

Energy Efficiency Plan

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EXECUTIVE SUMMARY

The City of Baraboo (City) has set objectives to lower energy use and carbon emissions by improving operations, employing energy-efficient equipment, and incorporating alternative energy generation. To assist the City with meeting their goals, this Energy Efficiency Plan (Plan) was developed. The goals of this Plan include:

- Development of a baseline energy use benchmark for each facility
- Identification of low-cost Energy Efficiency Measures (EEMs)
- Evaluation of opportunities for renewable energy installations

The development of this Plan consisted of data gathering, development of baseline energy benchmarks, and analysis of cost-effective EEMs. To develop the baseline energy profiles for each facility, facility data was gathered. Facility data helped baseline and benchmark costs and carbon emissions.

EEMs were identified for each facility to lower energy use, reduce carbon emissions, and reduce costs. Recognizing that not every recommendation can be implemented all at once, most recommendations have investment paybacks and apply technologies and actions that can be implemented with future planning. **Table 1** lists the combined EEM’s anticipated energy and cost savings. The potential energy savings are 12.5 percent while the cost reduction is 9.6 percent.

Table 1. EEM Annual Savings Summary – City of Baraboo

EEM	Energy Savings				Cost Reductions			
	Electricity [kWh]	Natural Gas [therms]	Energy Savings [%]	Emission [MTCO2e]	Electricity [\$]	Natural Gas [\$]	Total [\$]	Costs [%]
Total	132,818	17,862	12.5%	189	\$23,221	\$12,702	\$35,923	9.6%

Beyond the EEMs, the Plan addresses renewable energy project opportunities. Installing solar on all potential facilities could offset nearly all City Scope 2 operational greenhouse gas emissions for the facilities analyzed.

The following actions are recommended as they relate to evaluating opportunities for renewable energy installations:

1. **Pursue a Pilot Project:** Consider installing a solar array on the Municipal Building to demonstrate feasibility and build internal capacity.
2. **Engage Alliant Energy:** Request site-specific proposals for Customer-Hosted and Renewable Energy Partner programs.
3. **Apply for Incentives:** Coordinate with Focus on Energy and explore funding opportunities.

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1.0 INTRODUCTION

The City of Baraboo (City) has undertaken a significant initiative to enhance energy efficiency and reduce greenhouse gas emissions across its municipal facilities. Enabled by an Energy Efficiency and Conservation Block Grant (EECBG) from the Public Service Commission of Wisconsin Office of Energy Innovation, and in alignment with the U.S. Department of Energy's Blueprint 2A for Energy Audits and Building Upgrades, this assessment is designed to identify cost-effective energy efficiency measures (EEMs) and support the City's commitment to sustainability.

Eight municipal facilities were chosen for the assessment and subsequent EEMs. The facilities and facility types are:

- Carnegie-Schadde Memorial Library (CSML) – Public Library
- City Services Center (CSC) – Public Services
- Civic Center (CC) – Mixed Use: Social/Meeting Hall, Fitness, Office
- Corson Square Apartments (CSA) – Multifamily Housing
- Donahue Terrace (DT) – Multifamily Housing
- Municipal Building (MB) – City Hall/Police
- Pierce Park Hockey Pavilion (PPHP) – Ice Rink
- Water Resource Recovery Facility (WRRF) – Wastewater Treatment

These facilities account for more than 40% of the City's annual operational energy consumption costs. Other City energy-related expenses include street lighting and water treatment and conveyance operations.

Other facilities not included in the assessment include: Langer Park, Old Shop, Parks Shelters, Pool, Sirens, Street Lighting, Traffic Signals, Water Utility, and Zoo. Other emission sources such as fuel for fleet vehicles were not included in the assessment but also significantly contribute to the City's overall emissions and general operating costs.

City staff, elected officials, and citizen groups like Powered Up Baraboo have initiated various EEMs and renewable projects previously. This plan builds upon that effort and offers suggestions for future improvement. As part of this assessment, supplementary evaluations were provided to better assess previous project energy saving efforts and to integrate EEMs in future planned building.

2.0 METHODOLOGY OVERVIEW

The methodology applied in this plan is rooted in industry-standard practices, leveraging both qualitative and quantitative tools to provide a holistic view of current energy performance. The process included a review of utility bills and historical energy usage data to establish baseline consumption patterns for each facility. This initial step enabled the identification of energy-related trends and anomalies, such as periods of unusually high demand or unexpected spikes in usage, which could signal inefficiencies or operational issues.

To complement the data analysis, on-site audits were conducted to gather detailed information on building envelopes, mechanical and electrical systems, and occupant usage. Consideration was also given to the age and condition of key energy-related equipment, climate and lighting control strategies, and the integration of existing energy management systems. Select stakeholder engagement sessions were conducted with facility managers and staff to understand operational

challenges, maintenance activities, and opportunities for behavioral improvements that could yield additional savings.

Initial audit findings guided prioritization of further investigative steps, including targeted site audits and the deployment of energy monitoring devices. This phased approach ensured that recommendations would be both data-driven and context-sensitive, addressing the characteristics of each municipal building while aligning with the City’s overarching sustainability objectives.

3.0 FACILITIES

The facilities chosen for the assessment are listed in **Table 2**. The general property type and the facility address is also provided in the following table.

Table 2. City of Baraboo - Facility Summary

Property Name	Abbr.	Property Type	Address
Carnegie-Schadde Memorial Library	CSML	Public Library	230 4th Ave
City Services Center	CSC	Public Services	450 Roundhouse Ct
Civic Center	CC	Mixed Use - Social/Meeting Hall, Fitness Center, Office	124 2nd St
Corson Square Apartments	CSA	Multifamily Housing	920 10th St
Donahue Terrace	DT	Multifamily Housing	227 1st Ave
Municipal Building	MB	Mixed Use - City Hall/Police	101 South Blvd
Pierce Park Hockey Pavillion	PPHP	Ice Rink	1100 Walnut St
Water Resource Recovery Facility	WRRF	Wastewater Treatment Buildings	1000 Manchester St

Facilities and operations not included in the assessment include: Langer Park, Old Shop, Parks Shelters, Pool, Sirens, Street Lighting, Traffic Signals, Water Utility, and Zoo.

Other emission sources, like fuel for fleet vehicles, were not included in the assessment but might significantly contribute to the City’s overall emissions or general operating costs.

Brief facility and system descriptions are provided in the following subsections.

3.1 CARNEGIE-SCHADDE MEMORIAL LIBRARY (CSML)

- **General Building Information:** Public library with a dedicated area for community and educational activities. Operates extended hours to accommodate patrons and events.
- **Building Envelope:** Features a mix of historic and modern construction, with recent renovations (2023).
- **HVAC Systems:** Equipped with a hot water boiler system for heating and a chilled water system for cooling, the building features three air handling units with zoned variable air volume hot water terminal units.

- **Lighting System:** Predominantly LED lighting, supporting energy efficiency and sufficient illumination for study and reading spaces.
- **Domestic Hot Water Systems:** Standard electric and gas water heating for various new and renovated spaces.

3.2 CITY SERVICES CENTER (CSC)

- **General Building Information:** Facility supporting public works and city operations, with administrative and equipment storage spaces. Operates primarily during standard business hours.
- **Building Envelope:** The structure utilizes metal construction, with all insulation installed entirely above the roof deck.
- **HVAC Systems:**
 - Office spaces are heated and cooled using split system air conditioning paired with natural gas furnaces. Facility staff have recently replaced thermostats for better scheduling and general controls.
 - Vehicle storage and maintenance bays are equipped with natural gas-fired air handling units for heating, while the maintenance bay also utilizes infrared radiant systems to efficiently address the unique demands of those workspaces.
 - Exhaust is controlled to operate per schedule or if the limits of CO/NOx are exceeded.
- **Lighting System:** Facility staff are upgrading LED fixtures throughout vehicle storage areas, offering energy savings and improved visibility.
- **Domestic Hot Water Systems:** Gas water heaters for staff restrooms and break areas.
- **Process Systems:** A compressed air system is piped and operated for vehicle repair applications.

3.3 CIVIC CENTER (CC)

- **General Building Information:** Multi-use space hosting social, meeting, fitness, and office functions. Open for both scheduled events and regular community activities.
- **Building Envelope:** Mixture of older construction supplemented with more modern enhancements, like window retrofits.
- **HVAC Systems:** Equipped with a hot water boiler system for heating and split-system air-conditioning units for cooling with either unit ventilators or fan coil units.
- **Lighting System:** LED lighting throughout the facility as a result of a recent retrofit.
- **Domestic Hot Water Systems:** Gas water heating for restrooms, lockers, and kitchen areas.

3.4 CORSON SQUARE APARTMENTS (CSA)

- **General Building Information:** Multifamily residential property providing affordable housing. Residents occupying throughout the day and night. To be redeveloped.
- **Building Envelope:** Standard multifamily wood-framed construction with attention to weatherproofing and insulation for occupant comfort.
- **HVAC Systems:** Individual electric heating and window cooling systems for each apartment and tenant control.
- **Lighting System:** In-unit lighting varies by tenant.
- **Domestic Hot Water Systems:** Centralized natural gas water heaters serving all apartments.

3.5 DONAHUE TERRACE (DT)

- **General Building Information:** Multifamily housing facility with multiple electrical services, including a dedicated line for corridor exit lighting. Operates continuously for resident use.
- **Building Envelope:** Standard multifamily mass-wall construction to meet residential standards, with window treatments for energy conservation.
- **HVAC Systems:** Individual electric heating and optional cooling systems for each apartment and tenant control. Common areas are served by a packaged air handling unit.
- **Lighting System:** In-unit lighting varies by tenant.
- **Domestic Hot Water Systems:** Central natural gas-fired storage system serving residential and common needs.

3.6 MUNICIPAL BUILDING (MB)

- **General Building Information:** Serves as City Hall and Police Headquarters, with office, meeting, and administrative spaces. Operates standard business hours with extended hours for law enforcement.
- **Building Envelope:** Municipal construction, including masonry and updated fenestration for improved thermal performance.
- **HVAC Systems:**
 - Central HVAC with zoning to support the varied occupancy and operating hours of City departments.
 - Vehicle storage equipped with natural gas-fired air handling units for heating.
 - Exhaust is controlled to operate per schedule or if the limits of CO/NOx are exceeded.

- **Lighting System:** Modernized LED systems throughout offices, common spaces, and secure areas.
- **Domestic Hot Water Systems:** Central natural gas-fired storage hot water capacity for staff, public restrooms, and police facilities.

3.7 PIERCE PARK HOCKEY PAVILLION (PPHP)

- **General Building Information:** Ice rink and seasonal recreational pavilion. Occupied primarily during winter sports seasons, with fluctuating daily hours based on programming.
- **Building Envelope:** Installed on a tight budget with minimal roof insulation and no wall insulation.
- **HVAC Systems:** Minimal heating; ice rink equipment are primary systems.
- **Lighting System:** High-intensity LED fixtures for rink illumination; controls for energy savings when not in use.
- **Domestic Hot Water Systems:** Limited hot water provision for restrooms and concession areas.

3.8 WATER RESOURCE RECOVERY FACILITY (WRRF)

- **General Building Information:** Wastewater treatment facility with complex operational needs; runs 24/7 to serve the city.
- **Building Envelope:** Industrial-grade construction for process buildings, with attention to corrosion resistance and environmental control.
- **HVAC Systems:** Specialized process heating and ventilation, separate metering for electricity and four natural gas lines due to operational complexity.
- **Lighting System:** Industrial lighting, with energy-efficient options in office and control spaces.
- **Domestic Hot Water Systems:** Systems tailored to staff support areas and process requirements.

Facilities not included in this assessment but potentially relevant for future phases include parks, street lighting, water utilities, and the municipal fleet.

4.0 UTILITY DATA SUMMARY

Utility data was provided for a two-year period, from December 2022 through November 2024, encompassing electricity and natural gas usage and costs. All facilities are served by Alliant Energy and operate under a variety of rate structures, many utilizing time-of-use (TOU) rates designed to optimize cost based on demand periods.

Utility rate details and blended rates (2024 average: \$0.113 per kWh for electricity and \$0.699 per therm for natural gas).

4.1 ANNUAL ENERGY COSTS

Table 3 summarizes the facility’s annual expenditures for both electricity and natural gas, highlighting the total energy costs for each reporting cycle. These figures provide insight into year-over-year spending trends, which are influenced by operational demands, utility rate adjustments, and seasonal variations in energy consumption.

Table 3. City of Baraboo – Annual Energy Costs

	Electricity Cost [\$]	Natural Gas Cost [\$]	Total Energy Cost [\$]
Dec. 2022 – Nov. 2023	\$310,905	\$84,849	\$395,755
Dec. 2023 – Nov. 2024	\$313,264	\$59,159	\$372,423
Difference	\$2,359	-\$25,690	-\$23,332
Difference (%)	0.8%	-30.3%	-5.9%

Key observations from an annual perspective include:

- 2024 total energy costs declined by 5.9% from the previous year, largely due to a significant drop in natural gas rates early in 2024.
- Electricity costs now make up 84% of total energy expenses, an increase from 79% the year prior.

4.2 ANNUAL ENERGY

The annual electricity, natural gas, and total energy consumed by the City for a 2-year period (December 2022 – November 2024) for these facilities is shown in **Table 4**. Site energy consumption is the sum of all forms of energy consumption converted to a common unit, thousand British thermal units (kBtu) in this case. In this analysis, electricity consumption in kiloWatt hours (kWh) is converted to kBtu and added to natural gas consumption in therms (therm) converted to kBtu.

The overall annual energy consumed for the 2024 period was 17,919,858 kBtu, down 1,371,447 (7.1%) from the 2023 period.

Table 4. City of Baraboo – Annual Energy

	Electricity [kWh]	Natural Gas [therm]	Total Energy [kBtu]
Dec. 2022 – Nov. 2023	2,817,440	96,782	19,291,305
Dec. 2023 – Nov. 2024	2,773,200	84,577	17,919,858
Reduction	44,240	12,205	1,371,447
Improvement (%)	1.6%	12.6%	7.1%

4.3 BENCHMARKING SUMMARY

To compare municipal building performance, City data was entered into the ENERGY STAR Portfolio Manager (ESPM). ESPM focuses on benchmarking actual building energy consumption. By analyzing utility bills and normalizing data for factors like building size and use, ESPM generates key metrics such as the Energy Use Intensity (EUI) that enables comparison across similar facilities nationwide. This value reflects real-world operational efficiency, highlighting how effectively the building is managed and where operational improvements can yield savings.

Table 5 presents a comparison of the City’s building energy performance, specifically Source Energy Use Intensity (EUI), and the National Median Source EUI for similar facility types.

A negative value for the “Difference from Median Source EUI” indicates that the facility is operating below the national median – using less source energy per square foot than typical similar buildings and thus performing more efficiently.

Table 5. City of Baraboo – 2024 Benchmark Source EUI

Property Name	Abbr.	Source EUI [kBtu/sf]	National Median Source EUI [kBtu/sf]	Difference from Median Source EUI [%]
Carnegie-Schadde Memorial Library	CSML	97.6	143.6	-32%
City Services Center	CSC	52.6	89.3	-41%
Civic Center	CC	57.0	89.3	-36%
See Note 1				
Donahue Terrace	DT	97.6	122.8	-21%
Municipal Building	MB	131.3	89.3	47%
Pierce Park Hockey Pavillion	PPHP	75.5	112.0	-33%
	Abbr.	Source EUI [kBtu/gpd]	National Median Source EUI [kBtu/gpd]	Total Energy [kBtu/MG]
Water Resource Recovery Facility	WRRF	7.9	11.45	-31%

Note 1: Corson Square Apartments were removed from the benchmarking assessment as the tenants pay the utilities for non-communal spaces and the property is planned for redevelopment.

The Municipal Building stands out with a 47% higher Source EUI than the national median, while most other facilities perform better than comparable benchmarks – an encouraging sign for much of the City’s portfolio. The Municipal Building is a mixed-use facility comprising of City administrative and Police services. The 24/7 operations of the Police Department increases the facility’s overall energy consumption, though the building is still benchmarked against a national median building.

Additional facility utility data is provided in **Appendix A – Assessment of Current Conditions**.

4.4 ASSET SCORE REPORTS

To further support strategic decision-making, the use of Asset Scores, developed by the U.S. Department of Energy, as a central metric for evaluating building performance was used. The Asset Score provides a standardized assessment of each facility's energy characteristics, offering insights into building efficiency and upgrade opportunities. Detailed findings and recommendations for each property are documented in the accompanying Asset Score Reports, which serve as a qualitative resource for guiding targeted investments and tracking progress over time.

This data was gathered through a combination of reviewing building drawings and building specifications, conducting site visits, and reviewing building automation system records to ensure comprehensive and accurate reporting.

