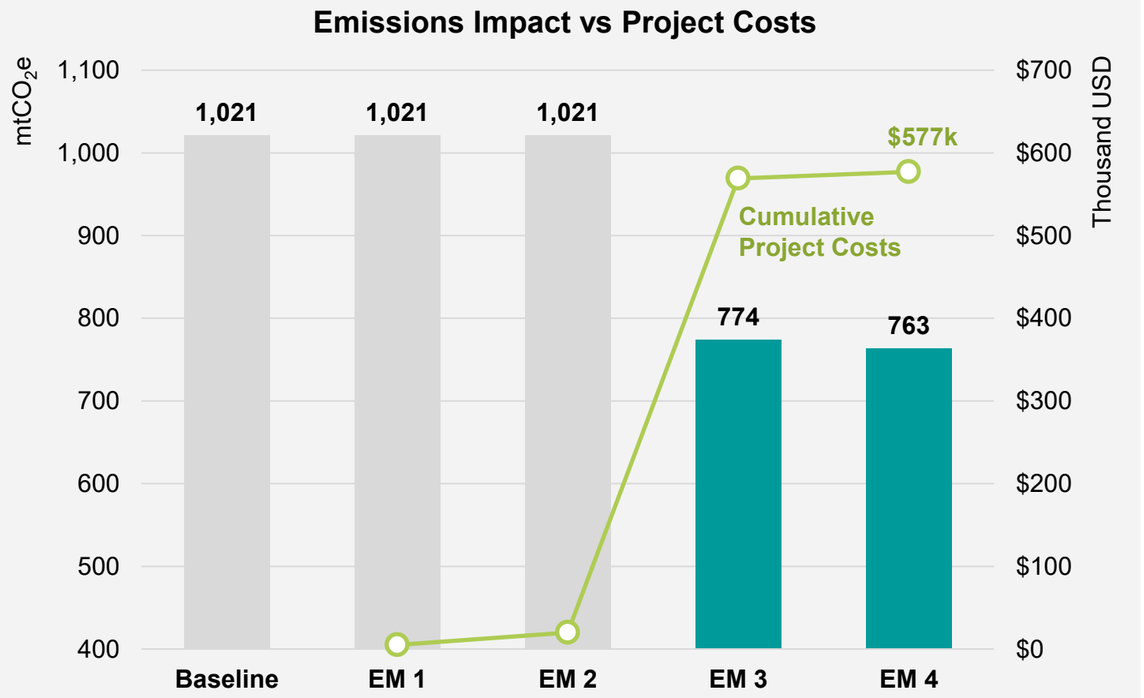


Building Implementation Plan

- ✓ Install submeters and review electrical capacity
- ✓ Perform hot water heating study and implement upgrades as needed
- ✓ Perform HVAC efficiency measures
- ✓ Implement electrification technologies
- ✓ Model electrified building energy use to determine electrical upgrade requirement

Building Electrical Capacity

Bldg. TX Capacity	750 kW
Switchgear Capacity	1,000 kW
Est. Peak Demand	195 kW
Remaining Capacity	555 kW
Required Capacity	300 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority	Electrification Measure (EM)	1st Year Project Costs	1st Year Steam Savings	1st Year Electricity Savings	1st Year Demand Savings	1st Year Gas Savings	1st Year Utility Cost Savings	1st Year Emissions Savings
No.	**Name**	**$**	**klbs**	**kWh**	**kW**	**MCF**	**$**	**$mtCO_2e$**
1	Install Demand Meters on Electrical System to Better Understand Remaining Capacity	$5,000	0	0	0	0	$0	0
2	Hot Water Piping Study/Design Spec Development	$15,000	0	0	0	0	$0	0
3	Replace steam hot water system with packaged heat pump forced air heating	$549,038	3,036	-257,322	-287	0	$2,057	247
4	Domestic Hot Water Electrification	$8,000	160	-19,972	-13	0	-$599	10
	Total	**$577,038**	**3,196**	**-277,294**	**-300**	**0**	**$1,458**	**257**

North Office Building

26 East

This building has outdated HVAC systems that can be replaced with high efficiency heat pump systems. There is an option to replace the steam coils in the air handling equipment with DX heat pump coils, or to connect the building to a GSPH heating system and use hot water as the heating medium. This option could utilize the chilled water piping in winter months and decommissioning the steam heating coil.

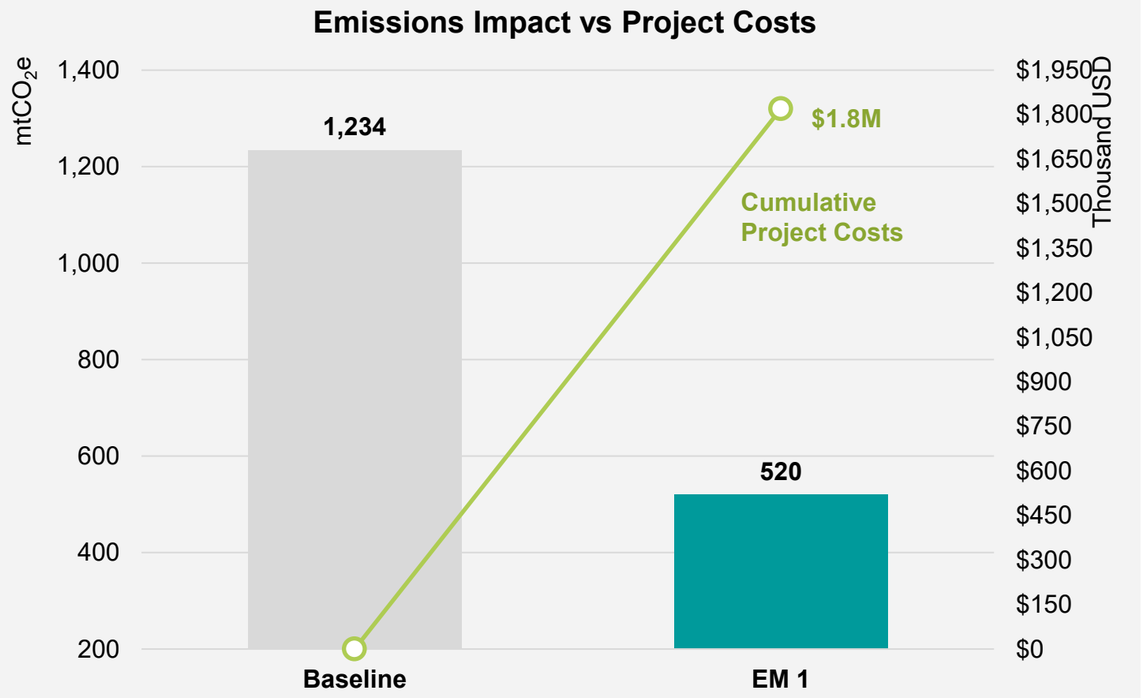


Building Implementation Plan

- ✓ Install submeters and review electrical capacity
- ✓ Upgrade building HVAC
- ✓ Decommission steam system
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	500 kW
Switchgear Capacity	665 kW
Est. Peak Demand	77 kW
Remaining Capacity	423 kW
Required Capacity	952 kW



Required capacity exceeds remaining capacity. Investigate electrical capacity at the building.

Priority	Electrification Measure (EM)	1st Year Project Costs	1st Year Steam Savings	1st Year Electricity Savings	1st Year Demand Savings	1st Year Gas Savings	1st Year Utility Cost Savings	1st Year Emissions Savings
No.	**Name**	**$**	**klbs**	**kWh**	**kW**	**MCF**	**$**	**$mtCO_2e$**
1	Replace AHU and RTU with Packaged Heat Pump Units	$1,819,532	9,174	-852,776	-952	0	-$2,065	714
	Total	**$1,819,532**	**9,174**	**-852,776**	**-952**	**0**	**-$2,065**	**714**

Medical Examiners

28 East

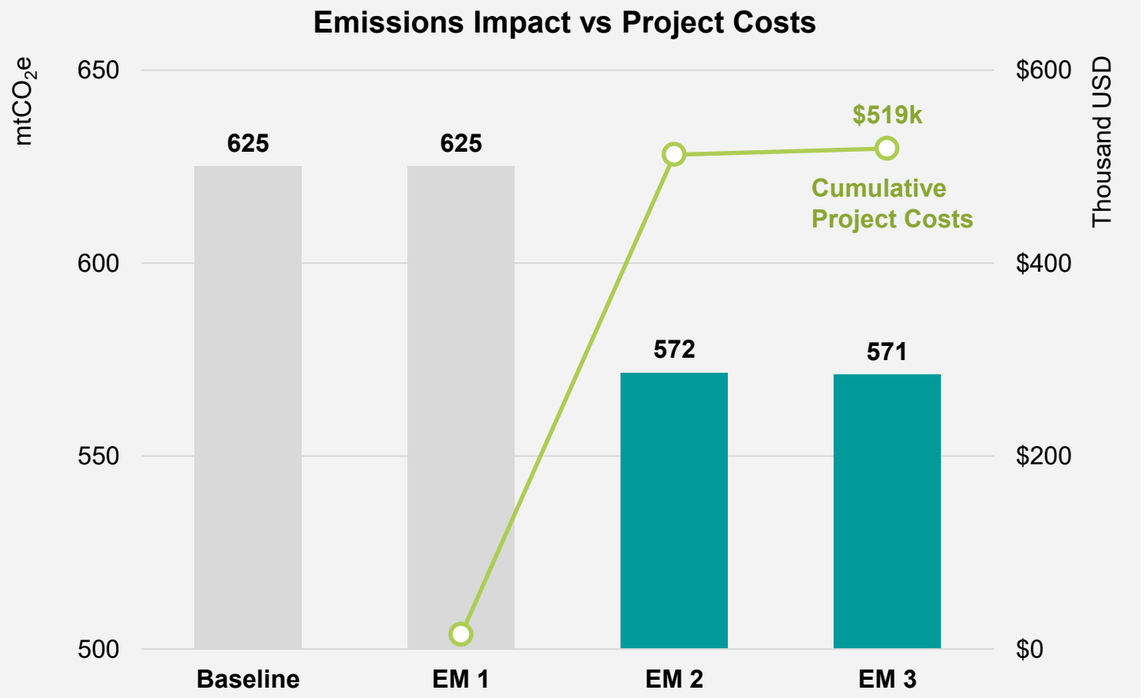
This building has a central steam heating system that can be replaced with a high-efficiency heat pump system. The existing steam boiler can be converted to an ASHP system, and the domestic hot water system can also be electrified with a dedicated heat pump water heater. The hot water piping will be upgraded as required in the Hot Water Piping Study / Design Specification Development to support the new system.



Building Implementation Plan

- ✓ Analyze and upgrade HVAC systems
- ✓ Install submeters and review electrical capacity
- ✓ Implement electrification technologies
- ✓ Upgrade building envelope
- ✓ Perform other efficiency measures

Building Electrical Capacity	
Bldg. TX Capacity	1,500 kW
Switchgear Capacity	1,660 kW
Est. Peak Demand	246 kW
Remaining Capacity	1,254 kW
Required Capacity	264 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	HW Piping Study / Design Specification Development	$15,000	0	0	0	0	$0	0
2	Replace Boiler with ASHP	$497,333	0	-233,089	-260	2,852	-$11,438	53
3	Replace DHW with ASHP	$6,445	0	-5,910	-4	68	-$311	1
	Total	**$518,778**	**0**	**-238,999**	**-264**	**2,920**	**-$11,750**	**55**

Patrol Services

57 West

This building has natural gas heating and ventilation systems that can be replaced with high-efficiency heat pump technologies, and the domestic hot water system can be electrified with a heat pump water heater. The existing hot water boiler and gas RTU can be replaced with a central heat pump system and an equivalent heat pump RTU, respectively. The hot water piping will be upgraded as required in the Hot Water Piping Study / Design Specification Development.

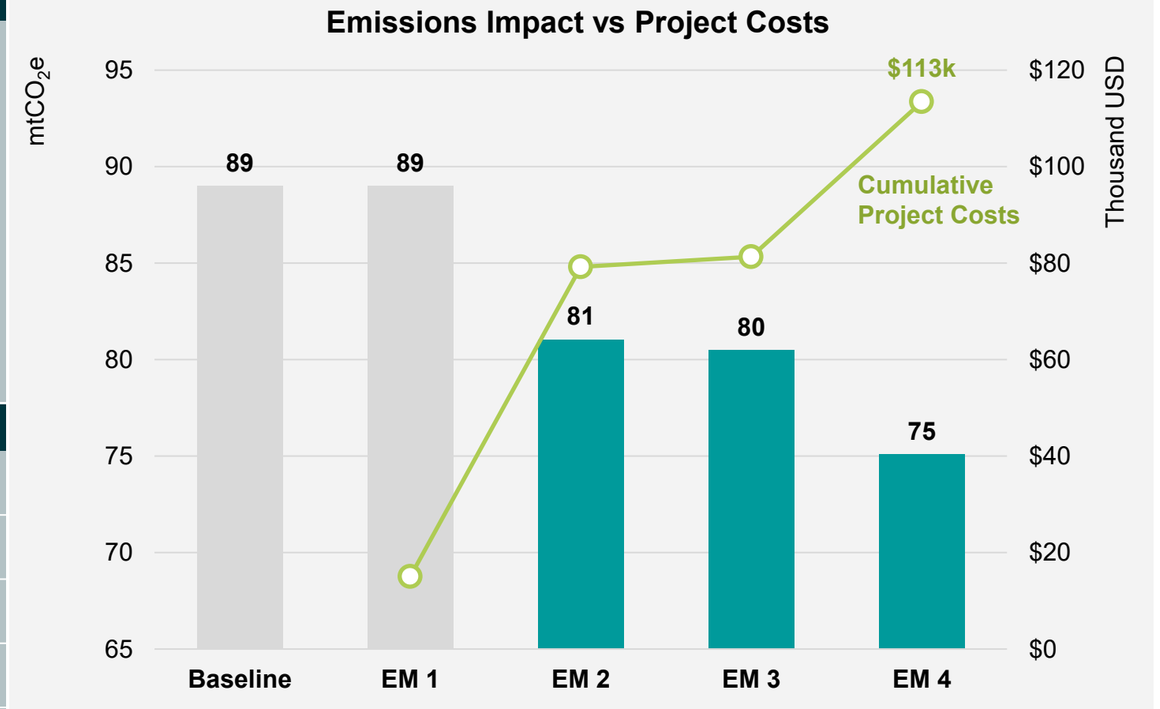


Building Implementation Plan

- ✓ Analyze and upgrade HVAC systems
- ✓ Install submeters and review electrical capacity
- ✓ Implement electrification technologies
- ✓ Upgrade building envelope
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	225 kW
Switchgear Capacity	216 kW
Est. Peak Demand	22 kW
Remaining Capacity	198 kW
Required Capacity	52 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	HW Piping Study / Design Specification Development	$15,000	0	0	0	0	$0	0
2	Replace Boiler and RTU with ASHP	$64,211	0	-45,142	-34	509	-$2,431	8
3	Replace DHW with ASHP	$2,093	0	-1,487	-1	22	-$54	1
4	Replace Gas RTU with Heat Pump Equivalent	$32,106	0	-19,353	-17	254	-$862	5
	Total	**$113,410**	**0**	**-65,982**	**-52**	**785**	**-$3,347**	**14**

Road Commission Complex

59 West

This complex contains multiple different fuel consuming equipment types of various ages. Electrification of these systems can be done but is most economical if planned at the time of needed system replacement, or end of useful life. Additionally, the electric service to this building may not support full electrification, so additional submetering and monitoring is recommended to fully understand energy use and capacity at the building. Energy efficiency can be implemented to reduce total energy consumption and minimize electric equipment sizing, but additional monitoring is recommended to fully understand impact of improvements.