Asset Score Reports were prepared for each facility, highlighting both current conditions and the projected benefits of proposed upgrades. These upgrades typically include retrofit of lighting to LED technology, HVAC system enhancements, building envelope improvements such as upgraded insulation and window glazing, and suggestions for review of controls to better match energy use with occupancy patterns.

The Asset Score Reports are provided in **Appendix B – Asset Score Reports**.

4.5 INTEGRATING ENERGY STAR PORTFOLIO MANAGER AND ASSET SCORE

By combining the insights from ESPM and Asset Score, the City can strategically align operational practices with capital improvement plans. The ESPM highlights current performance and operational anomalies, while the Asset Score proposes future improvements. Together, these tools support:

- Data-driven decision-making, balancing quick operational wins with major retrofit investments.
- Continuous performance monitoring using Portfolio Manager, validated against the technical benchmarks identified by the Asset Score.
- Targeted resource allocation, ensuring that energy and carbon reduction efforts address both behavioral and infrastructure-based opportunities.
- Measurement & Verification (M&V) frameworks for tracking the effectiveness of implemented measures over time.

For instance, **Figure 1** shows a hypothetical portfolio of multiple buildings with various ESPM and Asset Score metrics.

When a facility exhibits a high Asset Score but a low ENERGY STAR score, it indicates that the building's physical infrastructure – such as its insulation, equipment, and envelope – is fundamentally efficient, yet its day-to-day operation does not reflect this potential. The primary recommendation for such buildings is to focus on **Operational Improvements**.

Conversely, when a facility is characterized by both a low Asset Score and a low ENERGY STAR score, the findings signal significant opportunities on multiple fronts. In such cases, both the building's physical infrastructure and operational practices are underperforming relative to comparable

facilities. This combination suggests that the building not only lacks efficient equipment and envelope features – such as effective insulation, high-performance windows, or modern HVAC systems – but also operates below its potential due to suboptimal maintenance routines, scheduling, or occupant behavior. The recommended approach for these facilities is twofold: prioritize **Capital Improvements and Operational Improvements**.

Figure 1. Integrating Energy Star Portfolio Manager and Asset Scores

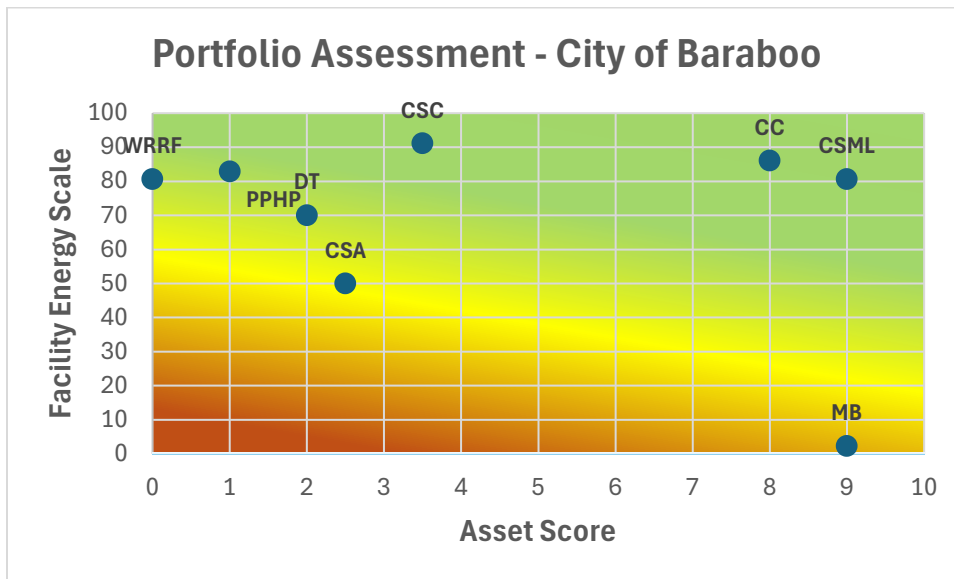


4.6 PORTFOLIO ASSESSMENT – CITY OF BARABOO

Figure 2 represents the portfolio assessment for the City of Baraboo facilities.

In the case of the Municipal Building (MB), the data reveals a high Asset Score coupled with a relatively low facility score. This suggests that, while the building’s physical infrastructure is up-to-date, there remains meaningful opportunities to further optimize everyday operations. For MB, the focus should be on **Operational Improvements** – refining schedules and fine-tuning equipment controls – to bridge the gap between existing physical potential and realized energy performance.

Figure 2. Portfolio Assessment – City of Baraboo



This high-level assessment provides actionable insights by comparing operational efficiency with the underlying technical potential of each building. Facilities that score well in both domains can serve as models, while discrepancies between operational and asset scores reveal specific opportunities for improvement, whether through operational changes, capital investments, or a combination of both.

The integration of these two tools can guide the City’s sustainable building strategy. By leveraging both operational and technical assessments, the City is in a better position to identify and implement opportunities in a transparent fashion.

5.0 ON-SITE ENERGY AUDITS

As part of the comprehensive energy assessment, structured walk-through tours were conducted at the sites. The initial walk-through visits were conducted on December 17, 2024, observing each facility’s operational routines, occupant behaviors, and maintenance practices. Detailed notes were recorded on operational parameters.

Follow-up site visits at the Civic Center and City Services Center were performed on April 4, 2025, refining the assessment and confirming consistency with earlier observations. Facilities were selected based upon lack of remote access to the building automation systems. To enhance the precision of our analysis, data loggers were installed in select locations at both the Civic Center and City Services Center.

Data loggers monitored light levels and occupancy patterns in selected rooms, notably within the Boys and Girls Club (Room 26) at the Civic Center. These devices captured details regarding the actual operating hours of new LED fixtures – results that differed from initial estimates. The weekly runtime data showed variability that informed a more accurate projection of energy savings. Data logger retrieval occurred on April 16, 2025, allowing for comprehensive post-installation review.

Similarly, at the City Services Center, data loggers were positioned to monitor indoor air quality via carbon dioxide (CO₂) measurements, HVAC runtimes, and compressed air operations.

5.1 POST-INSTALLATION LED EVALUATION AT THE CIVIC CENTER

In 2023, the City performed a LED light fixture upgrade at the Civic Center to reduce energy and realize energy cost savings. A post-installation evaluation was completed to quantify outcomes compared to original energy reduction projections. The review included the analysis of twelve months of utility data before and after the upgrade, adjusted for weather and operational changes. While the retrofit resulted in an annual reduction of 12,640 kWh (7.7%) and cost savings of \$552.37 (2.6%), these results were notably lower than anticipated. The evaluation attributed this gap to several factors: overestimated baseline usage, variations in fixture operating hours (as revealed by data logger insights), and increases in electricity time-of-use (TOU) rates. The findings highlighted the need for robust Measurement & Verification (M&V) plans in future projects and the importance of using site-specific data to refine assumptions and expectations.

This memo can be reviewed in additional detail in **Appendix C – LED Evaluation Civic Center**.

6.0 ENERGY EFFICIENCY MEASURES (EEM)

The primary objective of the on-site energy audits is an identification of pragmatic energy efficiency measures (EEMs) tailored to the City's facility's assets. EEMs are designed to empower the City to implement practical, low-cost or no-cost improvements that can yield immediate savings, while also providing a roadmap for more substantial energy upgrades to be considered during future capital improvement planning. By combining actionable short-term recommendations with strategic guidance for long-term investments, the City is more informed to make decisions that enhance operational efficiency, reduce energy costs, and meet sustainability goals across its municipal buildings.

EEMs are discussed in following sections. Renewable energy measures are discussed in detail in the Renewable Energy Assessment deliverable and can be reviewed in **Appendix D – Renewable Energy Assessment**.

For each measure identified, SCS calculated the anticipated savings and payback. Calculations were based on a combination of resources and engineering judgement. Measures are organized by simple payback to identify measures that will recover capital costs quickly. General engineering judgement was used for how much each measure applied to the building based on use type, square footage, hours of operation, and other factors. Costs are budgetary in nature and may vary pending any number of factors.

6.1 CITY SERVICES CENTER (CSC)

A few EEMs have recently been implemented in the City Services Center. Facility staff have replaced local office thermostats, as well as controls for the vehicle storage exhaust system, and installed LED lighting.

The following table lists the EEM for the City Services Center.

Table 6. EEM - City Services Center

Abbv.	EEM	Energy Savings			Cost Reductions			Implementation	
		Electricity [kWh]	Natural Gas [therms]	Energy Savings [%]	Electricity [\$]	Natural Gas [\$]	Total [\$]	Costs (±30%)	Simple Payback [yr]
CSC	Setback Garage Space Temperature		2,386	10.8%		\$1,671	\$1,671	\$100	0.1
CSC	Schedule Compressed Air System	2,769		0.4%	\$336	\$0	\$336	\$100	0.3
CSC	Optimize Garage Ventilation	27,704	3,086	18.3%	\$3,363	\$2,216	\$5,579	\$40,000	7.2
CSC	Add Roof Insulation		2,550	11.6%		\$1,785	\$1,785	\$152,100	85.2

EEM: Setback Garage Space Temperature

Description: Reduce heating temperature setpoints for vehicle storage heating. This EEM proposes setting back the current space temperature setpoint from 60°F all the time to 55°F during vacant periods (M-F 3pm-5am and weekends).

Justification: Decreases heating requirements, directly reducing natural gas consumption.

Additional Considerations: Ensure that setpoint reductions do not compromise other facility systems or operational needs. Alternative options like spot heating individual workstations with infrared heaters up to 60°F should also be evaluated by facility staff.

EEM: Schedule Compressed Air System

Description: Add on/off power controls so the compressed air system runs only during work hours or when needed.

Justification: Eliminates waste from unnecessary off-hours operation.

Additional Considerations: Confirm compatibility with system and inform users as needed.

EEM: Optimize Garage Ventilation

Description: This EEM proposes replacing the current intermittent ventilation strategy (0.75 cfm/sf for 5 hours/day, sensor-activated) with a hybrid approach consisting of continuous low-volume ventilation (0.05 cfm/sf for 24 hours/day) heat recovery ventilator supplemented by the existing elevated exhaust (0.75 cfm/sf per the CO/NO sensors). This strategy aligns with Method 1 of the Wisconsin Commercial Building Code for enclosed parking garages.

Justification: Curtails unnecessary fan operation, conserves energy, and maintains safe air quality.

Additional Considerations: Sensor calibration, code compliance, and occasional system maintenance may be required.

EEM: Add Roof Insulation

Description: Increase roof insulation to reduce heat loss. This measure evaluates adding 2” of additional rigid foam insulation to the roof.

Justification: Improves building envelope efficiency, lowering heating and cooling needs.

Additional Considerations: Ensure material compatibility and plan for installation at the end of the useful life of the current roof.

6.2 CARNEGIE-SCHADDE MEMORIAL LIBRARY (CSML)

Improved operational controls is the primary EEM opportunity at the recently renovated CSML.

The following table lists the EEM for the library.

Table 7. EEM – Carnegie-Schadde Memorial Library

Abbv.	EEM	Energy Savings			Cost Reductions			Implementation	
		Electricity [kWh]	Natural Gas [therms]	Energy Savings [%]	Electricity [\$]	Natural Gas [\$]	Total [\$]	Costs (±30%)	Simple Payback [yr]
CSML	RCx Services	27,437	1,324	13.6%	\$8,085	\$1,257	\$9,341	\$18,000	1.9
CSML	Water-to-Water Heat Pump		1,134	6.8%		\$793	\$793	\$10,000	12.6

EEM: Retro-Commissioning (RCx) Services

Description: Retro-Commissioning (RCx) is a systematic process to tune up existing systems for better energy performance. Some examples of issues observed that RCx could assist with include: calibrate outside air flow stations, evaluate the operation of AHU-3 and change it back from operating in a constant air volume mode to a variable air volume mode, evaluate the chilled water system for constant flow operations, consider reducing the minimum heating and cooling air flow setpoints for each zone, and lowering the hot water return temperatures.

Justification: Identifies and corrects inefficiencies, leading to immediate improvements.

Additional Considerations: Requires periodic follow-ups to sustain savings. Usually requires a third-party commissioning agent to review system controls. The commissioning agent will then make or recommend improvements that lead to a more comfortable building and more energy savings. Evaluating opportunities to implement and program the American Society of Refrigerating, Air-Conditioning, and Heating Engineer’s (ASHRAE’s) Guideline 36: High-Performance Sequences of Operation for HVAC Systems would likely improve occupant comfort and reduce energy consumption.

Below is a list of high-performance sequences that are usually implemented to reduce energy usage:

1. Supply Fan Control
2. Supply Air Temperature Setpoint Reset Control

3. Static Pressure Setpoint Reset Control
4. Economizer Damper Control
5. Return Damper Control
6. Return/Relief Fan Control
7. Minimum Outdoor Airflow Setpoint Reset
8. Freeze Protection
9. Automatic Fault Detection and Diagnostics
10. AHU Operating State
11. Chilled Water Reset Requests
12. Hot Water Reset Requests

EEM: Water-to-Water Heat Pump

Description: A water-to-water heat pump is a system that transfers heat between two water loops—such as a building’s hot water or chilled water loop. By moving thermal energy in this way, the system can efficiently provide both heating and cooling, adapting to a building's seasonal needs. This equipment is especially effective in facilities where simultaneous heating and cooling are required in different zones, maximizing energy use and enhancing overall system efficiency. Here a 5-ton water-to-water heat pump could help offset natural gas consumption for reheating and dehumidification applications in the summer.

Justification: Maximizes use of energy that would otherwise be rejected.

Additional Considerations: Integration and controls with existing chilled water and hot water systems is crucial. The hot water supply temperature must be decreased for proper heat recovery system operations.

6.3 CIVIC CENTER (CC)

The CC completed a recent lighting retrofit to LED fixtures and is generally operated relatively well.

The following table lists the EEM for the Civic Center.

Table 8. EEM – Civic Center

Abbv.	EEM	Energy Savings			Cost Reductions			Implementation	
		Electricity [kWh]	Natural Gas [therms]	Energy Savings [%]	Electricity [\$]	Natural Gas [\$]	Total [\$]	Costs (±30%)	Simple Payback [yr]
CC	Load Shifting	3,035		0.5%	\$827		\$827	\$500	0.6
CC	Lower Hot Water Supply Temp	-683	745	3.6%	-\$93	\$335	\$242	\$500	2.1
CC	Optimize Thermostat Controls		1,113	5.5%		\$779	\$779	\$4,500	5.8

EEM: Load Shifting

Description: Schedule energy-intensive activities (like cooling the gym) to occur during off-peak hours where possible. The high-rate period that this is most applicable to this facility would be from June – August from 11 am-7 pm, Monday – Friday and then again December – February from 4 pm-8 pm, Monday – Friday.

Justification: Shifting loads away from peak times reduces demand charges, lowers utility costs, and eases stress on equipment.

Additional Considerations: May require operational adjustments and staff coordination to avoid disrupting facility use patterns. Facility staff may not be able to administratively shift all loads for the entire high-rate period but some scheduling coordination will help. Often this strategy saves more utility costs than overall energy savings.

ECM: Lower Hot Water Supply Temperature

Description: Reduce the hot water supply temperature (HWST) setpoints for the building's heating system.

Justification: Lowering HWST boosts combustion efficiency, decreases standby losses, and can extend the operational life of heating systems.

Additional Considerations: Often the HWST can automatically be reset up the colder it is outside. Verification that the boilers can be programmed this way is important. Implementation may require adjustments to maintain occupant comfort.

EEM: Optimize Thermostat Controls

Description: Implement programmable schedules and temperature setbacks for building zones. Install thermostats that integrate occupancy sensors and have setback programming capabilities.

Justification: Optimizing controls ensures heating and cooling only occur when needed, minimizing energy waste.

Additional Considerations: Training for occupants and staff is recommended to ensure proper use and avoid overrides. Some spaces could benefit from having two occupied periods programmed in lieu of one long extended occupied period. Re-evaluate existing hot water valve wiring so that valves are commanded closed when fan motors are cycled, in lieu of current state of failing open.

6.4 PIERCE PARK HOCKEY PAVILLION (PPHP)

The PPHP is heavily used during winter activities. The facility had a recent lighting retrofit and is generally operated relatively well.

The following table lists the EEMs for the Hockey Pavilion.

Table 9. EEM – Hockey Pavillion

Abbv.	EEM	Energy Savings			Cost Reductions			Implementation	
		Electricity [kWh]	Natural Gas [therms]	Energy Savings [%]	Electricity [\$]	Natural Gas [\$]	Total [\$]	Costs (±30%)	Simple Payback [yr]
PPHP	Load Shifting	3,948		1.1%	\$927		\$927	\$500	0.5
PPHP	Heat Recovery		786	6.6%		\$550	\$550	\$15,000	27.3
PPHP	Wall Insulation		524	4.4%		\$367	\$367	\$40,000	109.1

EEM: Load Shifting

Description: The hockey pavillion is also under a TOU rate structure where the facility could implement strategies to shift energy consumption to off-peak periods during times of high refrigeration. The high-rate period that this is most applicable to this facility would be from December – February from 4 pm-8 pm, Monday – Friday.