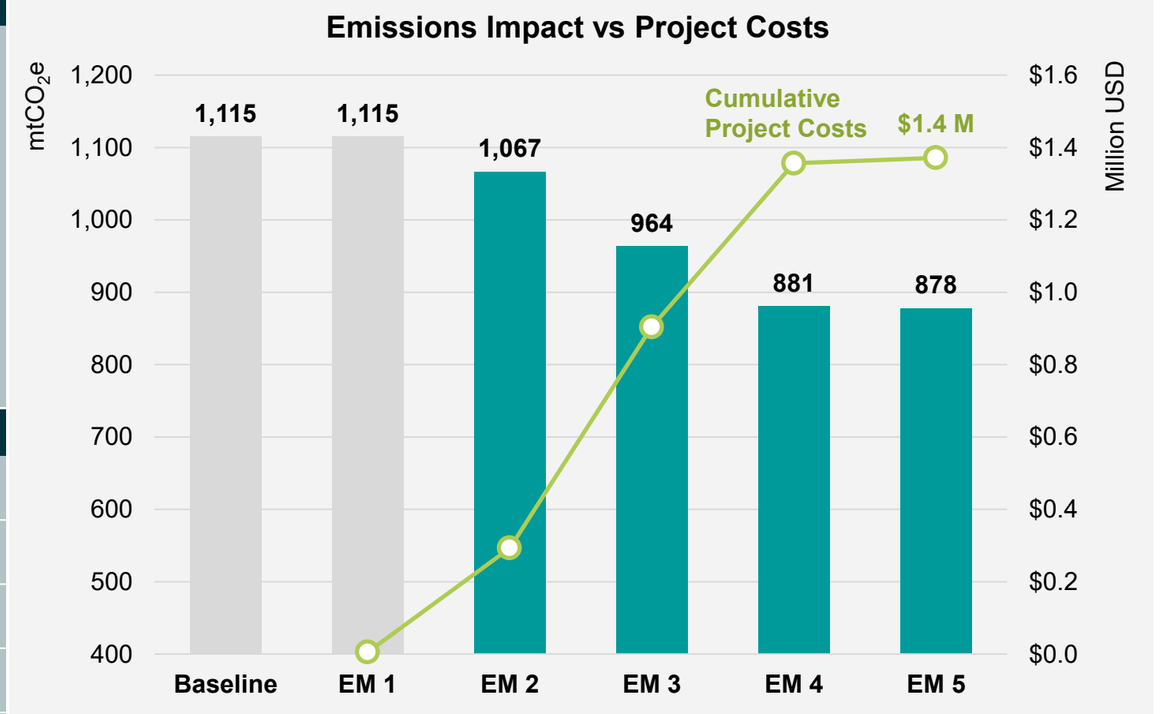


Building Implementation Plan

- ✓ Install electrical system submetering to continually analyze load
- ✓ Perform end-of-useful life replacements for ELEC 1-4
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	500 kW
Switchgear Capacity	576 kW
Est. Peak Demand	118 kW
Remaining Capacity	382 kW
Required Capacity	734 kW



Required capacity exceeds remaining capacity. Investigate electrical capacity at the building.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Install Electrical System Submetering	$5,000	0	0	0	0	$0	0
2	Replace Gas MAUs with Heat Pump Units	$287,596	0	-173,302	-151	2,279	-$7,712	48
3	Replace Unit and Infrared Heaters with Split System Heat Pumps	$611,142	0	-368,266	-320	4,843	-$16,389	103
4	Install Heat Pump Rooftop Units and Split Systems	$452,585	0	-296,346	-257	3,898	-$13,188	83
5	Domestic Hot Water Electrification	$15,000	0	-15,735	-6	181	-$829	3
	Total	**$1,371,324**	**0**	**-853,648**	**-734**	**11,201**	**-$38,118**	**237**

Credit Union

51 West

This building served by six RTUs that contain natural gas furnaces for heating. These units can be replaced with heat pump RTUs, with minimal infrastructure changes required within the building. Domestic hot water for the facility is currently provided by natural gas water heaters. This can be replaced with an ASHP to fully electrify the building.

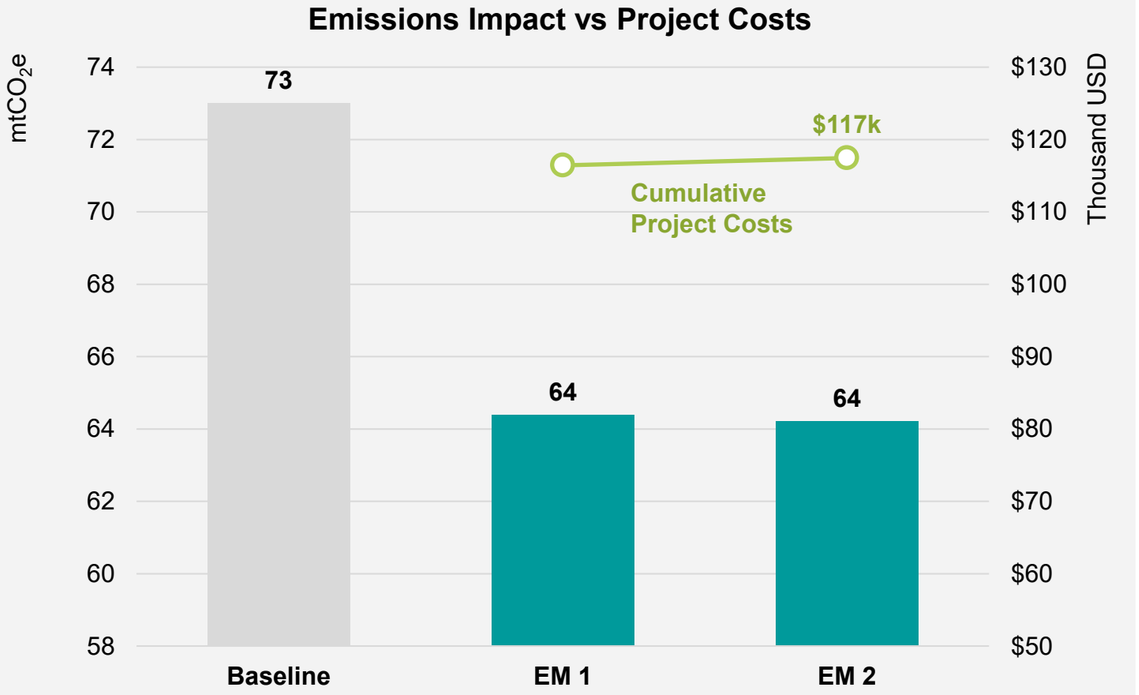


Building Implementation Plan

- ✓ Analyze and upgrade HVAC systems
- ✓ Install submeters and review electrical capacity
- ✓ Implement electrification technologies
- ✓ Upgrade building envelope
- ✓ Perform other efficiency measures

Building Electrical Capacity

Bldg. TX Capacity	500 kW
Switchgear Capacity	210 kW
Est. Peak Demand	18 kW
Remaining Capacity	202 kW
Required Capacity	62 kW



Required capacity does not exceed remaining capacity. No electrical upgrade required.

Priority No.	Electrification Measure (EM) Name	1st Year Project Costs $	1st Year Steam Savings klbs	1st Year Electricity Savings kWh	1st Year Demand Savings kW	1st Year Gas Savings MCF	1st Year Utility Cost Savings $	1st Year Emissions Savings $mtCO_2e$
1	Replace Natural Gas RTUs with Equivalent Heat Pump RTUs	$116,426	0	-54,566	-61	597	-$3,030	9
2	Replace DHW with ASHP	$1,015	0	-931	-1	11	-$49	0
	Total	**$117,441**	**0**	**-55,497**	**-62**	**608**	**-$3,079**	**9**

Law Enforcement Complex

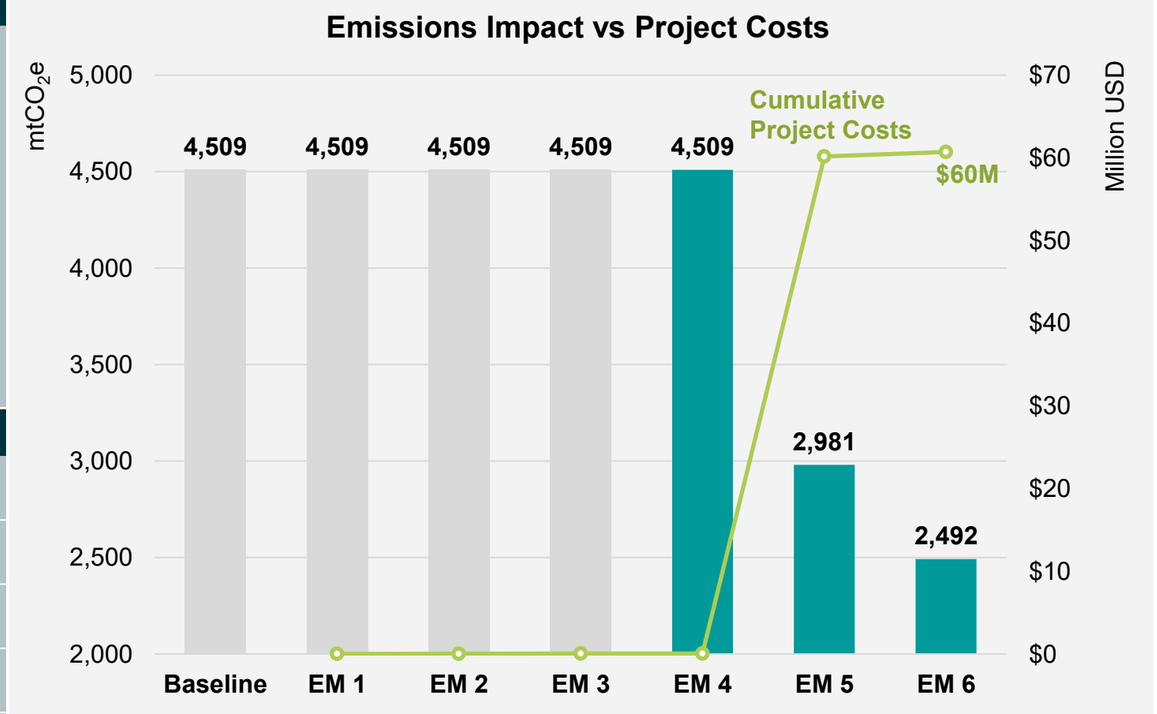
32 East

The building's HVAC systems can be modernized with high-efficiency heat pump solutions to improve energy performance and reduce emissions. Options include replacing the HHW system with a central ASHP or upgrading HVAC equipment and controls while installing a GSHP for baseboard heating. Unit and cabinet heaters should be replaced with split-system heat pumps as they reach end-of-life. With the lab relocating in Fall 2025, the future use of the space should be assessed to determine whether HVAC replacement is necessary or if the existing unit can be decommissioned. Steam usage should be monitored regularly to identify the right time to disconnect the steam connection, reducing costs and improving efficiency. This phased approach ensures a seamless transition to modern systems while supporting long-term sustainability goals.



Building Implementation Plan
✓ Perform HHW study
✓ Determine future use of lab space
✓ Perform HVAC efficiency measures
✓ Implement electrification technologies
✓ Decommission steam connection

Building Electrical Capacity	
Bldg. TX Capacity	750 kW
Switchgear Capacity	900 kW
Est. Peak Demand	590 kW
Remaining Capacity	160 kW
Required Capacity	1,685 kW



Required capacity exceeds remaining capacity. Investigate electrical capacity at the building.

Priority	Electrification Measure (EM)	1st Year Project Costs	1st Year Steam Savings	1st Year Electricity Savings	1st Year Demand Savings	1st Year Gas Savings	1st Year Utility Cost Savings	1st Year Emissions Savings
No.	**Name**	**$**	**klbs**	**kWh**	**kW**	**MCF**	**$**	**$mtCO_2e$**
1	Install Submeters on Electric System	$15,000	0	0	0	0	$0	0
2	Calibrate Steam Meter and Track Usage	$10,000	0	0	0	0	$0	0
3	Hot Water System Piping Capacity Study	$25,000	0	0	0	0	$0	0
4	Kitchen Electrification	$1,500	0	-634	-24	3	-$55	-0.1
5	Implement District Hot Water Heating System with GSHP Central Plant	$60,102,132	16,822	-1,070,301	-1,342	0	$50,485	1,528
6	Domestic Hot Water Electrification	$555,095	5,558	-389,010	-370	0	$12,791	489
	Total	**$60,708,727**	**$22,380**	**-$1,459,946**	**-$1,736**	**3**	**$63,222**	**2,017**

4 Electric Heating Plant Concept for Courthouse and Law Enforcement Complex

During the Scenario Planning Workshop, held on August 5th, 2025, AECOM presented a variety of decarbonization strategies and scenarios to Oakland County project leadership. During this meeting, the Oakland County Team expressed interest in the development of new central heating plant that supplied hot water to the two buildings with the highest current steam demand, which are the Courthouse and Law Enforcement Complex. The new central heating plant will provide heating hot water generated from high-efficiency heat pumps, minimizing the electrical usage and demand to provide the heating service to the buildings.

4.1 Existing Condition

The LEC and Courthouse Buildings consume nearly 70% of the current steam generated at the central heating plant, with 46% being consumed by the Courthouse alone. Table 2 provides the current steam consumption for comfort heating, with the equivalent heating energy in kWh provided for comparison as we shift into electrification energy use.

Table 2: Current Steam Consumption for Heating, Equivalent kWh

Building	Steam Heating Energy (klb)	Heating Energy (kWh)
Courthouse	50,458	17,657,414
Law Enforcement Complex	19,641	6,873,199

Based on degree day analysis, and annual climate data for average outdoor temperature, the total heating energy consumption vs. outdoor air temperature has been plotted. This analysis shows that the majority of energy consumption occurs between 20° F and 45° F outdoor air temperature, which reflects the higher number of hours per year that the local climate experiences those temperatures. These results are shown in Figure 2.

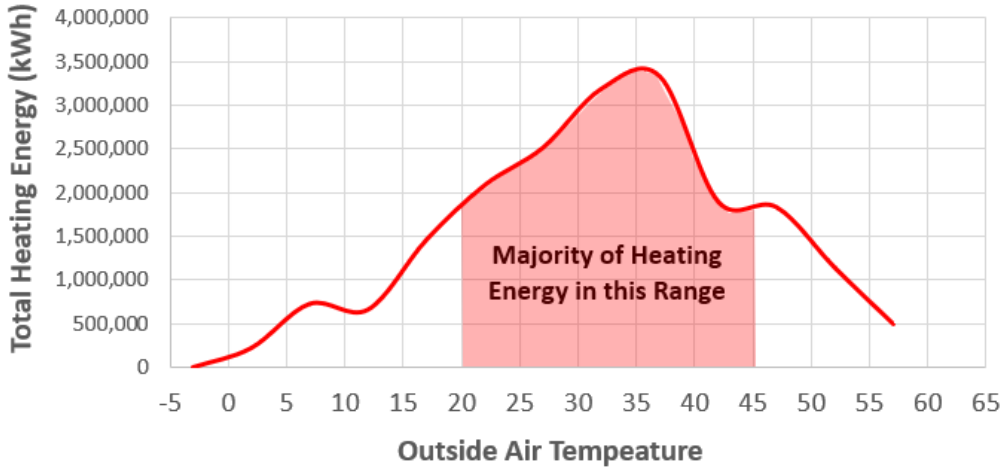


Figure 2: Heating Energy Consumption vs. Outside Air Temperature

The significance of this energy use pattern is that design of the new central plant should prioritize using premium efficiency equipment for providing heat in this temperature range, which requires a lower peak equipment capacity (higher temperature than design-day conditions), but consumes most of the energy and related operating costs. For higher demand conditions (design day temperatures), lower cost equipment can be used which will reduce capital costs and have limited increase in annual operating costs.

4.2 Required Capacity

Analysis of the current energy use from the Existing Conditions data, compared to the local climate data, yields a total required capacity of approximately 10,053 kW between the two buildings. This value is based on estimates used individual building analysis of electrification measures. Applying the impact of energy efficiency for each building, the total demand value is reduced by approximately 15%, or to 9,599 kW. Note that this analysis is specific to the reduction in peak demand, and the total impact on energy consumption will be greater due to higher part-load efficiency during non-peak periods. Table 3 summarizes this analysis for each building:

Table 3: Estimated Peak Heating Demand

Building	Estimated Peak Demand from Steam (kW)	Estimated Energy Efficiency Impact (Demand Only)	Modeled Peak Heating Demand (kW)
Courthouse	6,500	16%	5,460
Law Enforcement Complex	3,553	11%	3,162
		Total	**8,622**

Analyzing the required capacity against the peak capacity, it is seen that nearly 80% of the annual heating energy use only requires 60% or less or the total heating plant capacity, which is visualized in Figure 3.

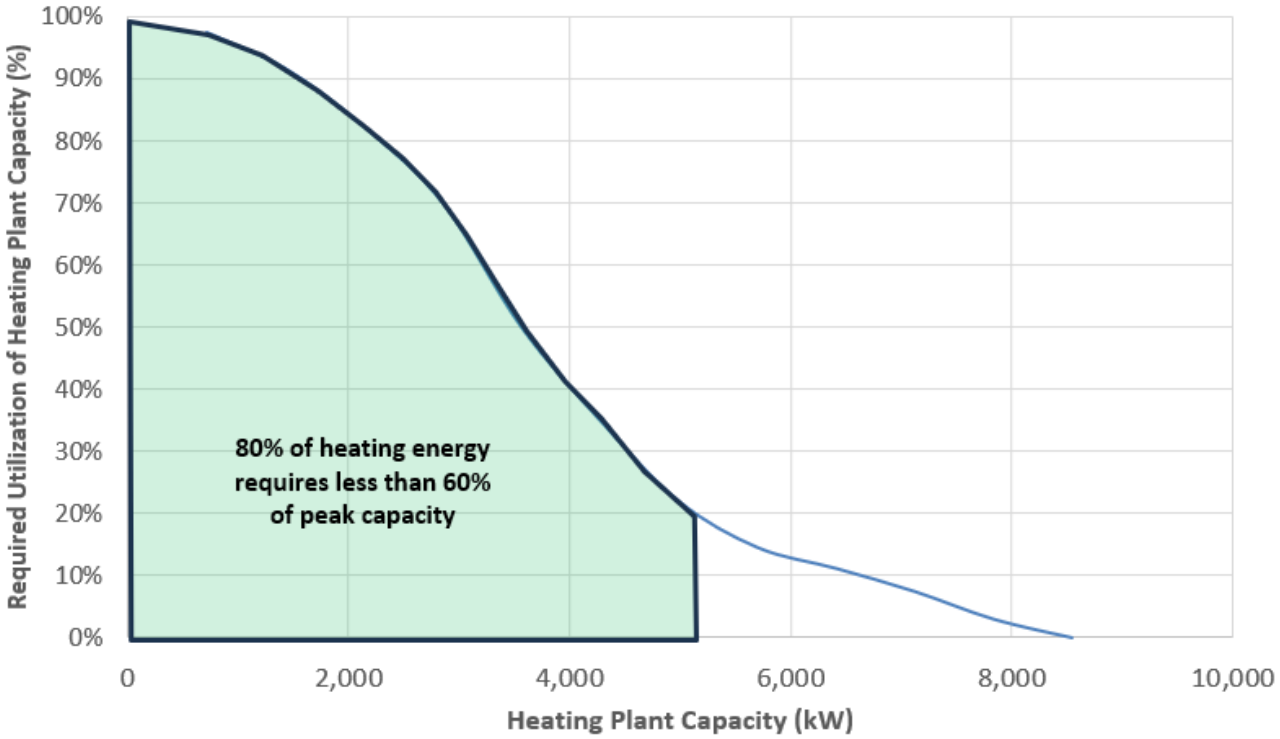


Figure 3: Heating Plant Capacity vs. Utilization of Capacity

Applying the result of Figure 3 to the heating plant design, a conclusion can be drawn that high efficiency heating technologies, such as ground source heat pumps, will create the most value (compared to their higher upfront cost), when sized to meet the first 60% or less of the required capacity. The exact optimum capacity of the ground source heat pump system requires additional modeling and cost information, but a safe conclusion is that the returns begin to diminish at the inflection point of the curve in Figure 3, or above about 4,000 kW.

4.3 Required Capacity

With the required capacity determined, selection of equipment was completed using the assumption that 60% of the total capacity be served by ground source heat pump equipment, with the remaining 40% served by air source heat pumps. Additionally, design factors of safety and equipment redundancy were included to provide some additional flexibility and contingency on the preliminary design. This analysis resulted in a recommended geothermal heating plant size of 1,800 tons and air source heating systems of 1,200 tons. This analysis, along with a sample image of the primary heating equipment types, are given in Table 4 and Figure 4, respectively.

Table 4: Heating System Capacity Calculations

Total Heating Capacity (Fully Utilized)	8,622	kW
Design Factor of Safety and Redundancy	25%	
Recommended Heating Capacity	10,778	kW
Total Heat Pump Tonnage	3,065	Tons
Ground Source Tonnage (60% of Peak)	**1,800**	**Tons**
Air Source Tonnage (40% of Peak)	**1,200**	**Tons**



Figure 4: Example Ground Source (Left, ~200 Ton) and Air Source (Right, 230 Ton) Heat pump Equipment

4.4 Heating Plant Spatial Requirements

The heating plant equipment specified above requires a mix of open space for new equipment, area to construct a structure for the new equipment, and land area for underground piping, all with reasonable proximity to the two buildings, the underground tunnel system, and the electrical substation to provide power. One advantage of the ground source heat pump equipment is the compact footprint, with each 175 ton unit only occupying about 25 sf. Compared to air source heat pump equipment, a similar 175 ton unit will occupy about 200 sf. The system also requires pumping manifolds and equipment, which increase the required space of the new central plant. A summarized list of major equipment is provided below, with detailed costs provided in Appendix B

Preliminary Equipment List:

1. 8x 175 Ton Air Source Heat Pump, Pad Mounted, Outdoor Units
2. 8x Primary Water Pumps for ASHP, 20hp
3. 12x 175 Ton Ground Source Heat Pumps
4. 12x Primary GSHP Pumps, 20hp
5. 4x Secondary Hot Water Pumps, 100hp
6. 950 geothermal bore holes, associated piping, manifolds, and intake equipment
7. 4x Primary Ground Water Pumps, 50hp
8. 2x Ground Water Heat Exchanger
9. 4x Secondary Ground Water Pumps, 30hp
10. 1x 4MW Backup Generator
11. Underground Piping to Buildings
12. Electrical Switchgear and Infrastructure

Arranging the various required equipment, a layout was created that is approximately 7,500 sf total, with 5,000 sf being housed within a new structure. Figure 5 provides on potential layout.

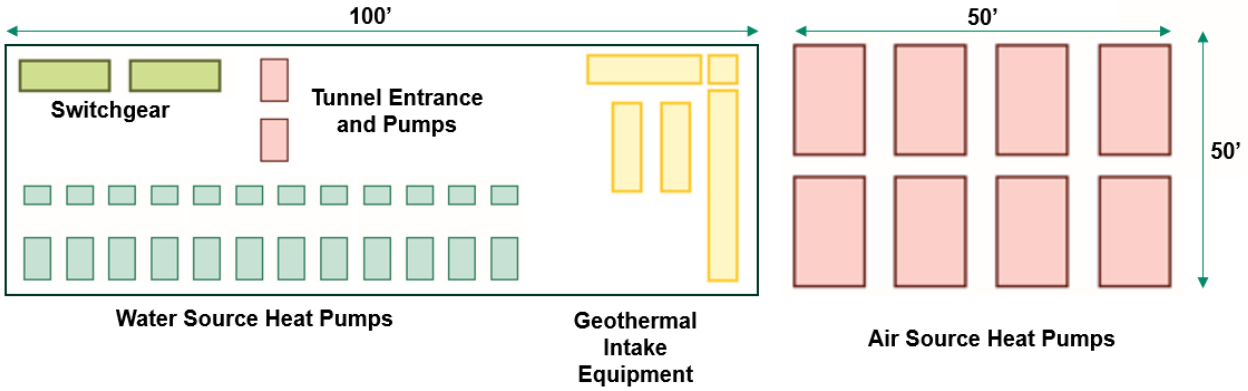


Figure 5: Sample Heating Plant Equipment Layout and Spatial Requirement

4.5 Geothermal Field Spatial Requirements and Plant Location

With 1,800 tons of estimated heating provided by geothermal, it is estimated that between 900-1000 boreholes will be needed. This analysis assumes 20’ spacing on boreholes, with a depth of 290 feet (ft), which provides approximately 1.9 tons of heat exchange per borehole. Using these parameters, it is estimated that the geothermal field will require around 8.5 acres of land. Analysis of open space around the facilities shows substantial open areas that can be utilized, with at least 15 acres of available space in just the parking lot area adjacent to the two buildings. For this analysis, three parking lots adjacent to the Courthouse Tower were used to model the required space usage. A new Central Plant Location was selected between these three parking areas, which is located directly above existing steam tunnels, and with close proximity to the electrical feeder room in the Courthouse. The example layout is provided in Figure 6:

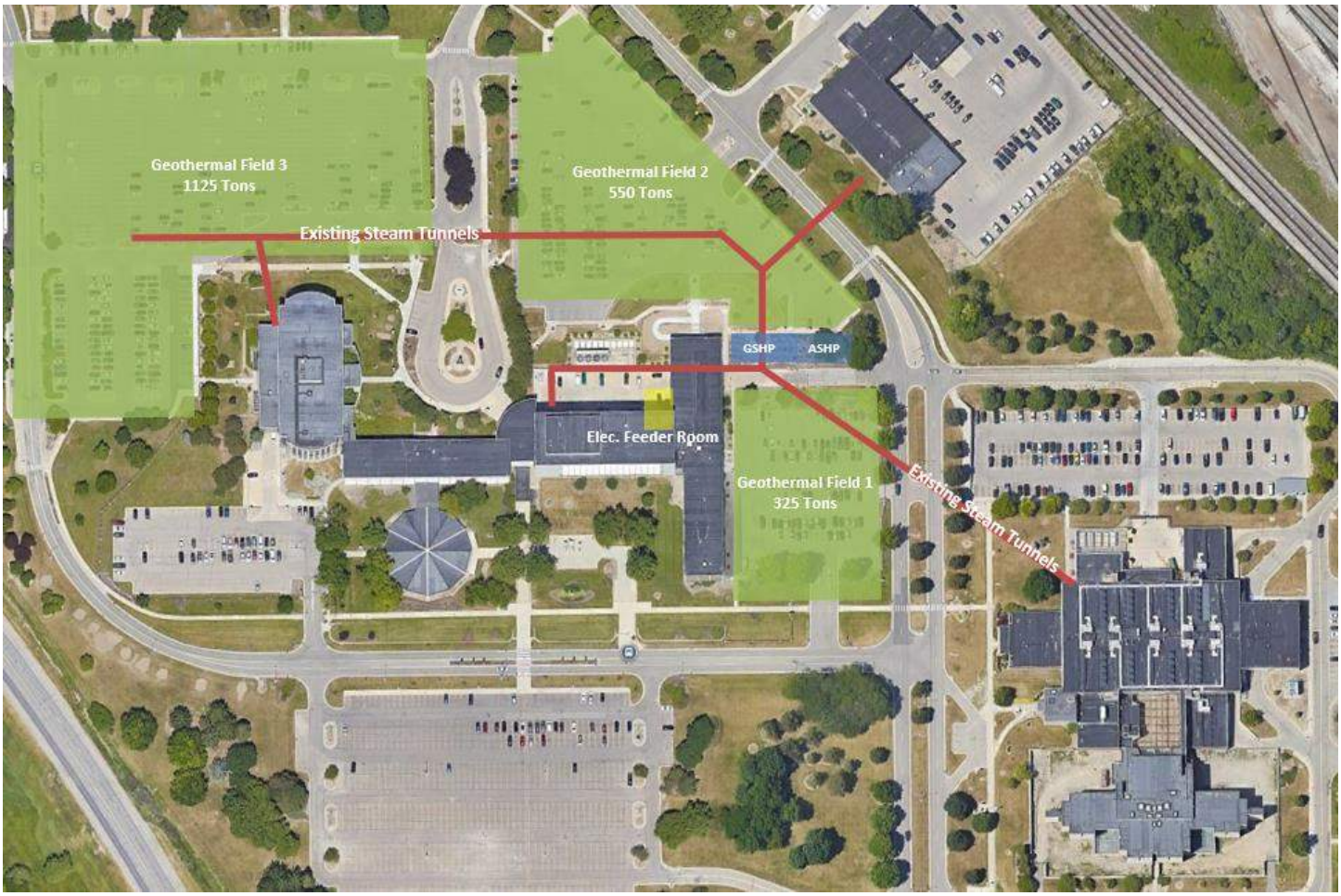


Figure 6: Sample Heating Plant Location, Geothermal Field Sizing, and Proximity of Existing Utility Infrastructure

Figure 6 shows the required space based on the plant capacity and layout described in this report but is not meant to be considered as the ideal location for a new plant, just as a representative spatial presentation. As the equipment selected in this analysis is modular, there are several combinations of arrangements that can be configure to fit any required space or location.