Justification: Load shifting helps manage energy costs, reduces peak demand charges, and minimizes equipment stress.

Additional Considerations: May require schedule adjustments and staff training to optimize operations without disrupting facility usage patterns.

EEM: Heat Recovery

Description: Capture waste heat from ice-making or HVAC systems for reuse in space heating or domestic hot water applications.

Justification: Utilizing recovered heat reduces overall energy consumption and enhances building sustainability.

Additional Considerations: Requires integration with existing mechanical infrastructure; upfront investment may be costly and could consider heat recovery opportunities at the end of the useful life of the aging refrigeration equipment.

EEM: Wall Insulation Upgrade

Description: Although not projected to be a significant energy saving measure because of the limited operations, improving the building’s thermal envelope by upgrading wall insulation to minimize heat loss in winter can help.

Justification: Enhanced insulation increases occupant comfort and lessens reliance on mechanical heating systems.

Additional Considerations: The facility operates sparingly in the winter months and infrared gas heaters were recently installed. The control of these heaters and the radiant floor system is important for energy savings and occupant comfort.

6.5 DONAHUE TERRACE (DT)

The DT apartment complex is continuously occupied.

The following table lists the EEMs for the Donahue Terrace.

Table 10. EEM – Donahue Terrace

Abbv.	EEM	Energy Savings			Cost Reductions			Implementation	
		Electricity [kWh]	Natural Gas [therms]	Energy Savings [%]	Electricity [\$]	Natural Gas [\$]	Total [\$]	Costs (±30%)	Simple Payback [yr]
DT	Window Sensors	20,131		2.7%	\$2,416		\$2,416	\$35,000	14.5
DT	Air Source Heat Pumps	See Note 1						\$700,000	
DT	Geothermal Heat Pumps	See Note 1						\$1,000,000	

Note 1: Although there would be projected electricity savings throughout the heating season, adding heat pumps provides the opportunity for air-conditioning that is not currently installed in all tenants' apartments for the cooling season. Electricity savings would not be anticipated.

EEM: Window/Vacancy Sensors

Description: Install window and/or room vacancy sensors that detect when a window is open or if the space is vacant. The sensor will automatically limit or disable electric heating in the affected area. By preventing unnecessary energy use when outside air enters, these sensors help maintain efficient operation and avoid wasted heating.

Justification: This simple yet effective measure prevents electric heaters from running when windows are open, reducing energy consumption, lowering utility costs, and extending the lifespan of heating equipment. It also encourages occupants to be more mindful of energy efficiency.

Additional Considerations: Installing sensors requires coordination with existing heating control systems to ensure seamless integration. Occupant education and clear communication are essential for optimal results. Vacancy sensors could be tied into other lighting or receptacles if desired.

EEM: Air Source Heat Pumps

Description: Install cold climate air-source heat pump systems designed to operate efficiently in subfreezing conditions, extracting ambient heat from outdoor air and delivering it indoors to maintain comfortable temperatures throughout the heating season.

Justification: These heat pumps provide a cost-effective, cleaner alternative to conventional electric or fossil fuel-based heating, helping reduce operational costs and carbon emissions even during the coldest months.

Additional Considerations: Installation may require electrical upgrades and adjustments to existing distribution systems to ensure compatibility and peak performance. An important added benefit of installing heat pumps is the introduction of air conditioning to apartments that currently lack cooling systems. Beyond the anticipated heating savings, residents would gain access to comfortable indoor

environments year-round – a substantial improvement in quality of life, particularly during the summer months when heat can otherwise become oppressive.

EEM: Geothermal Heat Pumps

Description: Deploy geothermal ground-source heat pumps to leverage stable underground temperatures for efficient, long-term heating and cooling at Donahue Terrace.

Justification: Utilizing the earth as an energy reservoir improves system efficiency and reliability, delivering substantial reductions in both utility costs and greenhouse gas emissions over the system’s lifespan.

Additional Considerations: Geothermal installations may involve site-specific design, drilling, and temporary disruption to landscaping or parking areas during construction. See the additional considerations listed for the air source heat pump option above.

6.6 CORSON SQUARE APARTMENTS (CSA)

A significant redevelopment is being planned for Corson Square Apartments and we suspect multiple design measures will be implemented. A community geothermal system should be seriously considered. An EEM was not calculated for this measure as the site is under significant redevelopment.

EEM: Community Geothermal Systems

Description: Implement a shared ground loop geothermal system designed to serve multiple buildings, such as apartment complexes or neighborhoods, by leveraging stable underground temperatures for communal heating and cooling. This collaborative approach reduces per-unit installation costs and distributes the benefits of advanced energy infrastructure across a broader community.

Justification: Utilizing a community-wide geothermal network maximizes efficiency and cost-effectiveness, making clean energy technology accessible to more residents. By concentrating installation efforts and resources, these systems drive significant reductions in utility expenses and greenhouse gas emissions, while supporting equitable access to sustainable living solutions.

Additional Considerations: Community geothermal projects require careful coordination among stakeholders, comprehensive site assessments, and potentially complex installation logistics. Temporary disruption to outdoor spaces or landscaping may occur during drilling and system integration, and ongoing collaboration is essential to ensure optimal system management and performance.

6.7 MUNICIPAL BUILDING (MB)

The Municipal Building is a relatively new facility and the primary EEM includes improvement of the operational controls. The following table lists the EEMs for the Municipal Building.

Table 11. EEM – Municipal Building

Abbv.	EEM	Energy Savings			Cost Reductions			Implementation	
		Electricity [kWh]	Natural Gas [therms]	Energy Savings [%]	Electricity [\$]	Natural Gas [\$]	Total [\$]	Costs (±30%)	Simple Payback [yr]
MB	Retro-Commissioning Services	43,128	4,213	14.1%	\$5,175	\$2,949	\$8,125	\$20,000	2.5

EEM: Retro-Commissioning (RCx)

Description: Implement a comprehensive RCx process to restore the Municipal Building’s existing systems to peak operational efficiency. This effort involves systematically reviewing control sequences, calibrating sensors, and adjusting equipment to eliminate inefficiencies that have emerged over time. By addressing these operational drifts, the building can achieve optimized performance while maintaining occupant comfort and safety.

Justification: RCx maximizes the value of current infrastructure by reducing unnecessary energy consumption and operational costs. Through targeted, data-driven adjustments, the process uncovers hidden opportunities for savings, extending equipment life and supporting the city’s long-term sustainability goals with minimal capital investment.

Additional Considerations: Requires periodic follow-ups to sustain savings. Usually requires a third-party commissioning agent to review system controls. The commissioning agent will then make or recommend improvements that lead to a more comfortable building and more energy savings. Evaluating opportunities to implement and program ASHRAE’s Guideline 36: High-Performance Sequences of Operation for HVAC Systems would likely improve occupant comfort and reduce energy consumption.

Below is a list of high-performance sequences that are usually implemented to reduce energy usage:

1. Supply Fan Control
2. Supply Air Temperature Setpoint Reset Control
3. Static Pressure Setpoint Reset Control
4. Economizer Damper Control
5. Return Damper Control
6. Return/Relief Fan Control
7. Minimum Outdoor Airflow Setpoint Reset
8. Freeze Protection
9. Automatic Fault Detection and Diagnostics
10. AHU Operating State
11. Chilled Water Reset Requests
12. Hot Water Reset Requests

6.8 WATER RESOURCE RECOVERY FACILITY (WRRF)

The Water Resource Recovery Facility (WRRF) has already implemented several energy efficiency upgrades, demonstrating a proactive commitment to optimizing resource use and reducing operational costs. These improvements reflect planning and an ongoing dedication to sustainable

practices. Moving forward, it remains important for the WRRF to regularly assess emerging technologies and operational strategies to ensure continued progress.

The following table lists the EEMs for the WRRF.

Table 12. EEM – Water Resource Recovery Facility

Abbv.	EEM	Energy Savings			Cost Reductions			Implementation	
		Electricity [kWh]	Natural Gas [therms]	Energy Savings [%]	Electricity [\$]	Natural Gas [\$]	Total [\$]	Costs (±30%)	Simple Payback [yr]
WRRF	Load Shifting	5,350		0.5%	\$2,185		\$2,185	\$3,000	1.4

EEM: Load Shifting

Description: The facility is also under a TOU rate structure where the operations could implement strategies to shift energy consumption to off-peak periods. The high-rate period that this is most applicable to this facility would be from June – August from 11 am-7 pm, Monday – Friday and then again December – February from 4 pm-8 pm, Monday – Friday.

Justification: Load shifting helps manage energy costs, reduces peak demand charges, and minimizes equipment stress. Review your operations during on-peak hours to identify idle operation of non-essential equipment. Determine if your treatment processes can operate during off-peak hours.

Additional Considerations: May require schedule adjustments and staff training to optimize operations without disrupting system obligations. Load shifting examples include:

1. Operate mixers and aerators in aerobic digesters during off-peak hours.
2. Modify the dissolved oxygen level in the aeration tank(s) during on-peak and off-peak hours.
3. Accept or treat hauled-in wastes during off-peak hours.
4. Utilize storage.
5. Shift filter backwash cycles to off-peak hours.
6. Bump diffusers to off-peak hours or not at all, if practical.
7. Test repaired equipment during off-peak hours.
8. Change lead-lag equipment operation during off-peak hours.
9. Do not mix solids holding tanks during on-peak hours.

7.0 RENEWABLE ENERGY ASSESSMENT

Renewable energy generation opportunities are available to the City through Alliant Energy’s renewable energy programs. A preliminary renewable energy assessment that evaluated the feasibility of solar photovoltaic (PV) installations on City-owned buildings, shelters, and vacant land was provided.

Alliant Energy provides three key renewable energy pathways:

1. Customer-Owned Solar Installations
2. Customer-Hosted Renewables
3. Renewable Energy Partner Program

Table 13 lists financial solar project offerings available from Alliant Energy.

Table 13. Solar Site Evaluations – Financial Analysis

Property Name	Location	Electricity Production (kWh/year)	Alliant Program	Upfront Cost to City	Revenue to City (\$/year)
Carnegie-Schadde Memorial Library	Roof	39,000	Customer-Owned	Donations On-going	\$0
City Services Center	Roof	741,000	Customer-Hosted	\$0	\$26,220
City Services Center	Ground	260,000	Customer-Hosted	\$0	\$9,200
Civic Center	Roof	91,000	Customer-Hosted	\$0	\$3,220
Closed Baraboo Landfill	Ground	3,120,000	Renewable Energy Partner	\$0	\$62,400
Corson Square Apartments	Roof	182,000	Customer-Hosted	\$0	\$6,440
Donahue Terrace	Roof	78,000	Customer-Owned	\$84,000	\$9,360
Fire Station #1 (New)	Roof	182,000	Customer-Hosted	\$0	\$6,440
Municipal Building	Roof	169,000	Customer-Hosted	\$0	\$5,980
Pierce Park Hockey Pavillion	Roof	481,000	Customer-Hosted	\$0	\$17,020
Water Resource Recovery Facility	Roof	299,000	Customer-Hosted	\$0	\$10,580
Water Resource Recovery Facility	Ground	390,000	Customer-Hosted	\$0	\$13,800
	Total	6,032,000		\$84,000	\$170,660

Note that the installation, upfront costs, and annual revenue provided are based on budgetary estimates and may be subject to adjustments.

The opportunity for achieving net-zero emissions is attainable with appropriate investment. Emissions associated with each building can be reviewed in section 4.5 GHG Analysis of **Appendix A - Assessment of Current Conditions**.

Installing solar on all potential facilities could offset not only Scope 2 operational emissions but Scope 1 operational emissions for facilities and fleet use as well.

The Renewable Energy Assessment can be reviewed in **Appendix D – Renewable Energy Assessment**.

8.0 FACILITY ASSET MANAGEMENT

Effective facility asset management accounting is fundamental to maximizing the value and functional longevity of facility investments. Central to this discipline is the careful tracking of equipment life expectancies, which informs not only annual budgeting but also long-term capital

planning. By maintaining accurate records of asset installations, service dates, and expected remaining useful life, organizations can proactively schedule maintenance, anticipate replacements, and avoid costly unplanned failures.

8.1 ANTICIPATED EQUIPMENT LIFE EXPECTANCIES

Understanding equipment life expectancy is indispensable for effective maintenance budgeting and capital forecasting. Typical major building systems have the following anticipated service lives under normal operating conditions:

- Roofing Systems: 20-30 years, depending on material and exposure
- Boilers and Furnaces: 20-30 years
- Chillers: 15-25 years
- Packaged HVAC Units: 15-20 years
- Pumps and Motors: 10-20 years
- Lighting Fixtures (LED): 10-20 years
- Plumbing Fixtures: 20-30 years
- Windows and Exterior Doors: 20-40 years
- Fire Alarm and Security Systems: 10-20 years
- Elevators: 20-30 years

Actual service life may vary substantially due to factors such as quality of installation, intensity of use, maintenance practices, and local environmental conditions. Proactive replacement planning, guided by regular condition assessments and industry benchmarks, helps municipalities avoid unexpected failures, allocate resources efficiently, and maintain optimal building performance throughout each system's lifecycle.

9.0 FUTURE FACILITIES

As the City continues to expand and modernize its municipal infrastructure, it will be important to integrate EEM into the planning and design of all future facilities. Where budgetary resources allow, new municipal buildings should prioritize the incorporation of advanced EEM technologies and systems from the earliest stages of development. By proactively embedding these features, the City can ensure newly constructed facilities are not only cost-effective to operate but also aligned with long-term sustainability objectives.

9.1 ENERGY DESIGN REVIEW MEMO FOR NEW FIRE STATIONS

An Energy Design Review (EDR) memo was provided for the fire stations that are currently in the design phase. This memo identified opportunities for energy savings before the facility is fully constructed. Opportunities identified included geothermal heat pump heating/cooling system, solar photovoltaic system on the flat roof and south facing pitched roof areas, insulating door panels for top and bottom overhead door panel sections, evaluating exhaust rates for the apparatus bays, and reconsideration of installing the exterior snow melt system. By embedding these principles early in the design process, the City positions its new fire stations as sustainable municipal construction models that provide long-term operational efficiency.

This memo can be reviewed in **Appendix E – Energy Design Review Fire Station**.

10.0 FUNDING OPTIONS

To successfully implement energy efficiency and renewable energy projects, the City of Baraboo can leverage a variety of funding mechanisms designed to reduce upfront costs and maximize long-term savings:

- **State and Federal Grants:** Pursue funding through programs such as the Focus on Energy initiative, the U.S. Department of Energy's grant opportunities, or the Environmental Protection Agency's Clean Energy Incentives. These grants can provide significant support for both infrastructure upgrades and renewable installations.
- **Federal Tax Credits and Incentives:** Take advantage of incentives like the Investment Tax Credit (ITC) for solar projects, which can offset a substantial portion of project costs. Recent federal legislation has expanded and extended these credits for municipal and public projects.
- **Public-Private Partnerships (P3):** Explore partnerships with private energy developers or service companies that can provide capital, technical expertise, and ongoing maintenance in exchange for long-term energy savings or shared revenue models.
- **Utility Rebates:** Collaborate with Alliant Energy and other local utilities to access rebates and performance-based incentives for energy efficiency upgrades and renewable generation.
- **Leasing and Power Purchase Agreements (PPAs):** Consider solar leasing or entering into PPAs, which allow the city to host renewable installations with little or no upfront capital, purchasing energy at a fixed, predictable rate over time.
- **Green Bonds and Municipal Financing:** Issue green bonds or utilize low-interest municipal loans to finance large-scale sustainability initiatives, spreading costs over the useful life of the improvements.
- **Community-Based Funding:** Engage local stakeholders through crowdfunding platforms or community solar programs, allowing residents and businesses to invest in or directly benefit from clean energy projects.

By strategically combining these funding options, Baraboo can accelerate its clean energy transition, reduce financial barriers, and ensure broad community participation and support.

11.0 IMPLEMENTATION RECOMMENDATIONS

One of the objectives is to potentially implement upgrades identified through energy audits. Here is a list of items to consider:

- **Meet to review the audit results.** Meet with the energy auditor and key building staff to review the analysis, results, and recommended upgrades.
- **Think about all benefits.** Discuss potential benefits from upgrades such as improved occupant comfort, energy savings, cost savings, and opportunities to participate in grid-interactive programs.

- **Discuss the ideal sequence of upgrades.** Some upgrades could be implemented immediately while others may need further study or could affect other projects. For example, weatherization measures (including building envelope improvements) can reduce the heat load and necessary size of new HVAC equipment.