4.6 Utility Connections

Power and piping requirements for the new central plant, based on the capacities for each building, are provided below:

Plant Electrical Requirements:

It is estimated that the new plant will require approximately 3.0MW of new electrical capacity from the campus feeder system. This capacity will require new connections to the 12kV feeder system and transformers to step the system down to 480V. This service can be achieved with a 400amp feeder line from the Courthouse electrical feeder room to the new plant location, approximately 400 ft away in this analysis. Costs for all new equipment are provided in Appendix B.

Distribution Piping Requirements:

The new plant location has been selected strategically with direct access to the steam tunnels that connect the Courthouse to the Law Enforcement Complex. These tunnels are estimated to be in fair condition, and it is assumed that they can be reused. The piping sizes for each building are estimated below.

Table 5: Heating System Capacity Calculations

Building	GPM	Pipe Size	Pipe Length (Supply + Return)
Courthouse	1,500	10”	700 feet
Law Enforcement Complex	800	8”	1,200 feet

4.7 Energy Consumption and Operating Cost:

The new central plant is designed to replace the comfort heating energy provided by steam to the Courthouse and Law Enforcement Complex. This analysis assumes that additional heating loads from steam, specifically domestic hot water, are now being generated with new equipment implemented at the buildings. This analysis also assumes that energy efficiency measures have been implemented in both buildings to reduce both the total heating energy usage and the peak heating demand. Current total heating loads, estimated energy efficiency impact, and the projected future heating energy consumption are given below:Table 9.

Table 6: Current and Projected Heating Energy Use

Building	Current Steam Consumption for Comfort Heating	Estimated Energy Efficiency Reduction	Estimated Heating Energy Consumption
Courthouse	50,458 klb	19,679 klb (39%)	30,780 klb (10,771,023 kWh)
Law Enforcement Complex	19,641 klb	2,820 klb (14%)	16,822 klb (5,886,657 kWh)
		Total	**16,657,387 kWh**

Converting from heating energy use to utility energy consumption requires an understanding of the efficiency of the current system as well as the proposed electrified system. Steam is generated from natural gas, which averages about 75% efficiency to generate. The county is billed for natural gas in units of thousand cubic feet (MCF), which are equal to 87% of the thousand pounds of steam unit (klb) that is collected for billing. Converting the metered steam use to natural gas yields a total heating energy use of 107,512 MCF.

In the electrified scenario, ground source heat pumps are estimated to operate at an average coefficient of performance (COP) of 4.8. This means that one unit of utility energy is required for every 4.8 units of heat required, which is equal to a system efficiency of 480%. The air source heat pumps are estimated to operate at an average COP of 2.5. Applying these efficiencies to the total energy use of the system, and using the post-energy efficiency heating values, we project an 88% reduction in total heating energy entering the building.

Table 7: Current and Projected Utility Use

Scenario	Estimated Energy Efficiency Reduction
Current	107,512 MCF (34,006,533 kWh)
Proposed	3,971,032 kWh
Energy Reduction	**30,035,032 kWh (88%)**

Converting the energy use to cost requires an understanding of both the rate structure from DTE and the estimated cost per unit of steam that the central plant generates. The values used in this analysis are assumed to be:

Direct Energy Electricity Usage Charge: **$0.057/kWh**

DTE Electric Demand Charge: **$6.15/kW/Month**

Natural Gas Cost: **$4.98/MCF**

Analyzing the monthly increase in peak demand, which increases as outside air temperature decreases, it was determined that the average monthly peak demand increases from a minimum of 300kW in summer months, to a maximum of 2500kW in peak winter months. Using average monthly minimum temperature estimates, it is estimated that the average monthly peak demand increase from the geothermal heating plant is 1,195kW.

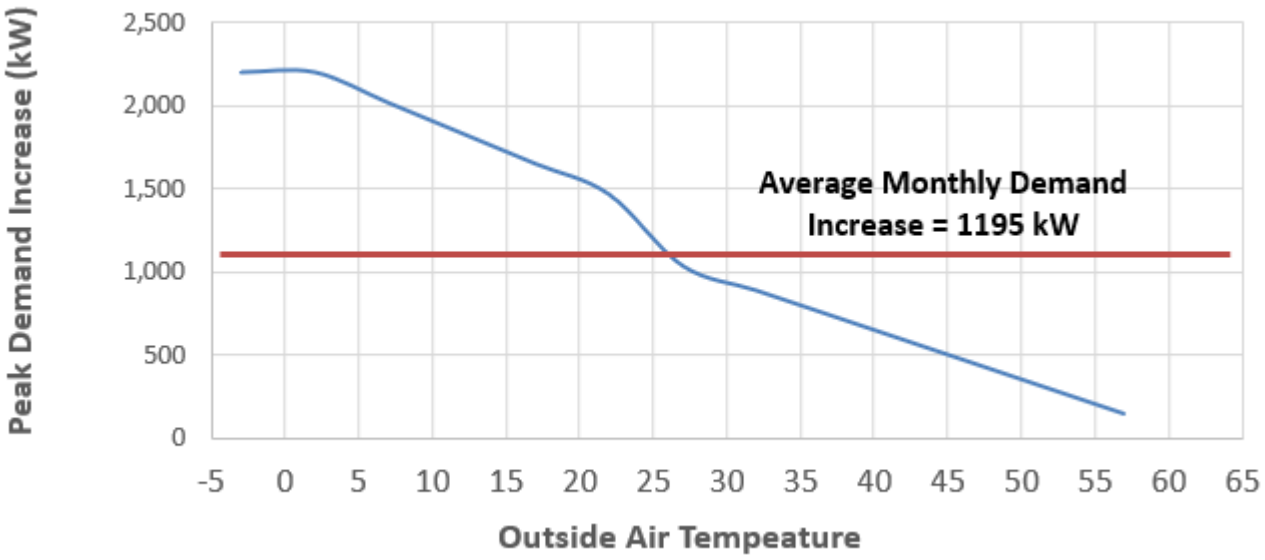


Figure 7: Electrical Peak Demand Increase vs. Outside Air Temperature

With the current steam usage, projected electricity usage, and projected monthly peak demand all known, the total annual cost of operating the heating plant can be calculated. A comparison of current vs. proposed costs are provided below.

Table 8: Current and Projected Energy Cost

Scenario	Annual Heating Energy Cost
Current Cost (Steam)	$535,412
Proposed Cost (Heat Pump)	$314,572
Cost Savings	**$220,839 (41%)**

Additional Cost Considerations

While the total energy use is projected to decrease 88%, the total cost is will only decrease by 41%, which is a function of the current low price of natural gas compared to electricity. While this report does not provide a full life-cycle analysis of the central plant renovation, there are several variables that should be considered should the project move to the planning stage:

1. The county currently pays very low rates for all energy streams. These rates may experience higher than average inflation, which will change the life cycle cost of ownership.
2. The cost of operating and maintaining the current steam plant are assumed into the total cost of $10.00/klb of steam. This is likely lower than the actual cost, due to the maintenance required on the aging equipment and need for multiple full time staff. The $220k/year savings does not consider the total operating cost of the existing central plant, which should be considered in any future analysis.
3. The cost of operating and maintaining the new central plant are not yet known and built into the analysis. Because this same assumption is used for the existing central plant, it is being assumed that the total non-energy operating expenses will be similar, when in reality it is very likely that the new central plant will have significantly lower overall operating costs. A full analysis of plant maintenance costs should be performed as part of any future planning program.

4.8 Heating Plant Construction Costs

A summary of the total cost of construction is provided below. Costs are based on AACE Level 5 estimates, which correspond with <2% design completion. The costs are based on the equipment list provided in Equipment Capacity section of this report. Piping distances and electrical capacities are based on parameters and locations used in the spatial considerations in Section 4.5. A full build-up of direct construction costs and project soft costs are provided in Appendix B.

Table 9: Heating System Capacity Calculations

Estimated Costs	QTY	UM	CAPITAL
GSHP Equipment	2000	Tons	$7,849,740
ASHP Equipment Cost	1400	Tons	$3,332,080
Geothermal Boreholes and Piping	1030	Holes	$22,064,165
Total HVAC Cost			$55,029,153
Total Electrical Cost			$10,124,998
Total Site Work and Building Cost	7500	SF	$6,486,050
Direct Construction Costs			**$71,640,201**
Design Fee and Permitting	30	%	$21,492,000
Additional Insurance, Expenses, and Contingency	25	%	$17,246,799
Estimated Additional Soft Costs	20	%	$26,100,000
Subtotal Major Construction Direct Costs			**$136,479,000**

	Low Range	-25%	Estimated Costs	High Range	+50%
TOTAL PROJECT COST	**$102,359,000**		**$141,259,000**	**$204,719,000**	

4.9 Additional Considerations and Next Steps

Timing of implementation for the construction of the new heating plant is critical, as the existing steam heating plant operation depends on the Courthouse and Law Enforcement Complex to maintain minimum operational demand. The Steam Plant Decommissioning Report outlines the sequence of decentralization of buildings from the steam system and concludes that the Courthouse and LEC are the final buildings that will remain on the steam system. Conversion of these buildings to electric heat will require work to be completed in parallel with the other steam plant decommissioning activities, with the final changeover to the new central plant happening in coordination with the steam plant shutdown. Due to this complication, alternative strategies may be required, and significant planning and investigation will be necessary to develop the final project designs. With these issues in mind, the following should be considered:

1. Technology selection for the final design should require full investment grade analysis. The value of the technologies presented in this report are based on assumptions for implementation cost, building steam usage that is unreliably metered, and building equipment that has only been visually observed and not analyzed through operational trending. All of these variables can dramatically change the final conclusion stated in this report
2. Plant location: This report suggests an optimal physical location based on existing infrastructure, however, additional issues with plant location need to be analyzed. The existing steam distribution tunnels can be utilized but a deeper analysis into the tunnel condition and existing space will need to be completed before designs are finalized.
3. Geothermal spacing, depth, and heating capacity assumptions are provided but are not customized specifically for Oakland County. Additional costs to drill bore holes may change the outcomes presented in this report.
4. Expanding to include heating and cooling: The current design is only considering replacement of the steam system. The geothermal wells could also be used to provide condenser water to the building cooling systems, or as a heat source for heat recovery chillers that can provide both heating and cooling in the summer months when heating demand is low. These additional benefits are not fully evaluated as they would require a deeper dive into the building cooling systems and replacement of the refrigeration equipment and cooling towers to complete.
5. Additional buildings can be added to this heating network using the steam tunnels, but added value is not included at this time. Additional study is required if expansion of the heating plant concept is desired.

With these considerations in mind, the following steps are recommended to improve the design of the heating plant:

1. Steam Submetering: Improving the accuracy of the steam metering system to the Courthouse and LEC will allow for more accurate projections of heating capacity requirements, and energy usage patterns. This will improve the analysis completed in Section 4.3 and better inform the technology selection for future iterations of this report.
2. Building Heating System Surveys: Hot Water Capacity Studies in the buildings will inform the level of effort necessary to convert the buildings to hot water heating from the existing steam system. Lower temperature hot water is generally more efficient to generate using heat pump technology. Understanding critical points in the heating hot water system will inform investments in energy efficiency, building upgrades, and the overall strategy for the central heating plant.
3. Implementing Energy Efficiency: Begin planning the implementation of the energy efficiency projects identified in the ASHRAE Level 2 Audits.
4. Central Heating Plant Investment Grade Audit: The plans laid out in this report are conceptual in nature, with many unknowns preventing a deeper dive into the analysis of the systems. A deeper dive into plant options (ambient loop, decentralized building systems, two pipe heating only vs. four pipe heating and

cooling, heat recovery chillers, additional buildings, etc.) should completed to better inform the design, planning and implementation of the electric heating system.

5 Implementation Plan

This section outlines the implementation strategy developed to guide Oakland County's transition toward electrified building operations. The approach integrates results from energy audits, electrical capacity analysis, and cost evaluation into a single actionable pathway. Using AECOM's proprietary Pathways Tool, the County's Integrated Project List (IPL) was modeled to evaluate phasing and investment strategies. The selected scenario represents a technically and economically feasible pathway toward electrification based on prioritization criteria and available budget.

5.1 Prioritization

To develop a clear and implementable pathway for the County, electrification and energy conservation measures (ECMs) were prioritized using a two-tiered approach. First, each building in the portfolio was assigned to a priority tier ranging from 1 to 7, where 1 represents the earliest implementation window. These priority tiers were used to define fixed implementation periods for each group of buildings, with the exception of the construction of the new Central Heating Plant, which will be spread over multiple years. The priority tiers are summarized in Table 10.

Table 10: Building-Level Implementation Sequence

Priority Tier	Starting Year	Ending Year	Buildings
1	2026	2028	Children's Village J Building, East Annex, Materials Management, Medical Examiners Facility, Resource & Crisis Center, Sheriffs Admin
2	2028	2030	Courthouse, Information Technology, Law Enforcement Complex & Jail, North Oakland Health Center, Pontiac Health Building
3	2030	2032	Children's Village B Building, Children's Village C Building, Little Oaks, North Office Building
4	2032	2034	Admin Annex II, Central Garage, Children's Village G Building, Children's Village H Building
5	2034	2036	Children's Village Kitchen, Children's Village School, Patrol Services, Public Works Building, Central Heating
6	2036	2038	Admin Annex I, Children's Village A Building, Children's Village Counseling Center, Children's Village D Building, Executive Office Building
7	2038	2040	Animal Control, Credit Union, Farmer's Market, Road Commission Complex

Within each building, individual measures were then sequenced based on measure-level priority. Prioritization considered the technical feasibility of electrification at each facility, including available electrical capacity, building size and system complexity, and known constraints documented during site assessments. Measures were further evaluated based on equipment age and condition, project payback, and logistical sequencing of improvements.

ECMs were categorized as High, Medium, or Low, based on their energy savings potential, operational criticality, and contribution to long-term electrification readiness. Electrification projects were ranked on a scale of 1 through 3, with "1" representing the highest priority for near-term implementation. Precedent projects such as feasibility studies and demand meter installation were given the highest priority.

5.2 Scenario Development

AECOM developed a single electrification scenario for Oakland County using the Pathways Tool to model the cumulative energy, emissions, and cost impacts of electrification. The purpose of the scenario is to illustrate a feasible implementation pathway that balances project prioritization, capital investment, and potential for energy savings and emissions reduction across the County's building portfolio.

The implementation timeline was informed by the prioritization logic outlined in Section 5.1. Larger, more complex projects, such as those associated with the new Central Heating Plant and larger buildings, were spread over multiple years due to technical feasibility and high capital investment.

Key performance indicators (KPIs) evaluated through the Pathways Tool include:

- Greenhouse gas (GHG) emissions reductions
- Annual and cumulative energy savings
- Annual and lifecycle utility cost impacts
- Total capital investment
- Project sequencing and phasing outcomes

A Business-as-Usual (BAU) strategy was developed as a point of comparison. This assumes existing operations are maintained across the County facilities.

5.2.1 Scenario Modeling Assumptions and Inputs

Modeling was performed using 2024 utility and energy consumption data across all County facilities as the baseline year. For buildings with incomplete data, missing monthly natural gas or steam consumption values were extrapolated using available data from previous months and years. The Pathways Tool produced annualized outputs for greenhouse gas emissions, energy end use by source, and associated costs, both net present value (NPV) and discounted.

All financial modeling applied a 4% discount rate and escalation rates of 8.3% for electricity and 7.4% for natural gas and steam. No annual spending cap was applied; project costs were distributed as evenly as practical across the study period. Project prioritization and sequencing were completed manually by AECOM using the methodology described previously.

GHG emissions included Scope 1 and Scope 2 sources. Scope 3 emissions were excluded.

- Electricity: Regional CO_2 emission coefficients from the RFCM eGRID subregion were applied to represent the County's grid mix. Electric emission coefficients were decreased over the study period in accordance with DTE's clean grid projections.
- Natural Gas and Steam: Standard U.S. EPA combustion factors were used to quantify direct fuel-use emissions.

Table 11: Pathways Tool Inputs

Input	Value
Discount Rate	4%
Electricity Escalation Rate	8.3%

Natural Gas Escalation Rate	7.4%
Steam Escalation Rate	7.4%
Electric Utility Cost	$0.11/kWh
Natural Gas Utility Cost	$4.98/MCF
Steam Utility Cost	$10/klb

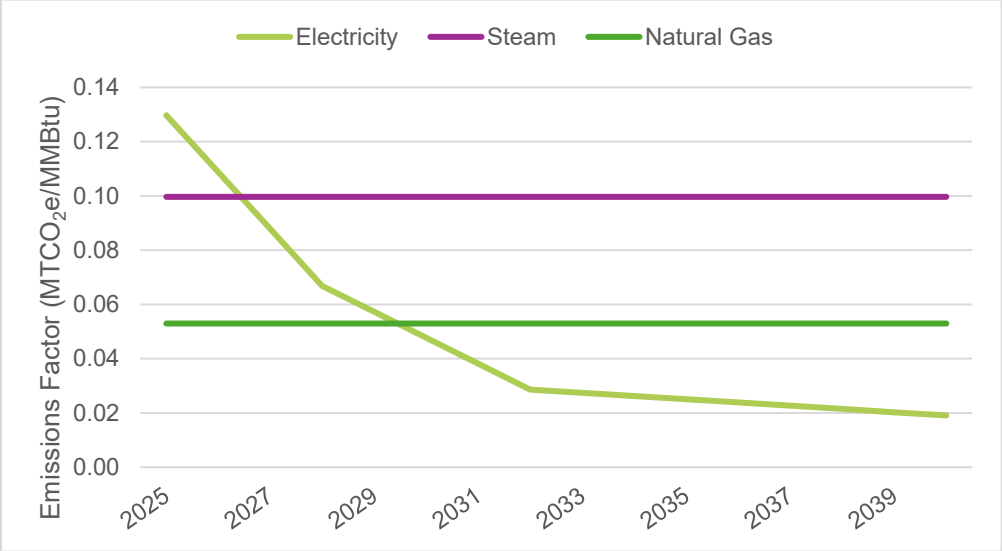


Figure 8: Emissions Factors Over Time

5.2.2 Scenario Results

Total energy consumption, emissions, capital costs, and utility costs of the BAU and electrification scenario are summarized in Table 12. This table outlines the total cumulative consumption, emissions, and costs expected between now and 2040.

Table 12: Cumulative KPI 2025-2040 Summary

KPI	Total Energy (MMBtu)	Emissions (MTCO2e)	Capital Costs (2025$)	Utility Costs (2025$)
Baseline	4,545,345	336,071	$ -	$88,042,521
Electrification Scenario	2,922,673	186,384	$167,339,340	$74,245,796
% Difference	-35.7%	-44.5%	-	-15.7%

The electrification scenario demonstrates significant long-term energy and emissions reductions compared to the baseline. As shown in Table 12, total energy consumption and greenhouse gas emissions are reduced by 36% and 45% between 2025 and 2040, respectively. By combining electrification projects with energy efficiency, $14 million in avoided utility costs are seen over the analysis period.

Figures 9 through 13 show these trends in greater detail. Figure 9 shows annual expenditures and capital costs against the BAU scenario. Figures 10 and 11 show the annual capital costs for the central plant and for all other energy efficiency and electrification measures, respectively.

Figure 11 shows the changes in energy end use breakdown, and Figure 12 shows the changes in emissions over time between the electrification and BAU scenarios.

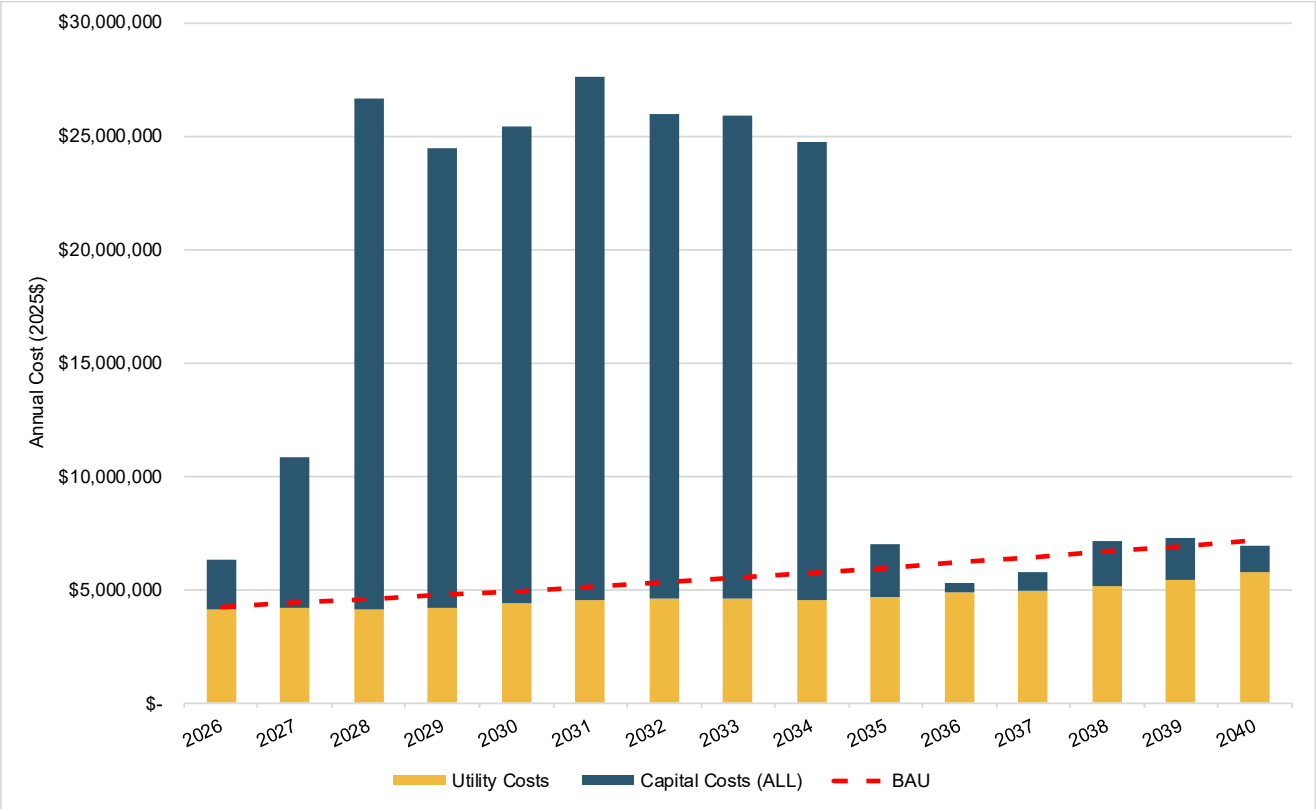


Figure 9: Electrification Scenario Annual Costs

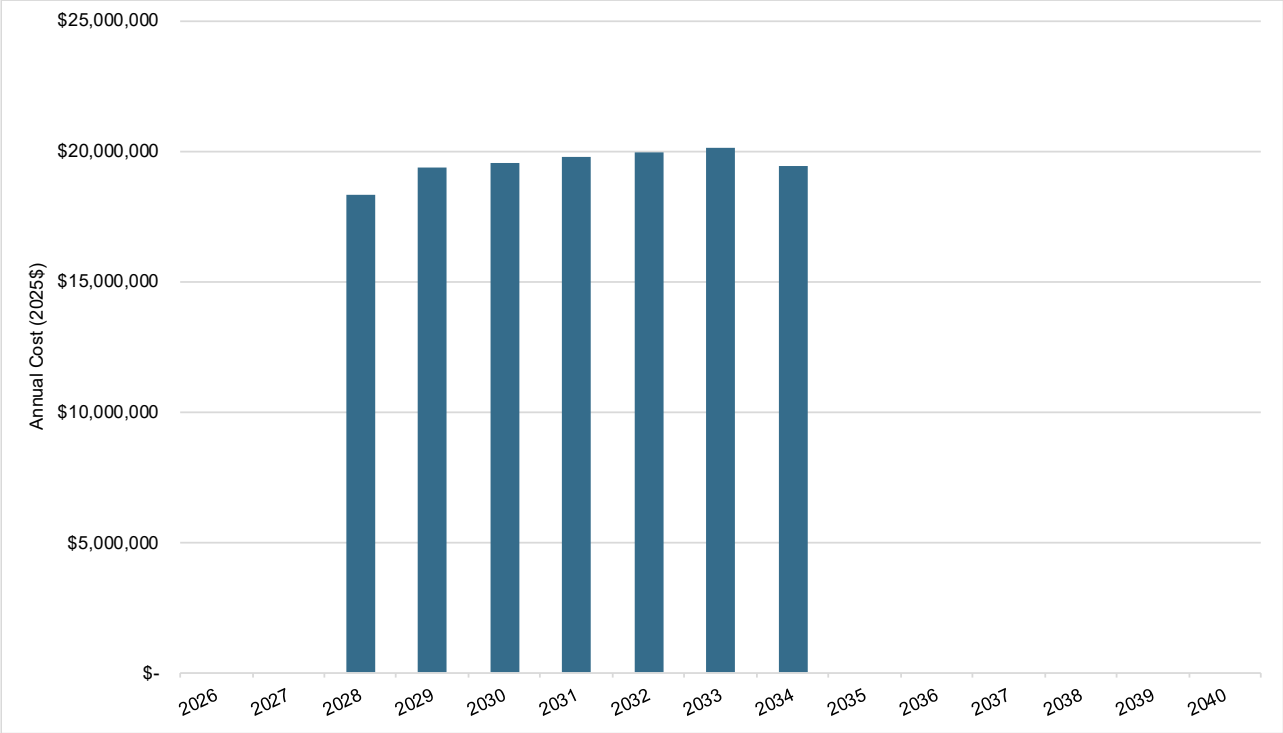


Figure 10: Electrification Scenario Capital Expenditures per Year – New Central Heating Plant