There are multiple ways to prioritize the implementation of EEMs, here are some things to consider:

- **Compare audit results to your capital improvement program (CIP) project list.** Consider which energy upgrades could be added to the scope of a CIP project (i.e., adjusting the efficiency specifications for new equipment), and consider upgrades that should be delayed until after a CIP project is completed (i.e., installing solar PV after a near-term rooftop replacement is complete).
- **Energy Offset Potential:** Focus on sites with high annual kWh production and alignment with on-site energy use.
- **Financial Return:** Consider sites with favorable payback periods or strong lease revenue.
- **Visibility and Public Impact:** Prioritize high-visibility sites (e.g., Municipal Building, Library) for educational and community engagement value.
- **Partnership Suitability:** Match sites to the most appropriate Focus program based on size, ownership preference, and financial goals.

Additional steps for the implementation of renewable projects:

1. **Pilot Projects:** Consider installing a small solar array at the Municipal Building to demonstrate feasibility and build internal capacity.
2. **Engage Alliant Energy:** Request site-specific proposals for Customer-Hosted and Renewable Energy Partner programs.
3. **Apply for Incentives:** Coordinate with Focus on Energy and explore federal funding opportunities.

12.0 CONCLUSION

This Energy Efficiency Plan provides an outline for the City of Baraboo to achieve significant energy savings and reduce greenhouse gas emissions. By implementing the recommended EEMs and leveraging available incentives, the City can improve building performance, increase sustainability by reducing GHG emissions, and reduce energy costs. **Table 14** summarizes the EEMs for each facility, sorted by the lowest simple payback.

Table 14. EEM Summary – City of Baraboo

Abbv.	EEM	Energy Savings			Cost Reductions			Implementation	
		Electricity [kWh]	Natural Gas [therms]	Emission [MTCO ₂ e]	Electricity [\$]	Natural Gas [\$]	Total [\$]	Costs (±30%)	Simple Payback [yr]
CSC	Lower Garage Space Temperature		2,386	13		\$1,671	\$1,671	\$100	0.1
CSC	Install Timer Compressed Air System	2,769		2	\$336		\$336	\$100	0.3
PPHP	Load Shifting	3,948		3	\$927		\$927	\$500	0.5
CC	Load Shifting	3,035		2	\$827		\$827	\$500	0.6
WRRF	Load Shifting	5,350		4	\$2,185		\$2,185	\$3,000	1.4
CSML	Retro-Commissioning Services	27,437	1,324	26	\$8,085	\$1,257	\$9,341	\$18,000	1.9
CC	Lower Hot Water Supply Temp	-683	745	3	-\$93	\$335	\$242	\$500	2.1
MB	Retro-Commissioning Services	43,128	4,213	53	\$5,175	\$2,949	\$8,125	\$20,000	2.5
CC	Optimize Thermostat Controls		1,113	6		\$779	\$779	\$4,500	5.8
CSC	Optimize Garage Ventilation	27,704	3,086	36	\$3,363	\$2,216	\$5,579	\$40,000	7.2
CSML	Water-to-Water Heat Pump		1,134	6		\$793	\$793	\$10,000	12.6
DT	Window Sensors	20,131		14	\$2,416		\$2,416	\$35,000	14.5
PPHP	Heat Recovery		786	4		\$550	\$550	\$15,000	27.3
CSC	Add Roof Insulation		2,550	14		\$1,785	\$1,785	\$152,100	85.2
PPHP	Add Wall Insulation		524	3		\$367	\$367	\$40,000	109.1
DT	Air Source Heat Pumps						\$0	\$700,000	
DT	Geothermal Heat Pumps						\$0	\$1,000,000	
CSA	Community Geothermal						\$0	\$1,000,000	

Table 15 totals all the EEMs identified during this assessment. The EEMs identified have the potential to reduce the City’s expected annual energy usage by approximately 12.5% and reduce overall energy costs by 9.6% or approximately \$35,900 annually.

Table 15. EEM Savings Summary – City of Baraboo

EEM	Energy Savings				Cost Reductions			
	Electricity [kWh]	Natural Gas [therms]	Energy Savings [%]	Emission [MTCO2e]	Electricity [\$]	Natural Gas [\$]	Total [\$]	Costs [%]
Total	132,818	17,862	12.5%	189	\$23,221	\$12,702	\$35,923	9.6%


Additional revenue and greenhouse gas emissions reductions can be generated from the installation of any number of solar projects. **Table 16** summarizes annual facility electricity consumption, estimated electricity production, and the associated emission reductions from the installation of solar projects on the facilities analyzed.

Installing solar on all potential facilities could offset nearly all City Scope 2 operational emissions for the facilities analyzed.

Table 16. Solar Emission Reductions – City of Baraboo

Property Name	Abbr.	Current		Solar	
		Electricity Consumed [kWh]	Electricity Emissions [MTCO2e]	Electricity Generated [kWh]	Offset Emissions [MTCO2e]
Carnegie-Schadde Memorial Library	CSML	228,640	161	-39,000	-27
City Services Center	CSC	197,200	139	-1,001,000	-706
Civic Center	CC	151,760	107	-91,000	-64
Corson Square Apartments	CSA	65,520	46	-182,000	-128
Donahue Terrace	DT	503,280	355	-78,000	-55
Municipal Building	MB	359,400	253	-169,000	-119
Pierce Park Hockey Pavilion	PPHP	197,400	139	-481,000	-339
Water Resource Recovery Facility	WRRF	1,070,000	754	-689,000	-486
	Total	2,773,200	1,954	-2,730,000	-1,924

This plan is left with the City and community members to implement these opportunities. Realizing that not everything can be done at once in municipal operations, this plan provides a sound foundation upon which to prioritize the next steps in meeting the City’s goals.



Appendix A
Assessment of Current Conditions

September 25, 2025
File No. 25224271.00

MEMORANDUM

TO: Mr. John Young, City of Baraboo

FROM: Tony Kriel, SCS Engineers

SUBJECT: Assessment of Current Conditions (Task 1 Deliverable)

1.0 INTRODUCTION

The City of Baraboo (City) was awarded an Energy Efficiency and Conservation Block Grant (EECBG) from the Public Service Commission of Wisconsin Office of Energy Innovation for services meeting the Department of Energy's Blueprint 2A: Energy Efficiency – Energy Audits, Building Upgrades. The EECBG addresses two critical objectives: reducing energy consumption and reducing greenhouse gas emissions.

SCS Engineers conducted energy auditing services for eight of the City's facilities.

This memorandum includes a summary of activities completed as part of Task 1. Task 1 included the following activities:

1. Facility Energy Use
2. Unit Prices for Energy Consumption Calculations
3. Baseline Greenhouse Gas Emissions Calculations
4. Benchmark Buildings

Additionally, the following data are presented in the attached appendices:

- Appendix A: City of Baraboo Electric and Gas Data
- Appendix B: Alliant Energy Rate Summary
- Appendix C: GHG Emission Factors

The audit summarizes cost-effective energy efficiency measures (EEMs) in a Task 2 report, separately provided.



2.0 FACILITY SUMMARY

The facilities chosen for the assessment are listed in **Table 1**.

Table 1. City of Baraboo - Facility Summary

Property Name	Abbr.	Property Type	Address
Carnegie-Schadde Memorial Library	CSML	Public Library	230 4th Ave
City Services Center	CSC	Public Services	450 Roundhouse Ct
Civic Center	CC	Mixed Use - Social/Meeting Hall, Fitness Center, Office	124 2nd St
Corson Square Apartments	CSA	Multifamily Housing	920 10th St
Donahue Terrace	DT	Multifamily Housing	227 1st Ave
Municipal Building	MB	Mixed Use - City Hall/Police	101 South Blvd
Pierce Park Hockey Pavillion	PPHP	Ice Rink	1100 Walnut St
Water Resource Recovery Facility	WRRF	Wastewater Treatment Buildings	1000 Manchester St

Facilities and operations not included in the assessment that the City might have utility accounts for include: Langer Park, Old Shop, Parks Shelters, Pool, Sirens, Street Lighting, Traffic Signals, Water Utility, Zoo, and others.

Other emission sources such as fuel for fleet vehicles were not included in the assessment but might significantly contribute to the City's overall emissions or general operating costs.

3.0 UTILITY DATA

The City provided data with utility costs and consumption information for a 2-year period (December 2022 – November 2024). Based upon our review of the data, the following observations were made:

- Electricity and natural gas is provided by Alliant Energy for every facility.
- Seven facilities operate on a time-of-use (TOU) electrical rate structure. These structures are appropriately applied.
- Carnegie-Schadde Memorial Library
 - Four months (June – September 2023) indicated no gas consumption. This may have been attributed to renovation and construction activities.
 - A new gas meter was installed during the renovation and construction activities.
- Donahue Terrace
 - This location has two electrical services with one configured based on hours operated for corridor exit lights and the other on a TOU rate structure.

- Water Resource Recovery Facility
 - This location has one electricity meter and four natural gas meters.

Utility data for each facility can be reviewed in **Appendix A: City of Baraboo Electric and Gas Data**.

3.1 RATE STRUCTURE SUMMARY

Table 2 lists the utility type, account number, rate, and rate type for electricity and natural gas at each facility. The table is sorted with electricity accounts first, followed by natural gas accounts.

Table 2. City of Baraboo - Facility Rate Summary

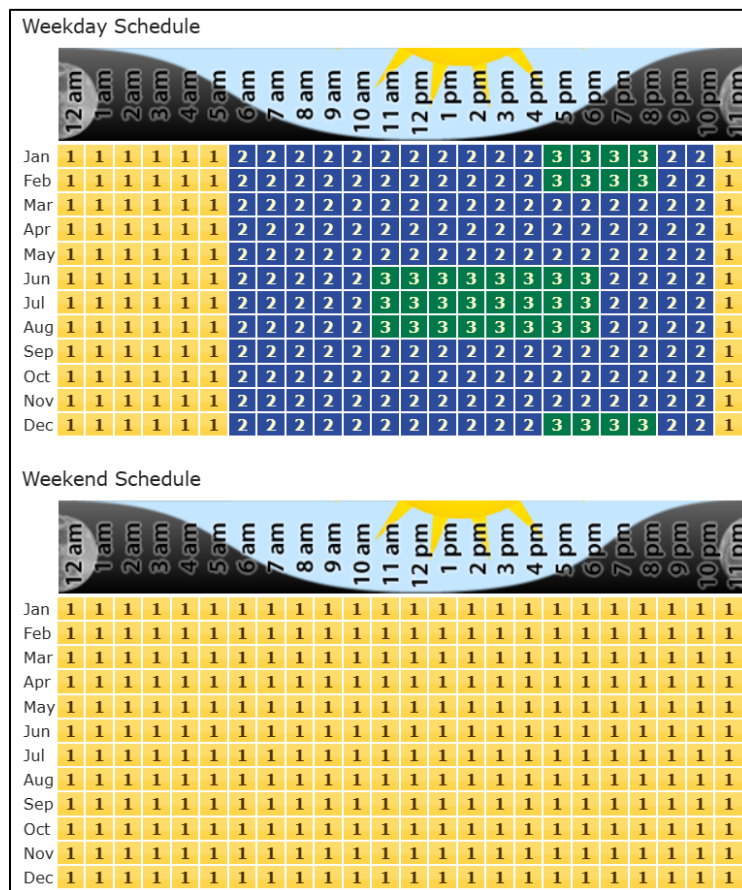
Property Name	Abbr.	Utility Type	Account Number	Rate	Rate Type
Carnegie-Schadde Memorial Library	CSML	Electricity	8860700000	WGS-1	General service
City Services Center	CSC	Electricity	6710250000	WCG-2TOD	Time-of-use
Civic Center	CC	Electricity	412720000	WGS-3	Time-of-use
Corson Square Apartments	CSA	Electricity	1968830000	WGS-3	Time-of-use
Donahue Terrace	DT	Electricity	5777020000	WCG-2TOD	Time-of-use
Donahue Terrace	DT	Electricity	5777020000	--	Hourly configured
Municipal Building	MB	Electricity	2692618800	WCG-2TOD	Time-of-use
Pierce Park Hockey Pavillion	PPHP	Electricity	6673610000	WGS-3	Time-of-use
Water Resource Recovery Facility	WRRF	Electricity	823300000	WCG-2TOD	Time-of-use
Carnegie-Schadde Memorial Library	CSML	Natural Gas	8860700000	WGC-2F	General service
City Services Center	CSC	Natural Gas	6710250000	WGC-2F	General service
Civic Center	CC	Natural Gas	412720000	WGC-2F	General service
Corson Square Apartments	CSA	Natural Gas	1968830000	WGC-1F	General service
Donahue Terrace	DT	Natural Gas	5777020000	WGC-2F	General service
Municipal Building	MB	Natural Gas	2692618800	WGC-3F	General service
Pierce Park Hockey Pavillion	PPHP	Natural Gas	6673610000	WGC-2F	General service
Water Resource Recovery Facility	WRRF	Natural Gas	823300000	WGC-1F	General service
Water Resource Recovery Facility	WRRF	Natural Gas	823300000	WGC-1F	General service
Water Resource Recovery Facility	WRRF	Natural Gas	823300000	WGC-1F	General service
Water Resource Recovery Facility	WRRF	Natural Gas	823300000	WGC-1F	General service

Figure 1 represents Alliant Energy’s Time-of-Use (TOU) rate schedule applicable to both WCG-2TOD and WGS-3. The rate schedule has the following defined TOU rate periods:

- Low Rate Hours: 11 pm – 6 am weeknights; all hours on weekends and holidays
- Regular Rate Hours: All other hours other than Low
- High Rate Hours: Summer = June/Jul./August 11 am – 7 pm; Winter = December/January/February 5 pm – 9 pm

Legend: Low Rate = 1/yellow, Regular Rate = 2/blue, High Rate = 3/green.

Figure 1. Alliant Energy WCG-2TOD and WGS-3 TOU Rate Schedule



[Source: <https://apps.openei.org/>]

The rates and rate structures can be reviewed in **Appendix B: Alliant Energy Rate Summary**.

The calculated blended rates (i.e. Total cost/consumption unit) for the City is:

- 2024 Electricity: \$0.113/kWh
- 2024 Natural Gas: \$0.699/therm

4.0 ANALYSIS

4.1 ANNUAL ENERGY COSTS

The annual electricity, natural gas, and total energy costs paid by the City for a 2-year period (December 2022 – November 2024) for these facilities is provided in **Table 3**. The overall annual energy cost for the 2024 period was \$372,423, down \$23,332 (5.9%) from the 2023 period.

Natural gas costs decreased significantly in 2024 due to a decrease in natural gas rates in early 2024. Electricity costs of \$313,264 accounted for ~84% of the \$372,423 overall annual energy costs in 2024, up from 79% the year before.

Table 3. City of Baraboo – Annual Energy Costs

	Electricity Cost [\$]	Natural Gas Cost [\$]	Total Energy Cost [\$]
Dec. 2022 – Nov. 2023	\$310,905	\$84,849	\$395,755
Dec. 2023 – Nov. 2024	\$313,264	\$59,159	\$372,423
Difference	\$2,359	-\$25,690	-\$23,332
Difference (%)	0.8%	-30.3%	-5.9%

4.2 FACILITY ENERGY COSTS

Table 4 shows the annual utility costs for each facility from December 2023 – November 2024. The Water Resource Recovery Facility has the largest annual total energy cost. The energy costs are mostly attributed to processing the City’s waste water. The Donahue Terrace and the Municipal Building account for the largest annual energy costs for buildings.

Table 4. City of Baraboo – 2024 Facility Energy Cost

Property Name	Abbr.	Electricity Cost [\$]	Natural Gas Cost [\$]	Total Energy Cost [\$]
Carnegie-Schadde Memorial Library	CSML	\$32,510	\$6,645	\$39,155
City Services Center	CSC	\$23,940	\$10,869	\$34,808
Civic Center	CC	\$20,681	\$10,420	\$31,101
Corson Square Apartments	CSA	\$7,992	\$1,205	\$9,197
Donahue Terrace	DT	\$53,706	\$5,571	\$59,277
Municipal Building	MB	\$42,019	\$17,289	\$59,308
Pierce Park Hockey Pavillion	PPHP	\$23,176	\$4,191	\$27,367
Water Resource Recovery Facility	WRRF	\$109,240	\$2,968	\$112,208
	Total	\$313,264	\$59,158	\$372,421

An industry method used to evaluate energy costs of a facility against other facilities includes normalizing the facility’s energy cost by dividing it by the area of the facility (i.e., square feet [sf]), termed as an energy cost intensity (ECI) and has units of [\$/sf]. Electricity, natural gas, and ECIs are provided in **Table 5** for the buildings. The Carnegie-Schadde Memorial Library and the Municipal building account for the largest annual ECI.

Table 5. City of Baraboo – 2024 Energy Cost Intensity (ECI)

Property Name	Abbr.	Area [sf]	Electricity Cost [\$/sf]	Natural Gas Cost [\$/sf]	Total Energy Cost [\$/sf]
Carnegie-Schadde Memorial Library	CSML	31,877	\$1.02	\$0.21	\$1.23
City Services Center	CSC	66,392	\$0.36	\$0.16	\$0.52
Civic Center	CC	52,903	\$0.39	\$0.20	\$0.59
Donahue Terrace	DT	57,871	\$0.93	\$0.10	\$1.02
Municipal Building	MB	48,600	\$0.86	\$0.36	\$1.22
Pierce Park Hockey Pavillion	PPHP	32,266	\$0.72	\$0.13	\$0.85
	Abbr.	Water [MG]	Electricity Cost [\$/MG]	Natural Gas Cost [\$/MG]	Total Energy Cost [\$/MG]
Water Resource Recovery Facility	WRRF	484.2	\$226	\$6.13	\$232

Note that Corson Square Apartments were not evaluated per area since tenants are individually responsible for utility costs.

Water and wastewater utility managers index facilities’ usage through a production or demand index, such as kWh per 1,000 lbs of Biological Oxygen Demand (BOD) or kWh per millions of gallons (MG) of influent flow. Here we evaluate energy costs index of the Water Resource Recovery Facility WRRF with MG for the period analyzed.

4.3 ANNUAL ENERGY

The annual electricity, natural gas, and total energy consumed by the City for a 2-year period (December 2022 – November 2024) for these facilities is shown in **Table 6**. Site energy consumption is the sum of all forms of energy consumption converted to a common unit, thousand British thermal units (kBtu) in this case. In this analysis, electricity consumption in kiloWatt-hours (kWh) is converted to kBtu and added to natural gas consumption in therms (therm) converted to kBtu.

The overall annual energy consumed for the 2024 period was 17,919,858 kBtu, down 1,371,447 (7.1%) from the 2023 period.

Table 6. City of Baraboo – Annual Energy

	Electricity [kWh]	Natural Gas [therm]	Total Energy [kBtu]
Dec. 2022 – Nov. 2023	2,817,440	96,782	19,291,305
Dec. 2023 – Nov. 2024	2,773,200	84,577	17,919,858
Savings	44,240	12,205	1,371,447
Improvement (%)	1.6%	12.6%	7.1%

4.4 FACILITY ENERGY

Table 7 shows the annual energy consumed for each facility from December 2023 – November 2024. The Municipal Building consumes the most annual total energy. The Water Resource Recovery Facility consumes the most electricity. The Municipal Building consumes the most natural gas.

Table 7. City of Baraboo – 2024 Facility Energy

Property Name	Abbr.	Electricity [kWh]	Natural Gas [therm]	Total Energy [kBtu]
Carnegie-Schadde Memorial Library	CSML	228,640	8,828	1,662,920
City Services Center	CSC	197,200	15,302	2,203,046
Civic Center	CC	151,760	14,891	2,006,905
Corson Square Apartments	CSA	65,520	1,453	368,854
Donahue Terrace	DT	503,280	7,976	2,514,791
Municipal Building	MB	359,400	28,089	4,035,173
Pierce Park Hockey Pavillion	PPHP	197,400	5,240	1,197,529
Water Resource Recovery Facility	WRRF	1,070,000	2,798	3,930,640
	Total	2,773,200	84,577	17,919,858

An industry method used to evaluate energy consumption of a facility against other facilities includes normalizing the facility’s energy consumption by dividing it by the area of the facility (i.e., square feet [sf]), termed energy use intensity (EUI) and has units of [kBtu/sf]. Electricity, natural gas, and total EUI are provided in **Table 8** for the buildings. The Municipal building accounts for the largest annual EUI at 83.0 kBtu/sf.

Table 8. City of Baraboo – 2024 Energy Use Intensity (EUI)

Property Name	Abbr.	Area [sq ft.]	Electricity [kWh/sf]	Natural Gas [therm/sf]	Total Site Energy [kBtu/sf]
Carnegie-Schadde Memorial Library	CSML	31,877	7.17	0.28	52.2
City Services Center	CSC	66,392	2.97	0.23	33.2
Civic Center	CC	52,903	2.87	0.28	37.9
Donahue Terrace	DT	57,871	8.70	0.14	43.5
Municipal Building	MB	48,600	7.40	0.58	83.0
Pierce Park Hockey Pavillion	PPHP	32,266	6.12	0.16	37.1
	Abbr.	Avg. Water [MG]	Electricity [kWh/MG]	Natural Gas [therm/MG]	Total Site Energy [kBtu/MG]
Water Resource Recovery Facility	WRRF	484.233	2,210	3.85	7,924

Corson Square Apartments were not evaluated per area since tenants are individually responsible for utility consumption. The WRRF was evaluated per million gallons (MG) for the period analyzed.

4.5 GHG ANALYSIS

The energy-related Greenhouse Gas (GHG) Emissions are the carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) gases released into the atmosphere as a result of energy consumption at the property. GHG emissions are expressed in carbon dioxide equivalent (CO₂e), a universal unit of measure that combines the quantity and global warming potential of each greenhouse gas. Emissions are totaled with units of metric tons (Metric Tons CO₂e or MTCO₂e).

In the previous sections, we calculated site energy, the amount of heat and electricity consumed by a building as reflected in utility bills. Here we account for source energy. Source energy includes losses that take place during generation, transmission, and distribution of the energy; thereby enabling a complete assessment of energy consumption resulting from building operations.

The energy-related (electricity and natural gas) GHG emissions for each facility were calculated by multiplying electricity consumption and natural gas consumption by appropriate emission factors and carrying out all necessary unit conversions.

Emissions from purchased or acquired electricity are categorized as Scope 2 emissions and were calculated using:

- A location-based method which reflects the average emissions intensity of grids on which energy consumption occurs; this method uses monthly grid-average emission factor data (Greenhouse Gas Protocol).
 - Emissions & Generation Resource Integrated Database (eGRID) emission factor: 1,409.75 lb CO₂e/MWh, eGRID Subregion Acronym: MROE

Emissions from stationary combustion of natural gas are categorized as Scope 1 emissions and were calculated using the emission factor for natural gas.

- Natural gas emission factor (CO_{2e} factor): 53.11 kg CO_{2e} per mmBtu

Table 9 includes the Scope 1 – Stationary Combustion emissions from the natural gas and Scope 2 – Purchased Electricity emissions from the local electric utility for the 2024 period. The Water Resource Recovery Facility produces the most emissions. The Municipal Building accounted for the largest natural gas emissions.

Table 9. City of Baraboo – 2024 Facility Emissions

Property Name	Abbr.	Electricity Scope 2 [MTCO _{2e}]	Natural Gas Scope 1 [MTCO _{2e}]	Total Source Emissions [MTCO _{2e}]
Carnegie-Schadde Memorial Library	CSML	161	47	208
City Services Center	CSC	139	81	220
Civic Center	CC	107	79	186
Corson Square Apartments	CSA	46	8	54
Donahue Terrace	DT	355	42	397
Municipal Building	MB	253	149	403
Pierce Park Hockey Pavillion	PPHP	139	28	167
Water Resource Recovery Facility	WRRF	754	15	769
	Total	1,954	449	2,404

Emission Factors are included in **Appendix C: GHG Emission Factors**.

For reference, the City uses 50,000-60,0000 gallons of fuel per year for fleet operations (~50% gas and 50% diesel). The estimated Scope 1 emissions for fleet operations would add approximately 522 MTCO_{2e}/year.

4.6 BENCHMARK BUILDINGS

Benchmarking site energy consumption helps building owners and managers evaluate the performance of a facility relative to other similar facilities. Benchmarking also provides a means to evaluate the energy consumption of a facility against energy or emission reduction goals and facility improvements.

An industry method used to evaluate energy consumption of a facility compared to other facilities includes normalizing the facility’s source energy consumption (i.e., kBtu) by dividing it by the area of the facility (i.e., square feet [sf]). This is often called the Source Energy Use Intensity (Source EUI) and generally has units of kBtu/sf. Source Energy Use is the total amount of raw fuel that is required to operate your facility.

Energy Star’s Portfolio Manager (ESPM) also normalizes other building characteristics like building type and operational hours to help compare similar buildings. A National Median Source EUI is provided, accounting for these characteristics.

Table 10 compares the Source EUI (kBtu/sf) and the National Median Source EUI of similar facilities, as calculated by ESPM.

A negative value for the “Difference from Median Source EUI” indicates that the facility is operating below the national median – using less source energy per square foot than typical similar buildings, and thus performing more efficiently.

The Municipal Building stands out with a Source EUI of 131.3 kBtu/sf (47% higher) compared to Source EUI than the National Median Source EUI, while most other facilities perform better than comparable benchmarks – an encouraging sign for much of the City’s portfolio.

Table 10. City of Baraboo – 2024 Benchmark Source EUI

Property Name	Abbr.	Source EUI [kBtu/sf]	National Median Source EUI [kBtu/sf]	Difference from Median Source EUI [%]
Carnegie-Schadde Memorial Library	CSML	97.6	143.6	-32%
City Services Center	CSC	52.6	89.3	-41%
Civic Center	CC	57.0	89.3	-36%
Donahue Terrace	DT	97.6	122.8	-21%
Municipal Building	MB	131.3	89.3	47%
Pierce Park Hockey Pavillion	PPHP	75.5	112.0	-33%
	Abbr.	Source EUI [kBtu/gpd]	National Median Source EUI [kBtu/gpd]	Total Energy [kBtu/MG]
Water Resource Recovery Facility	WRRF	7.9	11.45	-31%

Corson Square Apartments were not evaluated per area since tenants are individually responsible for utility consumption. The WRRF was evaluated per gallons per day (gpd) for the period analyzed.

5.0 SUMMARY


Among the facilities analyzed, the Carnegie-Schadde Memorial Library, Donahue Terrace, and Municipal Building exhibit relatively high Source EUIs. While Carnegie-Schadde Memorial Library and Donahue Terrace display elevated EUIs within the group, their values do not surpass the National Median Source EUI. Notably, the Municipal Building stands out with a Source EUI that exceeds the National Median Source EUI, indicating that it may be operating with less efficient equipment or practices compared to other facilities.

The City Services Center, Civic Center, Pierce Park Hockey Pavillion, and the Water Resource Recovery Facility stands out for their strong energy performance with Source EUIs ranging between 21% and 41% below the National Median Source EUI for comparable buildings.

This assessment of current conditions establishes effective operations of some facilities compared to similar facilities nationwide. Continued monitoring and maintenance are recommended for these facilities, while those with higher Source EUIs will likely be prioritized and recommended for upgrades or operational improvements.

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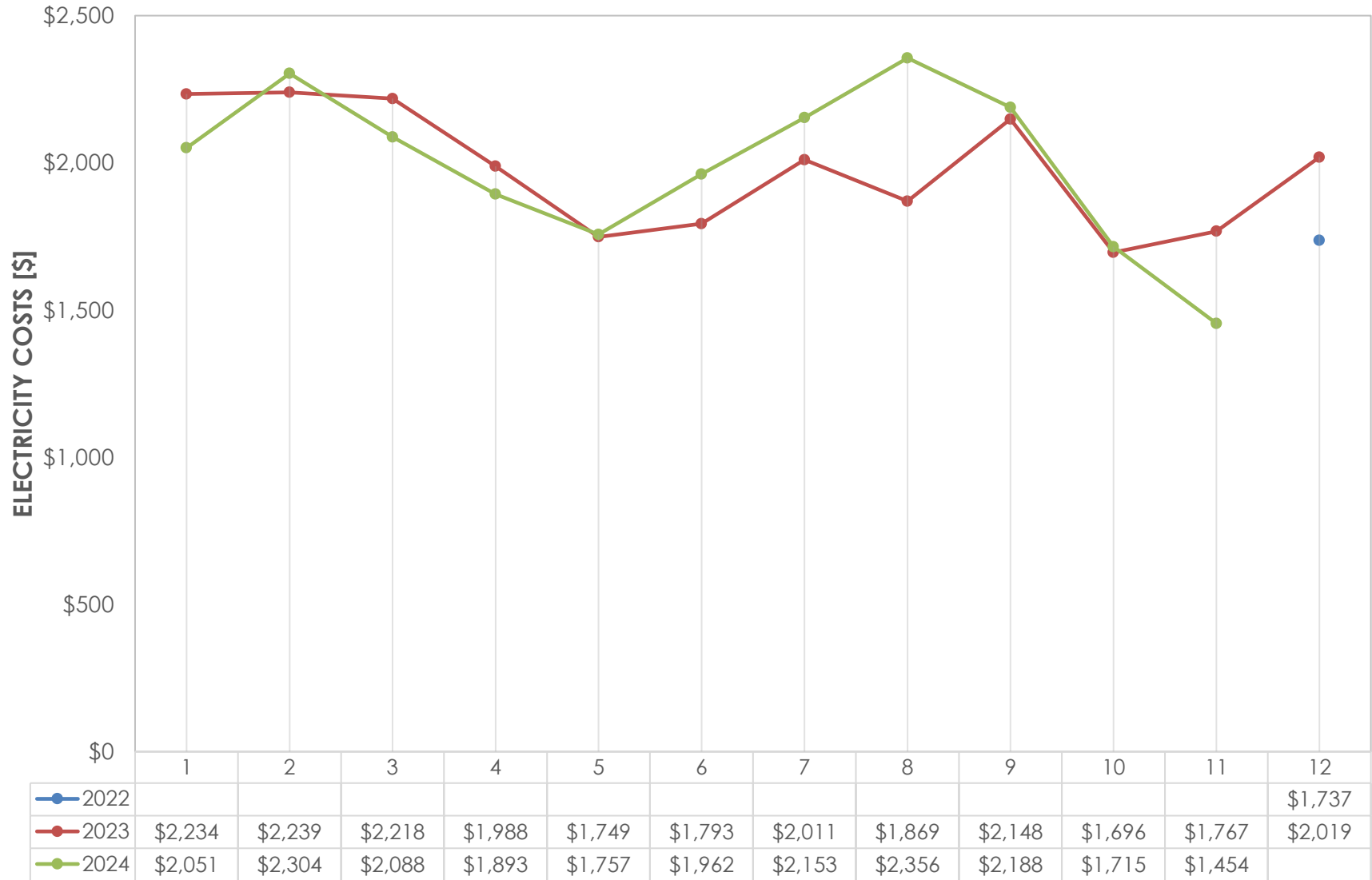
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Appendix A

City of Baraboo Electric and Gas Data

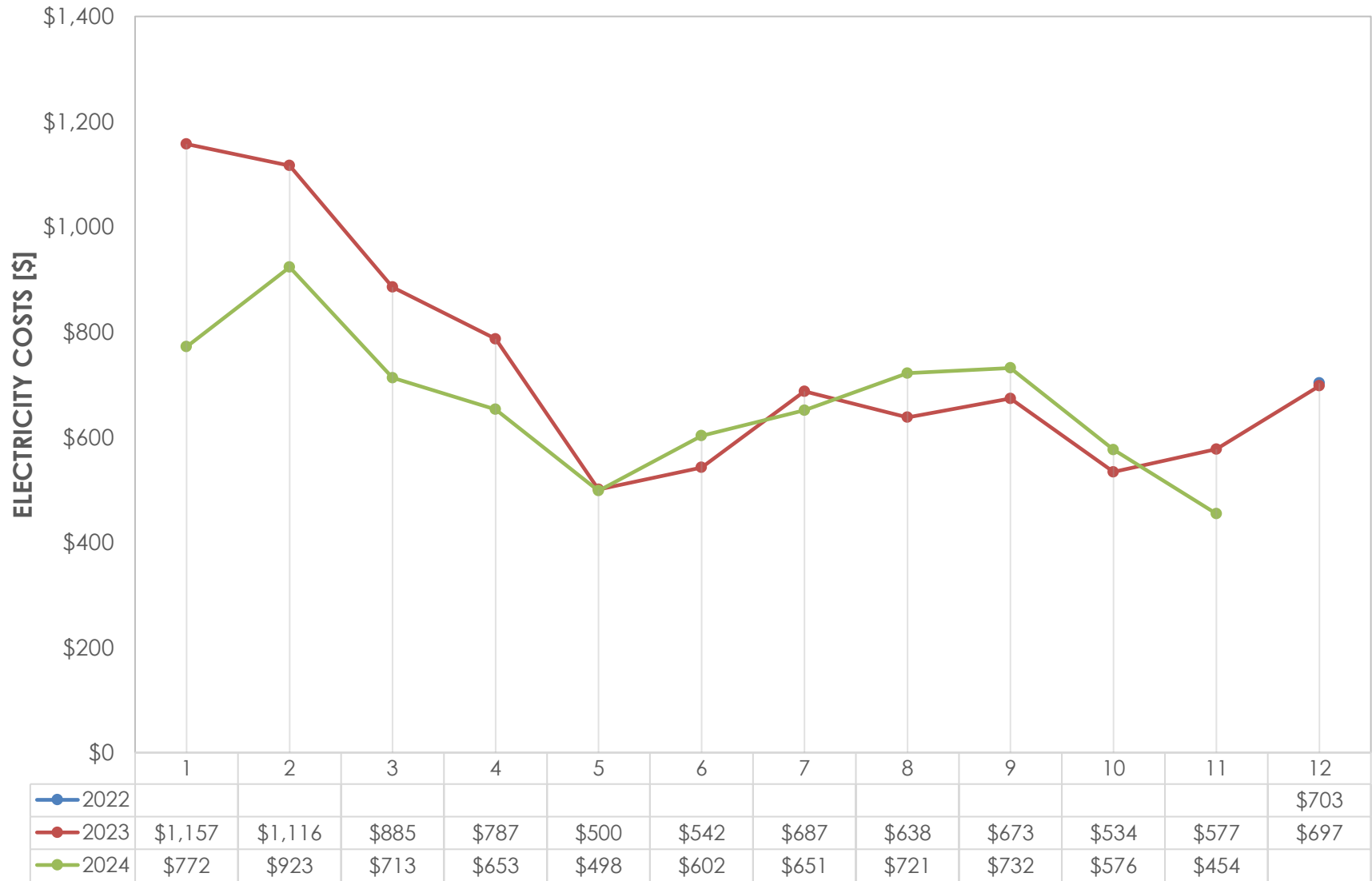
ELECTRICITY COSTS - CITY SERVICES CENTER