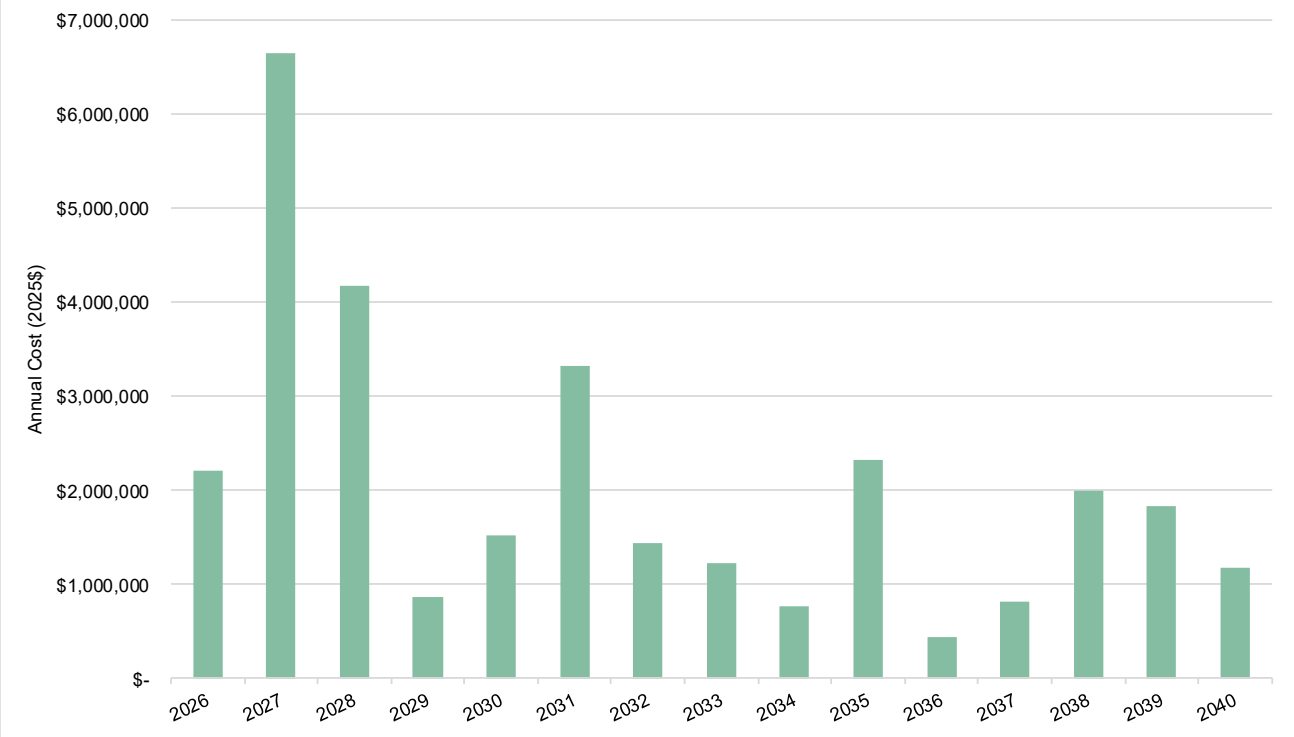


Figure 11: Electrification Capital Expenditures per Year – Energy Efficiency and Electrification

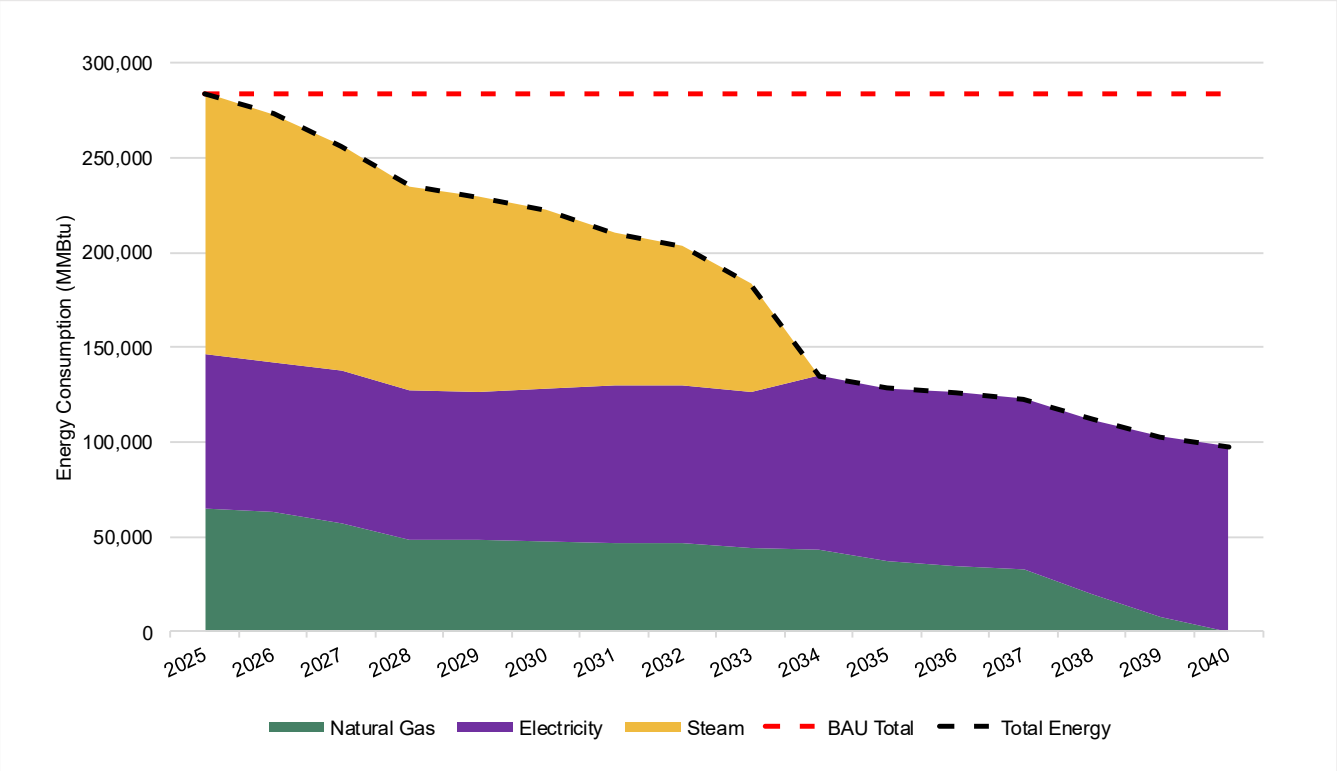


Figure 12: Electrification Scenario Energy Consumption Breakdown

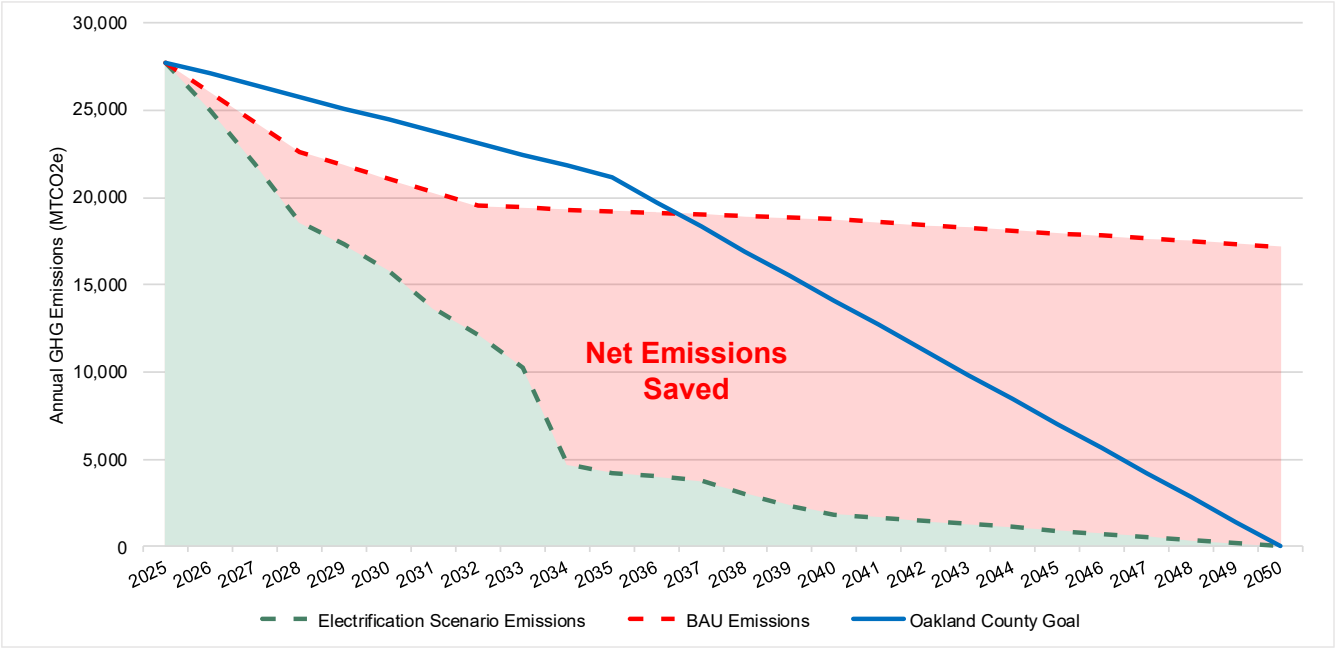


Figure 13: Electrification Scenario vs. BAU Greenhouse Gas Emissions

5.2.3 Renewable Energy Potential

AECOM's on-site renewable assessment identified approximately 2.9 MW-AC of feasible solar PV capacity across the Oakland County main campus, capable of producing roughly 4,300 MWh of clean electricity per year, which is enough to offset 18% of total campus electricity consumption under current operating conditions. If electrical infrastructure were upgraded to enable the full theoretical potential of 7.1 MW-AC, the campus could generate up to 10,500 MWh annually, offsetting approximately 44% of current electricity demand.

In the electrification scenario, modeled annual electricity use across the County portfolio increases from 82 million kBtu (BAU) to a peak of 97.3 million kBtu in 2035, a 19% rise in total electricity consumption as gas and steam systems are decommissioned. Over the 2025–2040 period, average annual electric demand in the scenario is approximately 85 million kBtu.

At this scale, the currently feasible 2.9 MW-AC PV portfolio (4.3 GWh/yr) would offset 17% of County-wide electric consumption under the electrified load, while full build-out of 7.1 MW-AC (10.5 GWh/yr) could supply up to 40% of the County's projected electricity demand by 2040. These results are summarized in Table 13.

Table 13: On-Site Renewable Generation Potential Relative to Electricity Consumption

PV System Capacity	Estimated Annual Generation	Electricity Consumption Offset	
		BAU	Electrification Scenario
2.9 MW-AC PV Portfolio	4.3 GWh/yr	18%	17%
7.1 MW-AC PV Portfolio	10.5 GWh/yr	44%	40%

The implementation of PV systems has the potential to reduce Scope 2 GHG emissions by approximately 1,896 metric tons CO_2e annually, equivalent to about 18% of the campus's current emissions. Given that 75% of Michigan's grid mix comes from fossil fuels—substantially higher than the national average—onsite renewable generation plays a critical role in advancing the County's decarbonization goals.

6 Financial Considerations

The County has a variety of options for funding projects included in this electrification implementation plan. The County's Capital Plan and its acquisition of bond funding can be supplemented with other opportunities such as grants, rebates, direct pay tax incentives, loans, energy saving performance contracts, and third-party ownership models to ease the upfront financial burden. The following sections outline federal, state, and local funding opportunities, as well as partnerships, and conclude with capital stacking strategies and next steps. Since 2025, several programs funded by the federal government may have been cancelled or in suspension. While some of them are still under legal review, the availability of these funding opportunities is uncertain. The federal funding landscape is evolving, and the County should refer to the latest information available from the government.

The County is starting the RFP process for pre-bond projects. The bond process requires that projects be itemized quarterly and requires a public hearing and comment period. There is no specified timeline of when the bond funding would become available. The bond is anticipated to include equipment replacements throughout the County's campus (e.g. air handlers, chillers, cooling towers, piping, valves), building commissioning, building management system and controls upgrades (lighting and mechanical), switchgear upgrades, and lighting efficiency improvements.

6.1 Federal Funding Incentives

The Inflation Reduction Act (IRA) and Infrastructure Investment and Jobs Act both provided expansive opportunities for investments in renewable energy and energy efficiency improvements. The IRA is responsible for multiple tax incentives that are available to municipal entities through elective pay ("direct pay"). For eligible, tax-exempt organizations, these tax credits are delivered as direct payments rather than credits on tax returns.

6.1.1 Clean Electricity Investment Tax Credit (Section 48)

Eligible projects originally included solar, wind, geothermal, clean hydrogen, microgrid controllers, and energy storage, among other clean electricity technologies. However, since the passing of the One Big Beautiful Bill Act (OBBB), there are new restrictions. With these changes, wind and solar projects are phased out sooner, needing to begin construction by July 4, 2026, or be complete by the end of 2027. Battery storage, fuel cells, geothermal systems designed for heating and cooling in commercial buildings (without power production), and carbon capture technologies may still qualify for federal Investment Tax Credits (ITC).[1]

Under current law, eligible geothermal heat pump and thermal energy systems can claim an ITC based on a percentage of qualified project costs. These systems qualify because they displace fossil-fuel combustion for heating and cooling, even though they do not produce electricity. The introduction of "foreign entity of concern" (FEOC) rules starting January 1, 2026, will likely impact pricing and timelines on solar and battery projects.

6.1.1.1 Timeline

As currently legislated, ITC will continue to be available for eligible geothermal projects that begin construction before December 31, 2033. After that date, the credits begin to phase down and are scheduled to sunset entirely after December 31, 2035. Under the OBBB, solar and other renewable energy projects must begin construction before July 4, 2026 or be placed into service by December 31, 2027. However, the FEOC restrictions begin for projects that begin after December 31, 2025.

[1] The information in this section is provided for informational purposes only and does not constitute tax, legal, or financial advice. Eligibility for ITC and its associated bonus credits remain subject to interpretation and future US federal guidance.

6.1.1.2 Tax Credit Value

Qualifying non-electricity producing geothermal investments may claim a base credit of 6% of eligible costs, with opportunities to earn bonus credits that can raise the total benefit to as much as 50% of project cost.

The tax credit is available in the two-tier structure shown in **Table 14** consisting of a base credit of 6% and a bonus rate of 30%. To achieve the bonus rate projects will need to have a thermal output of greater than 1 MW and meet prevailing wage and apprenticeship (PWA) requirements. The law also includes two additional bonus credits, the domestic content bonus credit, and the energy community bonus credit. Both of which provide an additional 2% credit.

Table 14: Geothermal Tax Credit Value

Credit Category	>1MW Output	>1MW + PWA
Base[2]	6%	30%
Domestic Content Bonus	2%	10%
Energy Community Bonus	2%	10%

6.1.1.3 Cost Basis

The credits are a percentage of the system cost basis. The basis is generally the direct cost of the equipment, material and installation as well as the indirect costs such as permitting, engineering, electrical, plumbing, etc. Geothermal equipment includes production equipment and distribution equipment.

Production equipment is equipment necessary to bring geothermal energy from the subterranean deposit to the surface, including well-head and downhole equipment (such as screening or slotting liners, tubing, downhole pumps, and associated equipment). Production, injection, and monitoring wells required for production of the geothermal deposit qualify as production equipment. Production equipment does not include equipment used for exploration and development of geothermal deposits, such as drilling wells.

Distribution equipment is equipment that transports geothermal energy from a geothermal deposit to the site of ultimate use. Distribution equipment also includes components of a building's heating and/or cooling system, such as pipes and ductwork that distribute within a building the energy derived from the geothermal deposit.