ELECTRICITY COSTS - CIVIC CENTER



ELECTRICITY COSTS - CORSON SQUARE



ELECTRICITY COSTS - DONAHUE TERRACE



ELECTRICITY COSTS - HOCKEY PAVILION



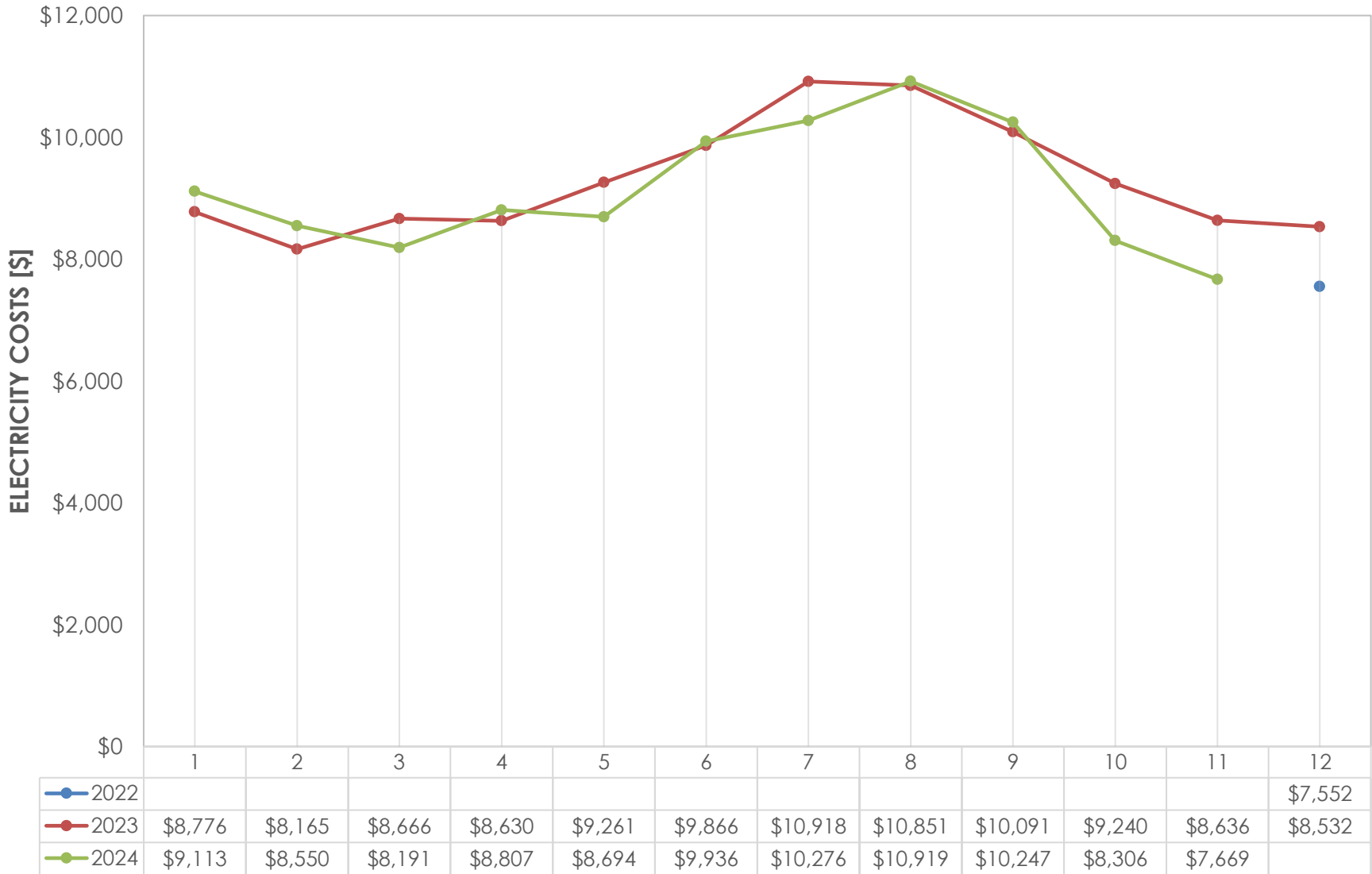
ELECTRICITY COSTS - MUNICIPAL BUILDING



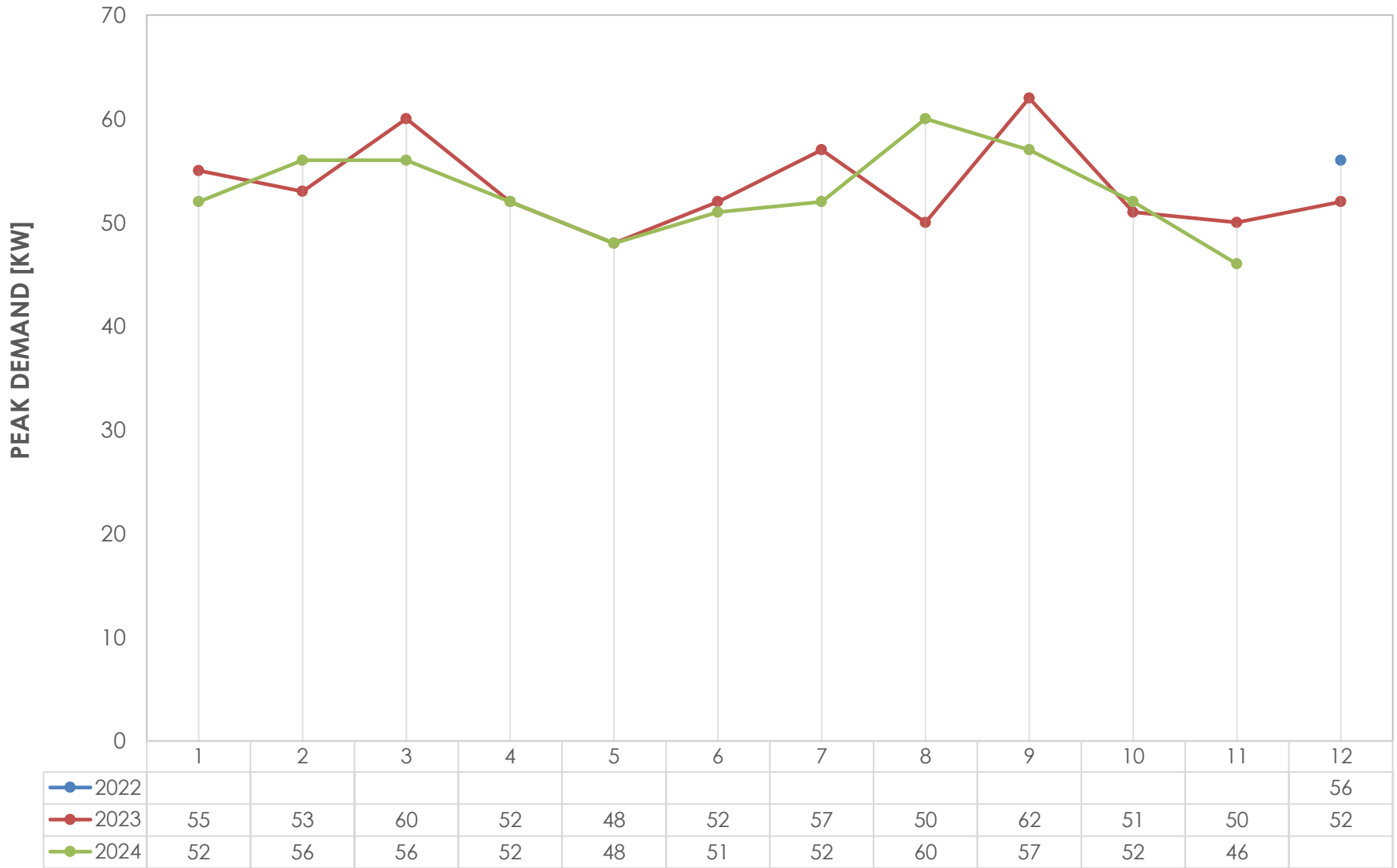
ELECTRICITY COSTS - PUBLIC LIBRARY



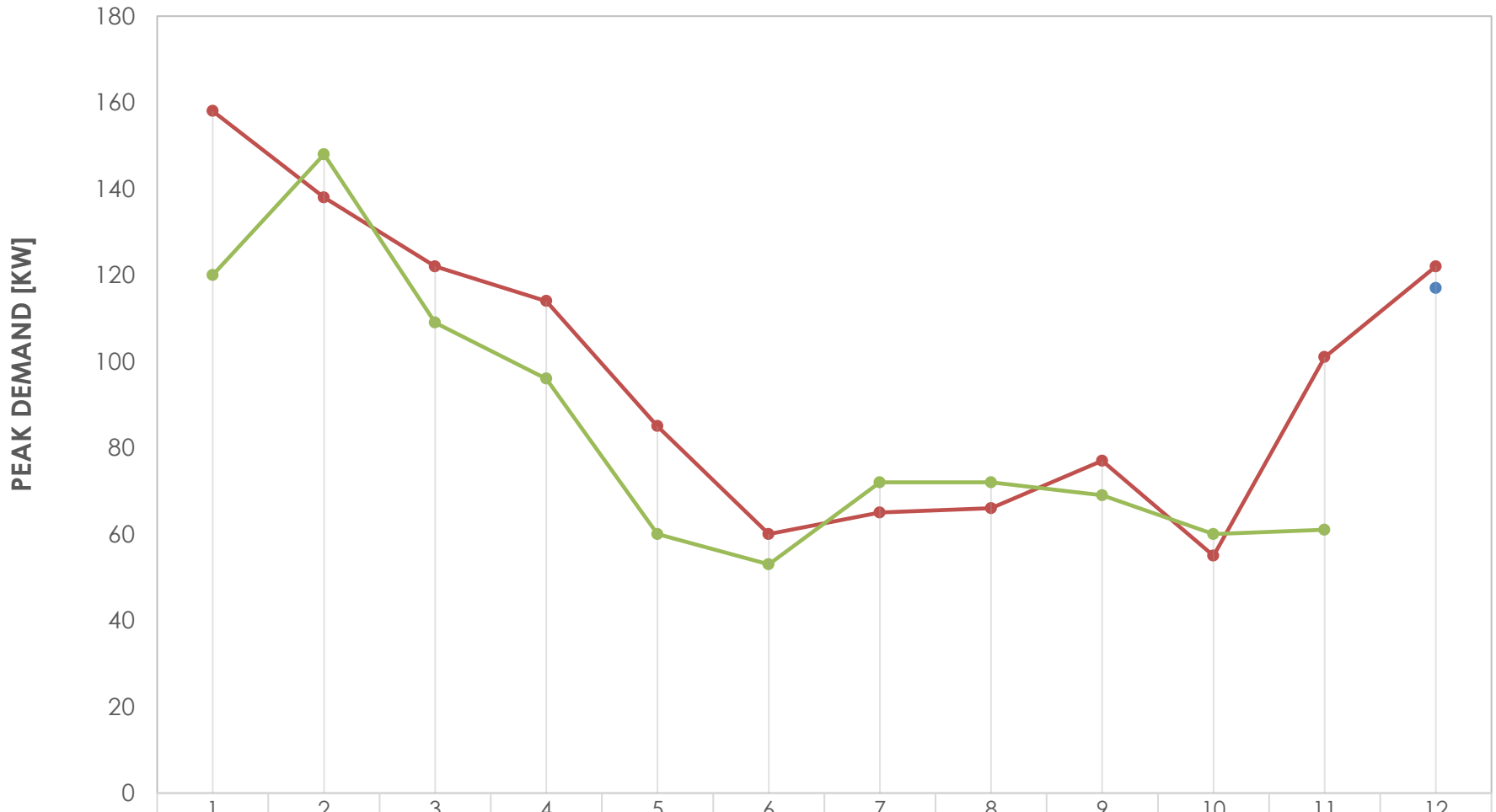
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ELECTRICITY DEMAND - CITY SERVICES CENTER