6.1.1.4 Prevailing Wage & Apprenticeship Requirements

In general, the PWA requires that all employees, contractors and subcontractors involved in the construction and alteration, or repair of a project must be paid the applicable prevailing wage. In general, PWA requires that an applicable percentage of labor hours (10-15% depending on the year in which construction of a project begins) must be performed by apprentices.

6.1.1.5 Domestic Content Bonus

To be eligible for the domestic content bonus, 100% of any steel or iron that is a component of the facility must be produced in the U.S. and a defined percentage of the total cost of manufactured products must be attributed to components that are mined produced or manufactured in the U.S. The defined percentage varies based on when the project begins construction (40% prior to 2025 and 55% after 2026). The defined percentage is

[2] Phase down: 2033: 5.2% and 26%, respectively; 2034: 4.4% and 22%, respectively.

determined by dividing the domestic manufactured products and components cost by the total manufactured product cost for the project.

6.1.1.6 Energy Community Bonus

To be eligible for the energy community bonus energy property must be installed in an "energy community" defined as one of the following:

- A brownfield site
- A city with a given population employed in or tax revenues derived from the extraction, processing, transport, or storage of coal or natural gas with unemployment rates above the national average
- Census tract or a census tract that is adjoining a census tract in which a coal mine has closed after 1999 or a coal-fired electric generating unit was retired after 2009

6.1.1.7 Foreign Entity of Concern (FEOC) Requirements

At present, the FEOC restrictions do not apply to geothermal exchange projects (projects that only supply heating and cooling). FEOC provisions restrict the use of battery components and critical minerals sourced from or controlled by certain foreign entities such as China. This is likely to have cost and schedule impacts on solar and battery projects that rely on the Chinese supply chain. The FEOC requirements begin with projects after December 31, 2025.

6.1.2 Alternative Fuel Vehicle Refueling Property Credit

This credit is available to businesses and individuals who install qualified refueling or recharging property, including electric vehicle charging equipment, in an eligible location. Eligible tax exempt and government entities can also claim the credit through elective pay. According to the OBBB, the credit will not be allowed for any property placed in service after June 30, 2026. The County's core campus is not in the eligible census tracts, but installations can be reviewed on a case-by-case basis.[3]

6.2 State Funding Incentives

Michigan's Department of Environment, Great Lakes, and Energy (EGLE) manages the distribution of state and federal funding for energy-related projects. Additionally, Michigan Saves, is the nation's first nonprofit green bank, established in 2009 from grants from the Michigan Public Service Commission and the U.S. DOE.

6.2.1 Michigan's Department of Environment, Great Lakes, and Energy (EGLE)

Michigan's EGLE has several funding opportunities. For example, the Greenhouse Gas Reduction Fund allowed the development of Solar for All, the Clean Communities Investment Accelerator, and National Clean Investment Fund.

- Michigan's Solar for All program was terminated by the U.S. EPA in August 2025. The program and EGLE are working with Michigan's Attorney General on next steps. The County can continue to monitor this program for a potential reopening.[4]
- The Clean Communities Investment Accelerator provides funding and technical assistance toward distributed energy, net-zero building, and zero-emission transportation projects dedicated to low-income and disadvantaged communities.[5]

[3] IRS. *Alternative Fuel Vehicle Refueling Property Credit.* https://www.irs.gov/credits-deductions/alternative-fuel-vehicle-refueling-property-credit
[4] EGLE. *MI Solar for All.* https://www.michigan.gov/egle/about/organization/climate-and-energy/mi-healthy-climate-plan/funding/ggrf/mi-solar
[5] EGLE. *Clean Communities Investment Accelerator.* https://www.michigan.gov/egle/about/organization/climate-and-energy/mi-healthy-climate-plan/funding/ggrf/ccia-ncif/ccia

- The National Clean Investment Fund helps to fund clean financing institutions such as Michigan Saves (see next section for available programs).[6]

The Climate Pollution Reduction Grant will be used to refine and implement the MI Healthy Climate Plan and prepare Michigan communities to compete in nationwide competitive federal funding competitions.[7]

Other currently available state and federal funding for energy efficiency upgrades, renewable energy installations, clean technology development, and EV charging installations are available on the EGLE website and include:

- The Renewables Ready Communities Award provides up to $5,000 per megawatt to eligible Michigan municipalities for an eligible renewable energy project that they will physically host and/or perform local permitting. The $30M allocation has been fully applied for but a waitlist is available.[8]
- The Community Energy Management Program offers financial incentives directly to communities to improve energy management and accelerate the transition to energy efficiency and renewable energy. The program has closed but can be monitored for future rounds of funding. Grant funding is available to local governments, tribal governments, and other public-service entities for energy-related projects. The maximum grant award is $100,000 per applicant.[9]
- The Charge Up Michigan Program[10] aims to build out the network of DC fast charging stations in the state of Michigan. Public or private organizations that can host publicly accessible charging stations, can fulfill program priorities, and are enrolled in a utility rebate program are eligible to apply for this grant. The grant amount will be the lesser of 33.3% of the total cost or a direct match of the amount the electric utility is paying, up to $70,000, and can only be used for eligible EV charging equipment. The remaining program funding will prioritize projects that cover unfilled "nodes" and areas where more charging stations are needed. There are no remaining nodes in Oakland County, but the County can continue to monitor the program. A Michigan Economic Development Corporation grant is funding public charging infrastructure at the Courthouse building in 2025.

6.2.2 Green Banks and Revolving Loan Funds

Green banks and revolving loan funds provide low-interest loans to lower the risk of energy projects, overcome financial barriers, and make them more affordable. The Climate United Fund, Coalition for Green Capital, and Power Forward Communities are institutions available for funding nationwide.[11,12,13]

Michigan's Green Bank, Michigan Saves, has a Climate Fund,[14] supported by the EPA's Greenhouse Gas Reduction Fund. This fund offers flexible financing for large-scale clean energy projects. The green bank provides financing up to $10 million per project with typical rates of 4-5%, but terms vary per project.

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[6] EGLE. *National Clean Investment Fund*. https://www.michigan.gov/egle/about/organization/climate-and-energy/mi-healthy-climate-plan/funding/ggrf/ccia-ncif/ncif

[7] EGLE. *Climate Pollution Reduction Grant*. https://www.michigan.gov/egle/about/organization/climate-and-energy/mi-healthy-climate-plan/funding/cprg

[8] EGLE. *Renewables Ready Communities Award.* https://www.michigan.gov/egle/about/organization/materials-management/energy/rfps-loans/renewables-ready-communities-award

[9] EGLE. *Community Energy Management Program.* https://www.michigan.gov/egle/about/organization/materials-management/energy/rfps-loans/community-energy-management-program

[10] EGLE. *Charge Up Michigan Program.* https://www.michigan.gov/egle/about/organization/materials-management/energy/rfps-loans/charge-up-michigan-program

[11] The Climate United Fund finances electric vehicles, green buildings, and solar and energy storage in primarily community infrastructure and small businesses. Climate United is soliciting requests for proposals from qualified organizations. https://weareclimateunited.org/tools-and-resources

[12] Coalition for Green Capital identifies net-zero emission buildings and distributed energy generation as priority project categories. Their municipal investment fund opened in January 2025. https://coalitionforgreencapital.com/work-with-us/

[13] Power Forward Communities is not a fund for the County to target as it mostly focuses on home improvements. https://powerforwardcommunities.org/

[14] Michigan Saves. *Climate Fund.* https://michigansaves.org/climatefund/

Government organizations are eligible for projects such as energy efficiency building upgrades, solar panels, batteries, geothermal, electrification, and EV infrastructure and fleets. At least 50% of the Climate Fund's projects must be located in low-income and disadvantaged communities, or in rural and tribal areas. In addition, their Bridge Financing Program provides government organizations upfront funding while waiting on IRA tax credit returns for geothermal, battery, and solar projects. It should be noted that Michigan Saves programs have been affected by the federal freeze on funding sources that provided much of the green bank's funding.

Michigan's Revolving Loan Funds focus on water, wastewater, and drinking water infrastructure projects.

6.3 Local and Utility Funding Incentives

Oakland County's electricity and gas supplier, DTE, has several incentive programs that support projects that reduce a building's energy consumption.

6.3.1 Commercial Loan Program

DTE has partnered with Michigan Saves on a Commercial Loan Program.[15] Qualifying projects cover over 150+ types, including HVAC, roofing, solar PV, indoor LED lighting, occupancy sensors, commercial kitchen equipment, water heaters, boilers, outdoor LED lighting, and EV charging stations. Eligible municipal customers may qualify for interest rates as low as 0% APR through their interest rate buydown program for projects up to $250,000 and terms up to 36 months.

6.3.2 DTE Rebate Programs

DTE offers rebates for common energy efficiency improvements for lighting, HVAC, refrigeration, data centers and more.[16] DTE will connect customers with an Energy Advisor who will review the project's goals and recommend equipment and available rebates. When your project is completed, the Energy Advisor will verify the energy savings and confirm the rebate before sending a rebate check in the mail. Rebates are available for DTE commercial and industrial electric and natural gas customers in good standing. Program funds are available on a first-come, first-served basis. Funding is still currently available. The program currently has an annual customer rebate limit of $1,000,000 for electricity-saving measures and $300,000 for gas-saving measures.

DTE also provides New Construction and Major Renovation rebates.[17] LEED Design Review Assistance allows you to receive a one-time $1,500 rebate to help pay for LEED certification. If you choose to pursue LEED Certification on a new building, DTE will pay rebates based on plan-modeled energy savings and level of certification achieved –Silver, Gold or Platinum. In addition, Systems Approach Incentives offer an alternative to pursuing LEED certification.

DTE Electric customers are also eligible for Telecom rebates[18] for projects that provide energy efficiency upgrades to improve system performance in data centers and server rooms.

DTE has several EV charging rebates available for fleet vehicles, workplace charging, and public charging. Rebates are up to $70,000 per fast charger and up to $2,500 per Level 2 port.[19] The County can also consider

[15] Michigan Saves. *Commercial Building Clean Energy Financing.* https://michigansaves.org/commercial-loans/
[16] DTE Energy. *Rebates for Equipment Upgrades.* https://www.dteenergy.com/us/en/business/energy-efficiency/getting-started/rebate-programs/Energy-Efficiency-Programs-for-Business/equipment-upgrade.html
[17] DTE Energy. *Rebates for New Construction and Major Renovations.* https://www.dteenergy.com/us/en/business/energy-efficiency/getting-started/rebate-programs/Energy-Efficiency-Programs-for-Business/New-Construction-and-Major-Renovations.html
[18] DTE Energy. *Rebates for DTE Telecom.* https://www.dteenergy.com/us/en/business/energy-efficiency/getting-started/rebate-programs/Energy-Efficiency-Programs-for-Business/DTE-Telecom.html
[19] DTE Energy. *Electric Vehicle Resources.* https://www.dteenergy.com/us/en/business/service-request/pev/plug-in-electric-vehicles-pev.html

coordinating with DTE to determine the best time-of-use rates available for EV charging stations to maximize overnight charging and minimize charging costs.

6.4 Partnerships

Effective partnerships allow for opportunities for the County to shift risk and upfront costs to other entities while realizing emissions and energy savings.

6.4.1 Solar Leasing and Power Purchase Agreements

Solar leasing and power purchase agreements (PPAs) both allow for customers to pay no upfront cost for the installation of renewables while still receiving the benefits. In both cases, solar energy is available to the customer for use while the physical panels belong to a third party. They differ, however, in the exact terms of agreement: solar lease contracts offer a fixed monthly rate regardless of usage while PPA contracts assign a fixed price to each kWh of electricity used and therefore the cost per month is dependent on electricity consumption. For both leases and PPAs, any incentives or rebates go to the developer. Additionally, the owner of the equipment is the owner of the Renewable Energy Certificates (RECs). In another form of PPAs, virtual PPAs, the customer purchases RECs rather than purchasing the clean electricity directly as a mechanism for meeting sustainability goals.

Both solar leases and PPAs can come with long-term agreements that may charge hefty fees for early termination. Additionally, although fixed monthly or kWh pricing increases stability, it is possible to overpay for electricity if the contract cost is above fluctuating market prices. However, it is more common to underpay and save money in the reverse situation.

Oakland County has entered a Power Purchase Agreement with CMS Energy to purchase 75% of its total annual electric load from solar energy. This will go into effect in 2026.

6.4.2 Energy Savings Performance Contracts

Energy Savings Performance Contracts (ESPCs) provide a mechanism for budget-neutral building efficiency improvements by using cost savings to pay off capital funding. Though ESPCs are most popular for government buildings, schools, and hospitals, many energy service companies (ESCOs) will work with other non-residential building owners to design, implement, and arrange financing for building upgrades. Their service will commonly involve building audits and financial analyses to determine the best upgrade options as well as upgrade installation and post-installation monitoring and maintenance.

ESPCs are beneficial because they have guaranteed energy savings and ESCOs take responsibility for much of the project allowing for high reliability and reduced burden of project management. However, ESCO involvement does mean that some of the cost savings from energy reductions will have to be paid to the ESCO for their services.

6.4.3 Energy Service Agreements

Energy services agreements (ESAs) are a common type of efficiency-as-a-service financing solution that involves a provider and customer entering a set contract for the provider to introduce equipment to upgrade efficiency and the customer pays the provider per kWh saved. ESAs are very similar to PPAs, but for energy efficiency rather than renewable energy. These agreements typically require no upfront capital investment for customers and lower utility bills in the long run due to reduced energy consumption.

Most ESA agreements are for large projects ($1M+), but it is possible to bundle multiple sites that would have smaller projects into a larger ESA contract. Similar to PPAs, contract length can be a burden if the customer wants to terminate early.

6.4.4 Public Private Partnerships

Partnerships can provide local governments with ways to deploy charging stations by transferring the upfront costs, and sometimes the operation and maintenance expenses, to another entity in exchange for revenue generated from charging station usage.

These partnerships can take various forms, including utility-owned stations, third-party ownership, and charging-as-a-service models. In such arrangements, municipalities usually serve as site hosts and power off-takers. In these setups, the vendor typically dictates the pricing for the power supplied and uses this strategy to generate profit.

6.5 Capital Stacking

County staff noted that publicly agreeable projects that address critical infrastructure needs, resolve deferred maintenance, and address occupants needs will have the best chance at securing internal capital funding. The ability to leverage the bond and capital plan funding will be supported by clear communication of the co-benefits of projects (e.g., indoor air quality, occupant comfort, resiliency), return on investment (if any), and clear itemized scopes. Projects can also be backed by recommendations in this plan, the County's climate action plan, and other campus planning efforts.