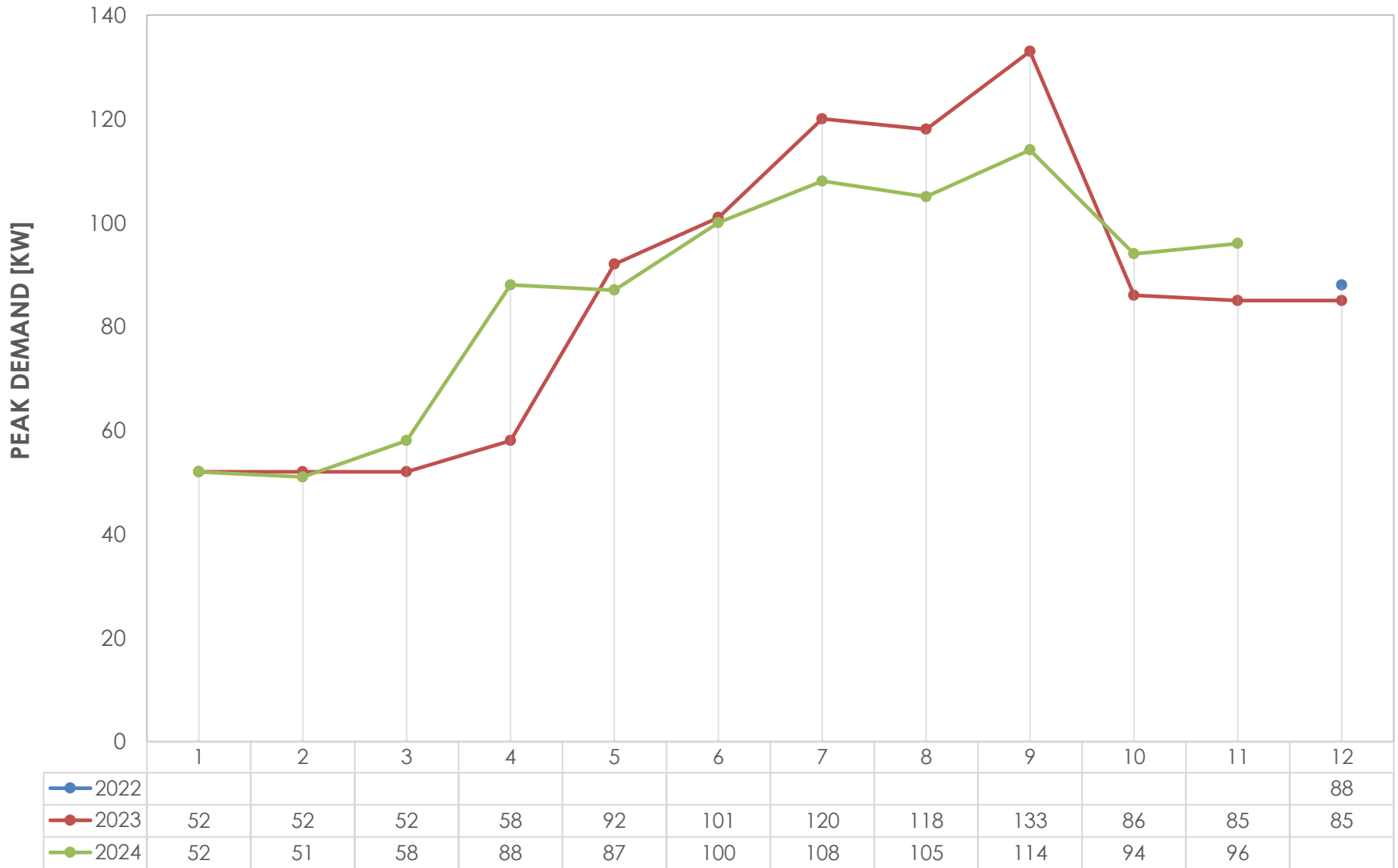


ELECTRICITY DEMAND - DONAHUE TERRACE

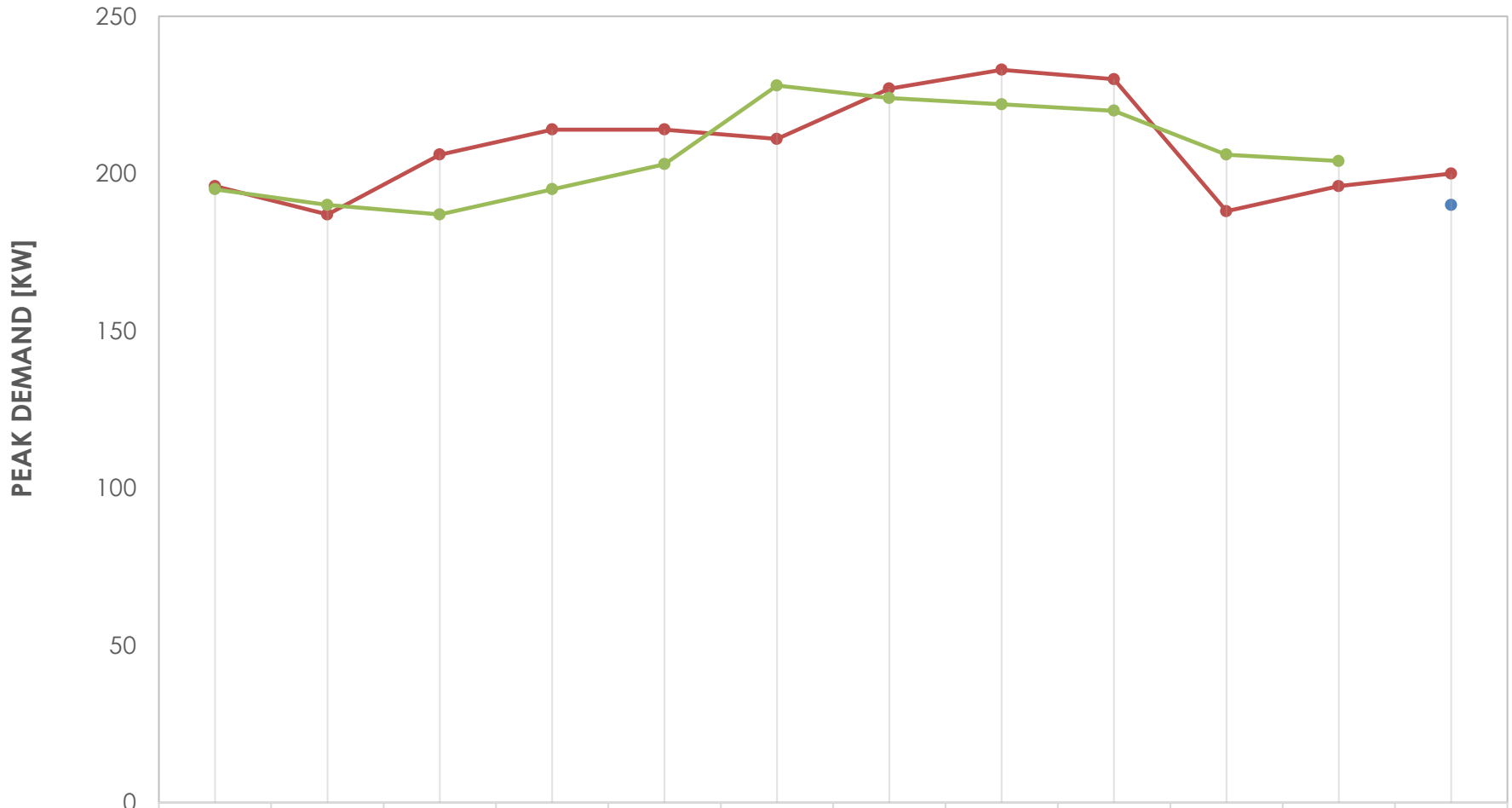


● 2022												117
● 2023	158	138	122	114	85	60	65	66	77	55	101	122
● 2024	120	148	109	96	60	53	72	72	69	60	61	

ELECTRICITY DEMAND - MUNICIPAL BUILDING

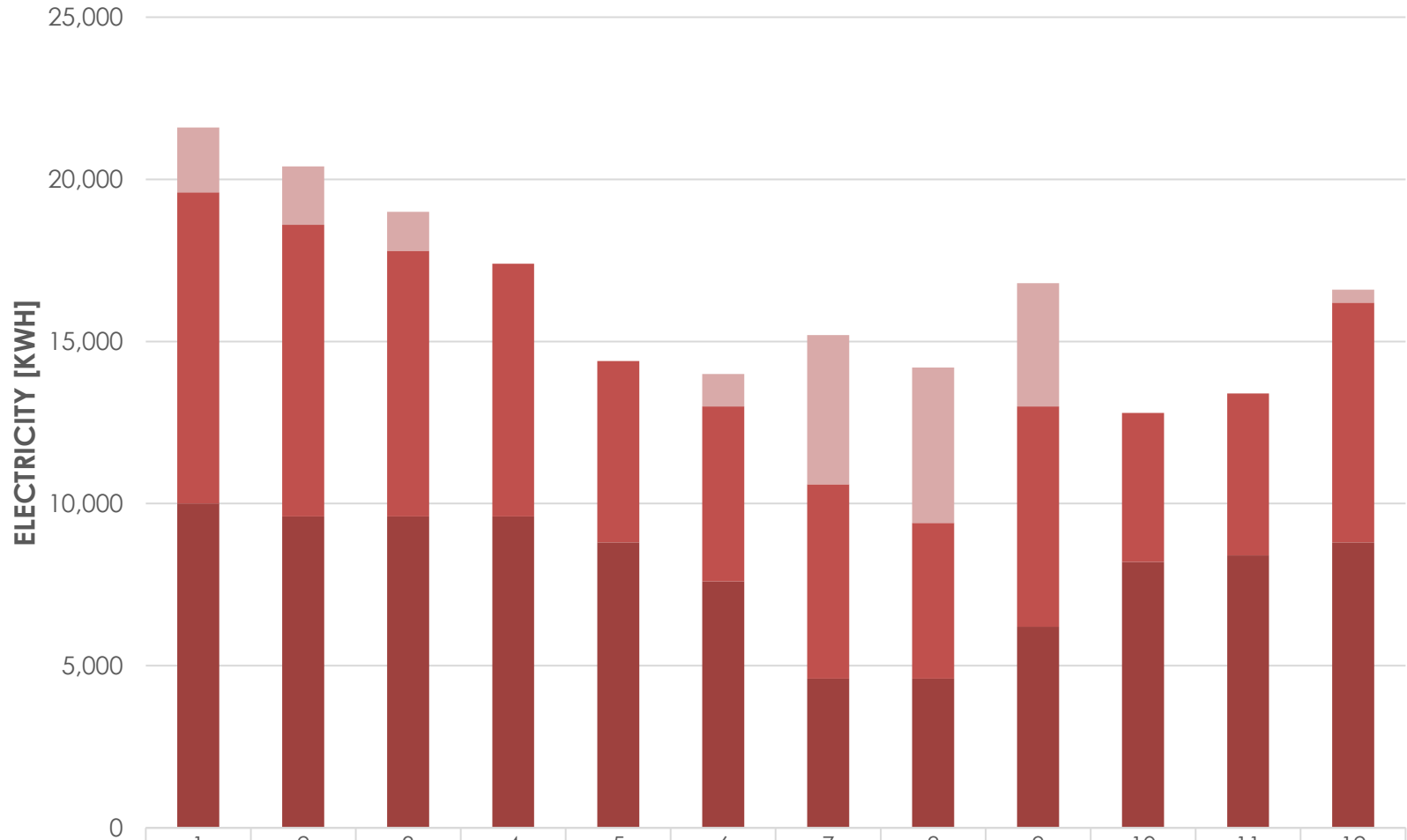


ELECTRICITY DEMAND - WATER DEPARTMENT



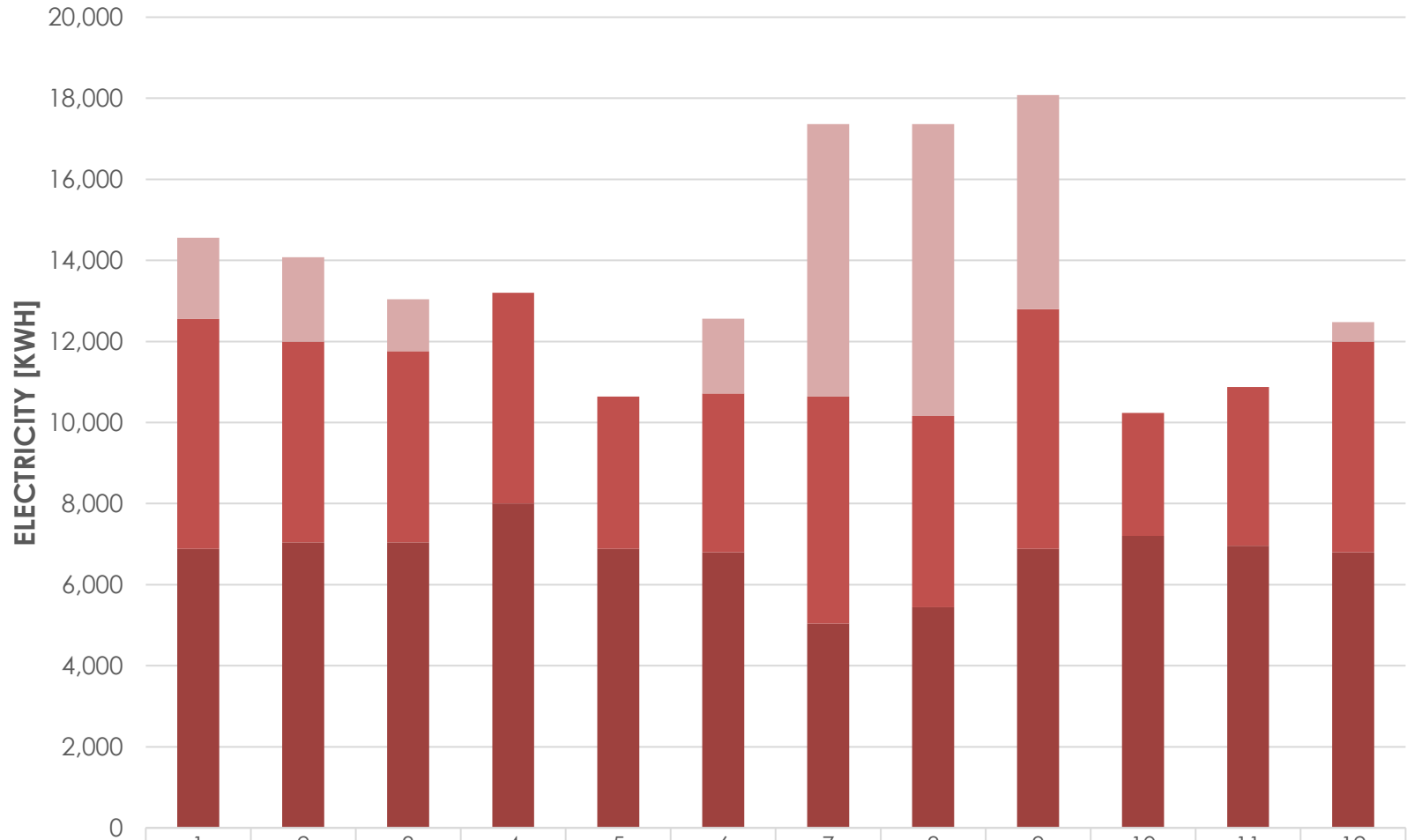
● 2022												190
● 2023	196	187	206	214	214	211	227	233	230	188	196	200
● 2024	195	190	187	195	203	228	224	222	220	206	204	

ELECTRICITY PERIODS - CITY SERVICES CENTER



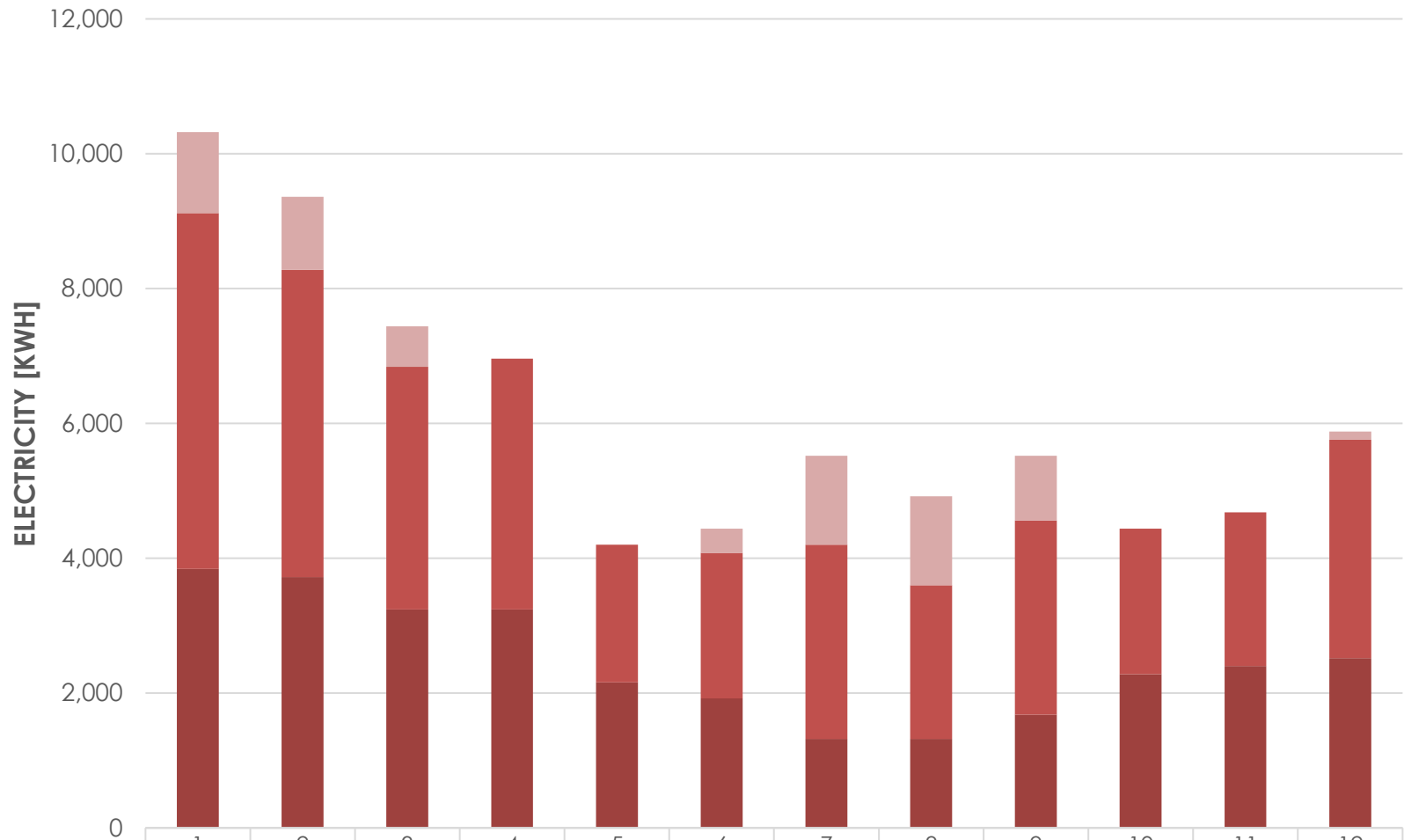
	1	2	3	4	5	6	7	8	9	10	11	12
2023 - High Rate	2,000	1,800	1,200	0	0	1,000	4,600	4,800	3,800	0	0	400
2023 - Low Rate	9,600	9,000	8,200	7,800	5,600	5,400	6,000	4,800	6,800	4,600	5,000	7,400
2023 - Reg Rate	10,000	9,600	9,600	9,600	8,800	7,600	4,600	4,600	6,200	8,200	8,400	8,800