Leveraging multiple sources of funding is a good way to ensure an entire project is funded. Stacking multiple funding sources decreases your reliance on one specific funding source and increases flexibility. Capital stacking can also be utilized to meet match requirements in some grant opportunities. Diversified funds can come from government funding programs, third-party ownership models, or the applicant's own funds. In addition to upfront funding sources, some investments provide returns on a one-time or more frequent basis. For example, direct pay from IRA funding can provide either a one-time deposit based on the cost of the project, or an annual bonus based on the amount of generation from the renewable source.

Funding opportunities that do not have to be repaid should be utilized first when possible, such as grants, rebates, and direct pay incentives. Financing should be used to fill the gaps in the capital stack and achieve full project funding. Financing that is not supplied by the federal government can also generally be used to meet grant match requirements. The available funding and financing mechanisms differ by project so there is no one-size-fits-all approach to establishing a capital stack. The DOE's Better Buildings Financing Navigator can help identify which financing solution best aligns with specific projects, and then local, state, or national financing institutions can be easier to identify based on the selected approach.[20]

6.6 Next Steps

Funding and financing strategies and capital stacking can be overwhelming to navigate, but the right combination of resources can make otherwise unattractive projects more financially attractive. The following next steps are recommended.

1. Establish bond and capital plan funding availability, and its ability to cover the projects identified in this plan.
2. Identify primary funding gaps.
3. Identify high priority grants, rebates, and tax credits, especially those with impending expirations.
4. Identify key dates and deadlines.
5. Establish staff to support funding and financing application and implementation processes.
6. Gather documentation and information to support applications.

[20] https://betterbuildingssolutioncenter.energy.gov/financing-navigator/find

7. Maintain and continually update a funding opportunity tracker at regular intervals with new opportunities and updates.

7 Appendix A – Integrated Project List

Provided as attached Excel document

8 Appendix B – Cost Sheets

Level 5 Total Construction Cost Estimate:

Class 5 Estimate

AV/PC Estimate of Project Cost

Oakland County Service Center

Geothermal Hot Water Plant with Supplemental Air Source Heaters

Dated: Wednesday, November 12, 2025 Estimate Type: ROM

Estimated Direct Costs	QTY	UM	UP	CAPITAL	EXPENSE	ERL	TOTAL
SUBSTRUCTURE		LS	N/A	$0	$0	$0	$0
SHELL		LS	N/A	$0	$0	$0	$0
INTERIORS		LS	N/A	$0	$0	$0	$0
SERVICES	1	LS	$65,154,000	$65,154,000	$0	$0	$65,154,000
EQUIPMENT & FURNISHINGS		LS	N/A	$0	$0	$0	$0
SPECIAL CONSTRUCTION & DEMOLITION		LS	N/A	N/A	$0	$0	$0
SITE WORK	1	LS	$6,486,000	$6,486,000	$0	$0	$6,486,000
Subtotal Major Construction Direct Costs				**$71,640,000**	**$0**	**$0**	**$71,640,000**
Design Development Allowance			30.0%	$21,492,000	$0	$0	$21,492,000
Insurance and Liability			7.5%	$6,985,000	$0	$0	$6,985,000
Escalation 5% to mid-point of construction				$0	$0	$0	$0
MACC				$0	$0	$0	$0
GC, Home Office OH, Bond & Profit				$0	$0	$0	$0
				$0	$0	$0	$0
Estimate of Probable Construction Cost (Est. Bid Amount)				**$100,117,000**	**$0**	**$0**	**$100,117,000**
Other POS Direct Costs (Includes Construction Contingency)							
Utility Costs (Design, Construction, Permit Fees)				$0	$0	$0	$0
Contingencies							
Construction Contingency			10.0%	$10,012,000	$0	$0	$10,012,000
Other POS Direct Costs (Excludes Construction Contingency)							
Owner Furnished Material & Equipment				$0	$0		$0
Subtotal				**$110,129,000**	**$0**	**$0**	**$110,129,000**
Environmental Costs							
ENV / HAZMAT / RMM				$0	$0	$250,000	$250,000
Bid Amount (including Contingency)				$0	$0	$0	$0
Materials				$0	$0	$0	$0
Equipment				$0	$0	$0	$0
Subtotal PCS Construction Costs				$0	$0	$250,000	$250,000
Construction Management				$0	$0	$0	$0
Subtotal Construction Costs w/ ODC's & Contingency				**$110,129,000**	**$0**	**$250,000**	**$110,379,000**
PMG & Other Soft Costs							
Design (DS)							
A / E Design and Construction Support - Consultant			7.0%	$7,709,000	$0		$7,709,000
Design and Construction Support - In House			1.0%	$1,101,000	$0		$1,101,000
Project Management (PM)							
Project Mgmt. (Des & Constr)			4.0%	$4,405,000	$0		$4,405,000
Commissioning			2.0%	$2,203,000	$0		$2,203,000

Construction Management (CM)					
Construction Management	5.0%	$5,506,000	$0		$5,506,000
Testing & Inspection	1.0%	$1,101,000	$0		$1,101,000
Safety	1.0%	$1,101,000	$0		$1,101,000
Survey	0.0%	$0	$0		$0
Central Procurement Office (CPO)					
Central Procurement Office	0.10%	$110,000	$0		$110,000
Administration (AD)					
County Admin	2.0%	$2,203,000	$0		$2,203,000
Environmental & Permitting (EP)					
Environmental Support & Reviews	0.1%	$110,000	$0		$110,000
Legal	0.05%	$55,000	$0		$55,000
Building Dept / Permitting	0.5%	$496,000	$0		$496,000
Subtotal PMG & Other Soft Costs	**24%**	**$26,100,000**	**$0**	**$0**	**$26,100,000**
TOTAL ESTIMATED PROJECT COST		**$136,229,000**	**$0**	**$250,000**	**$136,479,000**

	Low Range - 25%	Estimated Costs	High Range +50%
TOTAL PROJECT COST	**$102,359,000**	**$136,479,000**	**$204,719,000**

Direct Construction Cost Detail:

Project Name:						Date:	11/12/2025
ASHP/GSHP Heating Plant	**Units**	**Type**	**Hr. Rate**	**LABOR AMT**	**Material Unit**	**MAT AMT**	**TOTAL**
HVAC							
HVAC Equipment							
ASHP-1 to 8, 1,400 Tons heating	8	EA	180.00	477,360	320,000.00	2,560,000	3,037,360
ASHP-1 to 8, Water Pump, Vertical Inline, 30 HP	8	EA	180.00	69,120	28,200.00	225,600	294,720
WCH-1 to 3, Water Cooled Heater, 2000 tons Heating	12	EA	180.00	1,053,000	325,000.00	3,900,000	4,953,000
WCHPP-1 to 5, WCH Primary Pump, Vertical Inline, 30 HP	12	EA	180.00	103,680	26,000.00	312,000	415,680
GWPP-1 to 6, Geothermal Water Primary Pump, Horizontal Split Case, 300 HP	4	EA	180.00	345,600	282,000.00	1,128,000	1,473,600
ET-1, Heating Water Expansion Tank, 1000 GAL	1	EA	180.00	14,400	100,000.00	100,000	114,400
ET-2, Geothermal Water Expansion Tank, 3000 GAL	1	EA	180.00	43,200	300,000.00	300,000	343,200
AS-1, Heating Water Air/Dirt Separator, 24"	1	EA	180.00	2,880	26,000.00	26,000	28,880
AS-2, Geothermal Water Air/Dirt Separator, 30"	1	EA	180.00	3,600	32,500.00	32,500	36,100
AS-3, Chilled Water Air/Dirt Separator, 24"	1	EA	180.00	2,880	26,000.00	26,000	28,880

GHX-1 to 4, Geothermal HX, Plate and Frame, 20,000 MBH	2	EA	180.00	216,000	120,000.00	240,000	456,000
GWSP-1 to 6, Geothermal Water Secondary Pump, Horizontal Split Case, 100 HP	4	EA	180.00	115,200	94,000.00	376,000	491,200
Geothermal Borehole, 290 FT Deep, 20 FT on center	950	EA	160.00	8,512,000	4,500.00	4,275,000	12,787,000
Geothermal manifolds and exterior loop piping	1	LS	180.00	498,000	8,287,965.00	8,287,965	8,785,965
Equipment Piping							
Equipment connection to WCH, 12" dia.	20	EA	160.00	400,000	26,000.00	520,000	920,000
Equipment connection to HWPP, 4" dia.	20	EA	160.00	51,200	3,900.00	78,000	129,200
Equipment connection to GWPP, 8" dia.	4	EA	160.00	17,920	9,200.00	36,800	54,720
Equipment connection to HWSP, 8" dia.	12	EA	160.00	53,760	8,000.00	96,000	149,760
Equipment connection to ET	2	EA	160.00	2,240	2,000.00	4,000	6,240
Equipment connection to AS	2	EA	160.00	1,280	1,800.00	3,600	4,880
Equipment connection to GHX, 12" dia.	6	EA	160.00	149,760	31,500.00	189,000	338,760
Equipment connection to GWSP, 8" dia.	4	EA	160.00	17,920	9,200.00	36,800	54,720
Heating Water Pipe, 4" dia.	1,000	LF	160.00	96,000	57.00	57,000	153,000
Heating Water Pipe, 8" dia.	1,000	LF	160.00	156,800	100.00	100,000	256,800
Heating Water Pipe, 12" dia.	800	LF	160.00	179,200	145.00	116,000	295,200
Geothermal Water Pipe, 8" dia.	750	LF	160.00	117,600	100.00	75,000	192,600
Geothermal Water Pipe, 12" dia.	250	LF	160.00	56,000	145.00	36,250	92,250
Controls							
DDC Controls to ASHP	8	EA	210.00	287,784	23,400.00	187,200	474,984
DDC Controls to WHC	12	EA	210.00	431,676	23,400.00	280,800	712,476
DDC Controls to HWPP	20	EA	210.00	191,856	6,240.00	124,800	316,656
DDC Controls to GWPP	4	EA	210.00	38,371	6,240.00	24,960	63,331
DDC Controls to HWSP	4	EA	210.00	38,371	6,240.00	24,960	63,331
DDC Controls to GHX	2	EA	210.00	71,946	23,400.00	46,800	118,746
DDC Controls to GWSP	4	EA	210.00	38,371	6,240.00	24,960	63,331
Utility Corridor							
Allow for additional custom supports and other accessories	1	LS	120.00	0	-	0	0
Miscellaneous							

Testing & Commissioning	1	LS	175.00	225,289	1,192,599.75	1,192,600	1,417,889
Builder's work in connection with the above scope	1	LS	-	0	751,337.84	751,338	751,338
Premium for access restriction and renovation works	0.25	LS	-	0	-	0	0
Sub GC & Contingency	20%			2,816,053	25,795,932.59	5,159,187	7,975,240
Sub OH & Profit	15%			2,534,448	30,955,119.11	4,643,268	7,177,716
Sub-total HVAC				**19,430,766**		**35,598,387**	**55,029,153**
Electrical							
Normal Power							
12.47KV Receiving station/switchgear, 400A bus, 2 sections	1	EA	190.00	49,400	210,000.00	210,000	259,400
12.47KV feeders	400	LF	190.00	36,480	193.00	77,200	113,680
MV terminations	8	EA	190.00	20,520	1,090.00	8,720	29,240
Ductbank, concrete encased, 4 x 4"	400	LF	190.00	32,680	106.00	42,400	75,080
Trenching allowance	400	LF	190.00	146,680	126.00	50,400	197,080
480V Double ended switchgear with 2x2000KVA 12.47KV-480V transformer, 4000A bus, 20 branches	1	EA	190.00	239,400	823,000.00	823,000	1,062,400
480V feeders and conduit, normal power	1,500	LF	190.00	114,000	67.00	100,500	214,500
Emergency Power							
Transformer, 12.47KV-480KV, 3500KVA	1	EA	190.00	95,000	375,000.00	375,000	470,000
12.47 KV Generator, 3.5MW	1	EA	190.00	68,400	2,640,000.00	2,640,000	2,708,400
12kV feeder and conduit	200	LF	190.00	20,520	152.00	30,400	50,920
MV cable termination	8	EA	190.00	20,520	1,090.00	8,720	29,240
Transfer Switch	1	EA	190.00	187,758	644,400.00	644,400	832,158
480V feeders and conduit	100	LF	190.00	7,600	67.00	6,700	14,300
Mechanical Power Supply							
Disconnect switch to ASHP, 200A 480V	8	EA	190.00	10,336	880.00	7,040	17,376
Disconnect switch/starter panel to WCH, 200A 480kV	12	EA	190.00	72,960	20,000.00	240,000	312,960
Disconnect switch to HWPP, 100A 480V	20	EA	190.00	25,840	880.00	17,600	43,440
Disconnect switch to GWPP, 100A 480V	4	EA	190.00	12,920	880.00	3,520	16,440
Disconnect switch to HWSP, 100A 480V	4	EA	190.00	12,920	880.00	3,520	16,440
Disconnect switch to GWSP, 400A 480V	4	EA	190.00	12,920	880.00	3,520	16,440
Conduit and wire, 100A	1,500	LF	190.00	66,405	19.26	28,890	95,295

Conduit and wire, 400A	400	LF	190.00	38,760	103.26	41,304	80,064
Miscellaneous							
Testing & Commissioning	1	LS	190.00	64,601	268,141.70	268,142	332,743
Builder's work in connection with the above scope	1	LS	190.00	40,699	168,929.27	168,929	209,628
Premium for access restriction and renovation works	0	LS	190.00	139,732	-	0	139,732
Sub GC & Contingency	20%			307,410	5,799,904.97	1,159,981	1,467,391
Sub OH & Profit	15%			276,669	6,959,885.97	1,043,983	1,320,652
Sub-total Electrical				**2,121,130**		**8,003,869**	**10,124,998**
Sitework/Site Improvements							
Demo/patch surface area ductbank	5,000	LF					375,000
Demo/patch surface area utilidor	5,000	LF					900,000
Demo/patch surface area geo wells	670	EA					211,050
Utility relocation allowance	1	LS					500,000
New Central Utility Plant	7,500	SFA					4,500,000
Sub-total Sitework/Site Improvements							**6,486,050**
TOTAL DIRECT COST				**21,551,895**		**43,602,256**	**71,640,201**
	7,500.00	SF					9552.026813