ELECTRICITY PERIODS - CIVIC CENTER



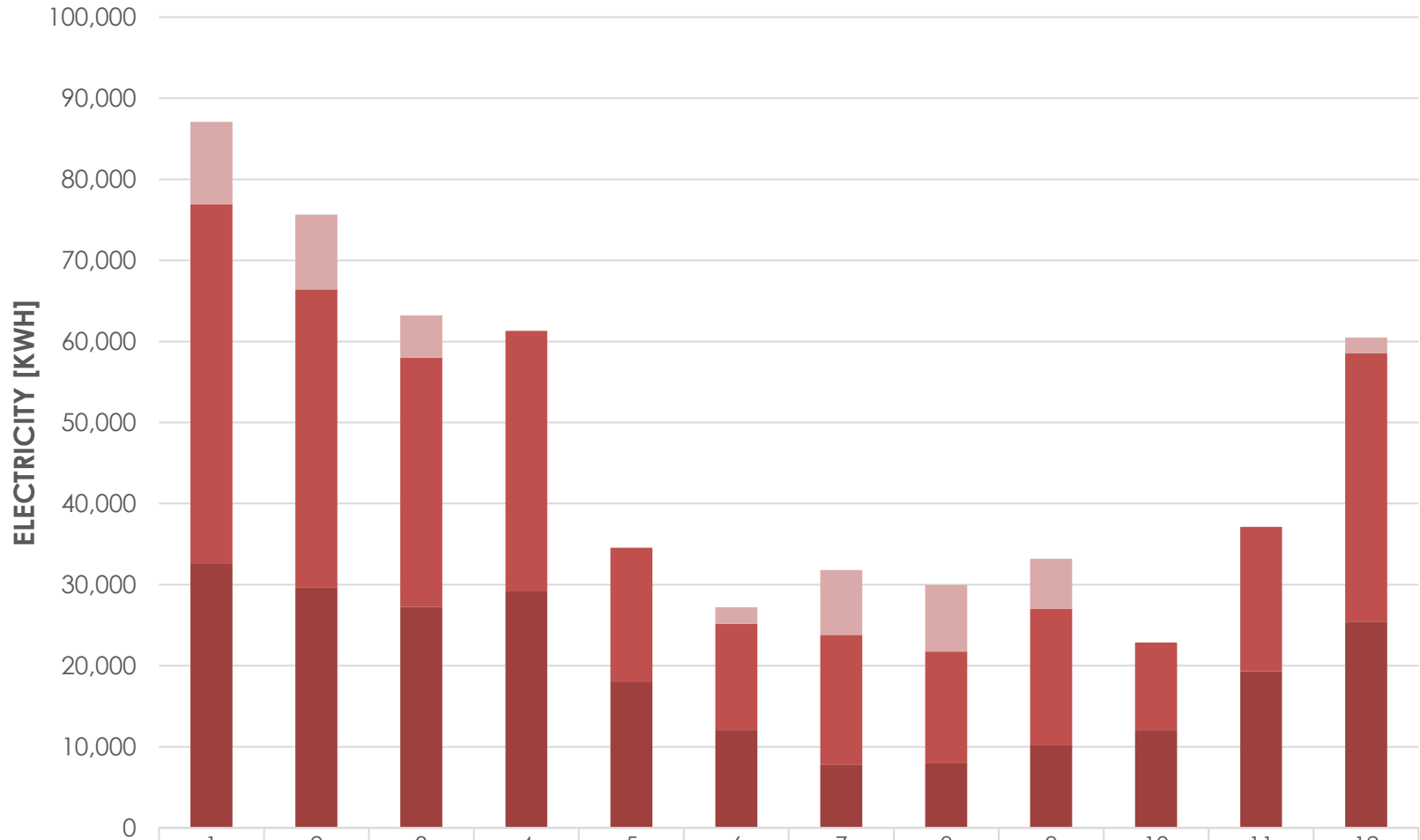
2023 - High Rate	2,000	2,080	1,280	0	0	1,840	6,720	7,200	5,280	0	0	480
2023 - Low Rate	5,680	4,960	4,720	5,200	3,760	3,920	5,600	4,720	5,920	3,040	3,920	5,200
2023 - Reg Rate	6,880	7,040	7,040	8,000	6,880	6,800	5,040	5,440	6,880	7,200	6,960	6,800

ELECTRICITY PERIODS - CORSON SQUARE



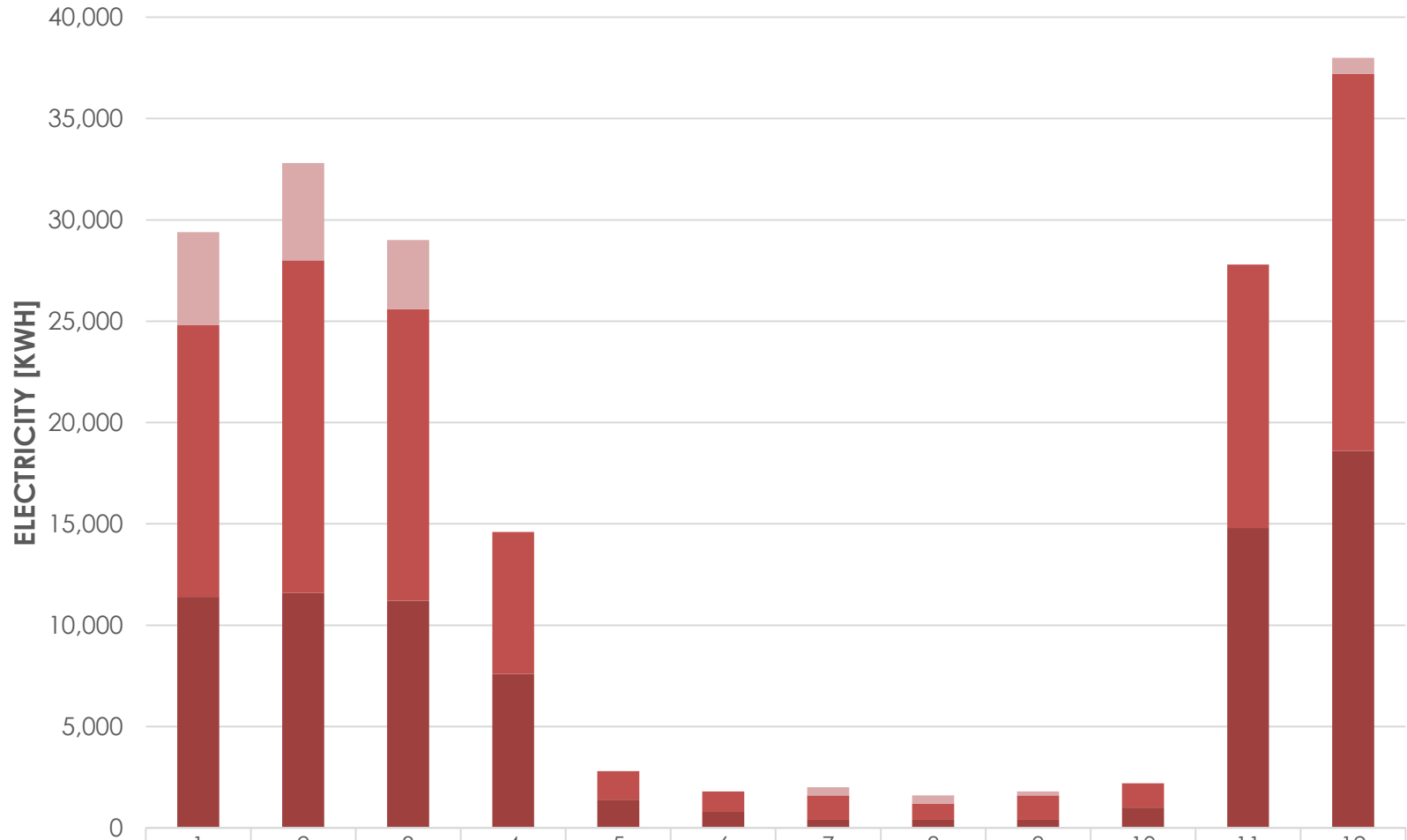
	1	2	3	4	5	6	7	8	9	10	11	12
2023 - High Rate	1,200	1,080	600	0	0	360	1,320	1,320	960	0	0	120
2023 - Low Rate	5,280	4,560	3,600	3,720	2,040	2,160	2,880	2,280	2,880	2,160	2,280	3,240
2023 - Reg Rate	3,840	3,720	3,240	3,240	2,160	1,920	1,320	1,320	1,680	2,280	2,400	2,520

ELECTRICITY PERIODS - DONAHUE TERRACE



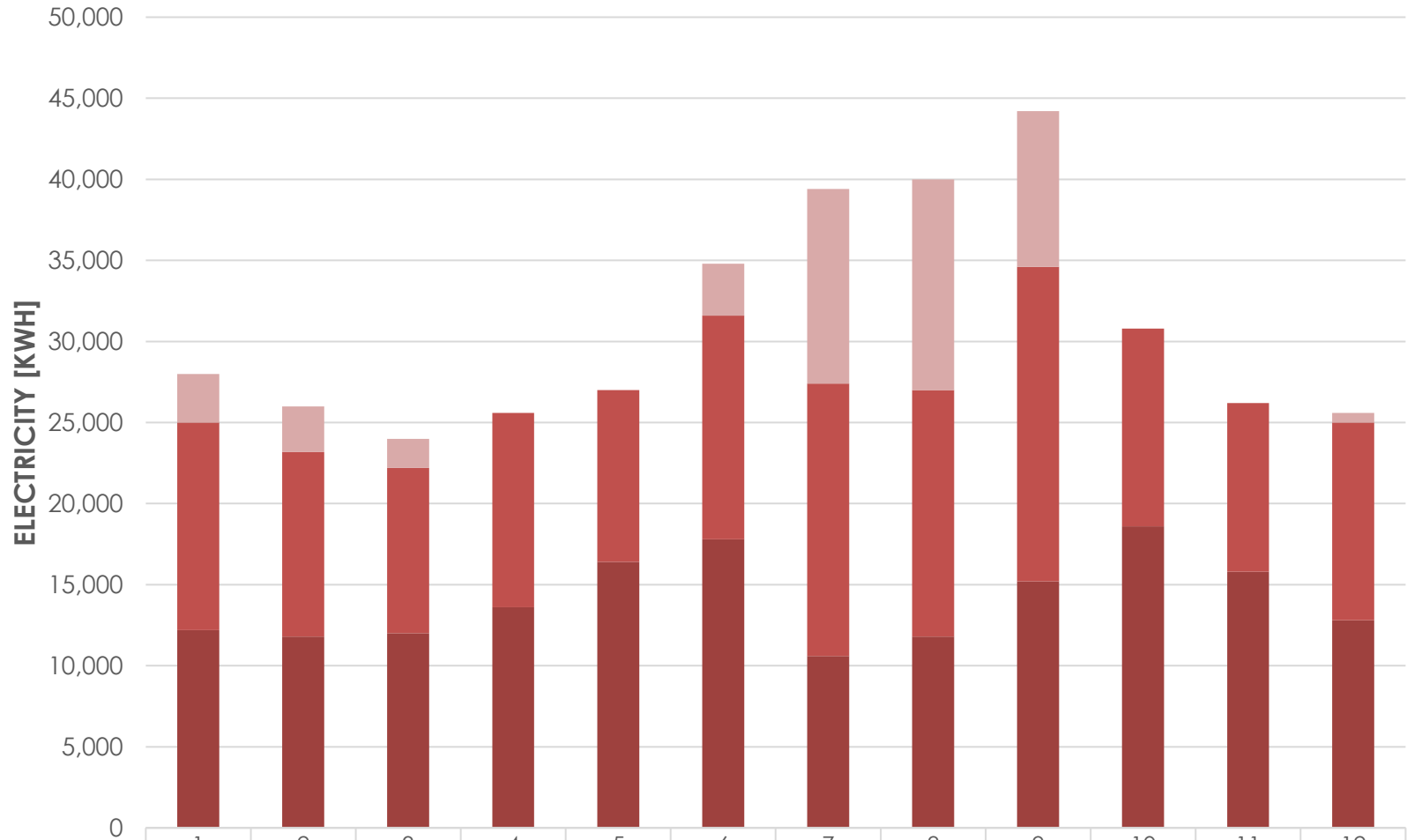
	1	2	3	4	5	6	7	8	9	10	11	12
2023 - High Rate	10,160	9,200	5,240	0	0	2,040	8,000	8,200	6,160	0	0	1,960
2023 - Low Rate	44,400	36,840	30,760	32,160	16,480	13,080	16,040	13,800	16,800	10,800	17,800	33,080
2023 - Reg Rate	32,520	29,600	27,240	29,160	18,080	12,080	7,760	7,960	10,240	12,080	19,320	25,440

ELECTRICITY PERIODS - HOCKEY PAVILION



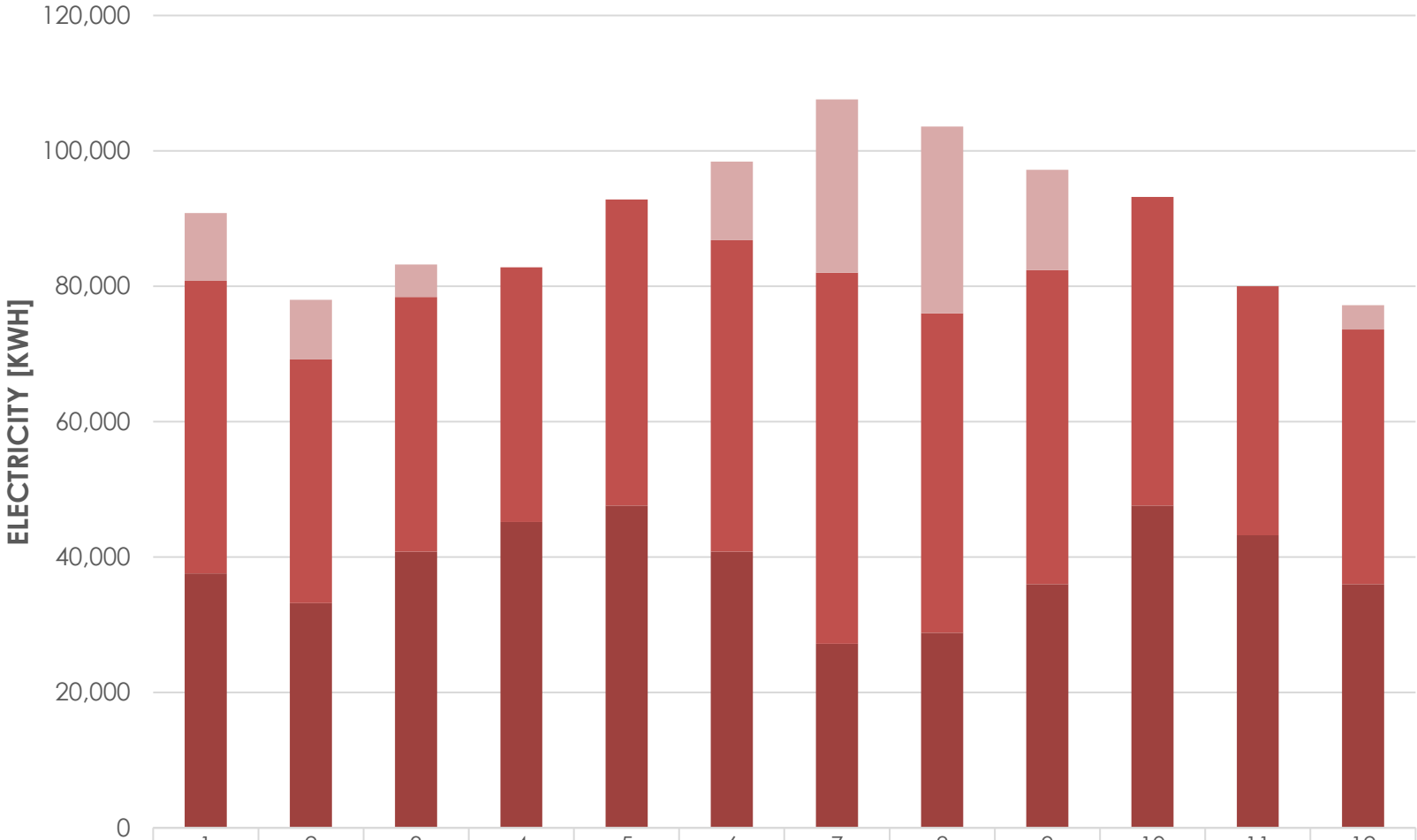
	1	2	3	4	5	6	7	8	9	10	11	12
2023 - High Rate	4,600	4,800	3,400	0	0	0	400	400	200	0	0	800
2023 - Low Rate	13,400	16,400	14,400	7,000	1,400	1,000	1,200	800	1,200	1,200	13,000	18,600
2023 - Reg Rate	11,400	11,600	11,200	7,600	1,400	800	400	400	400	1,000	14,800	18,600

ELECTRICITY PERIODS - MUNICIPAL BUILDING



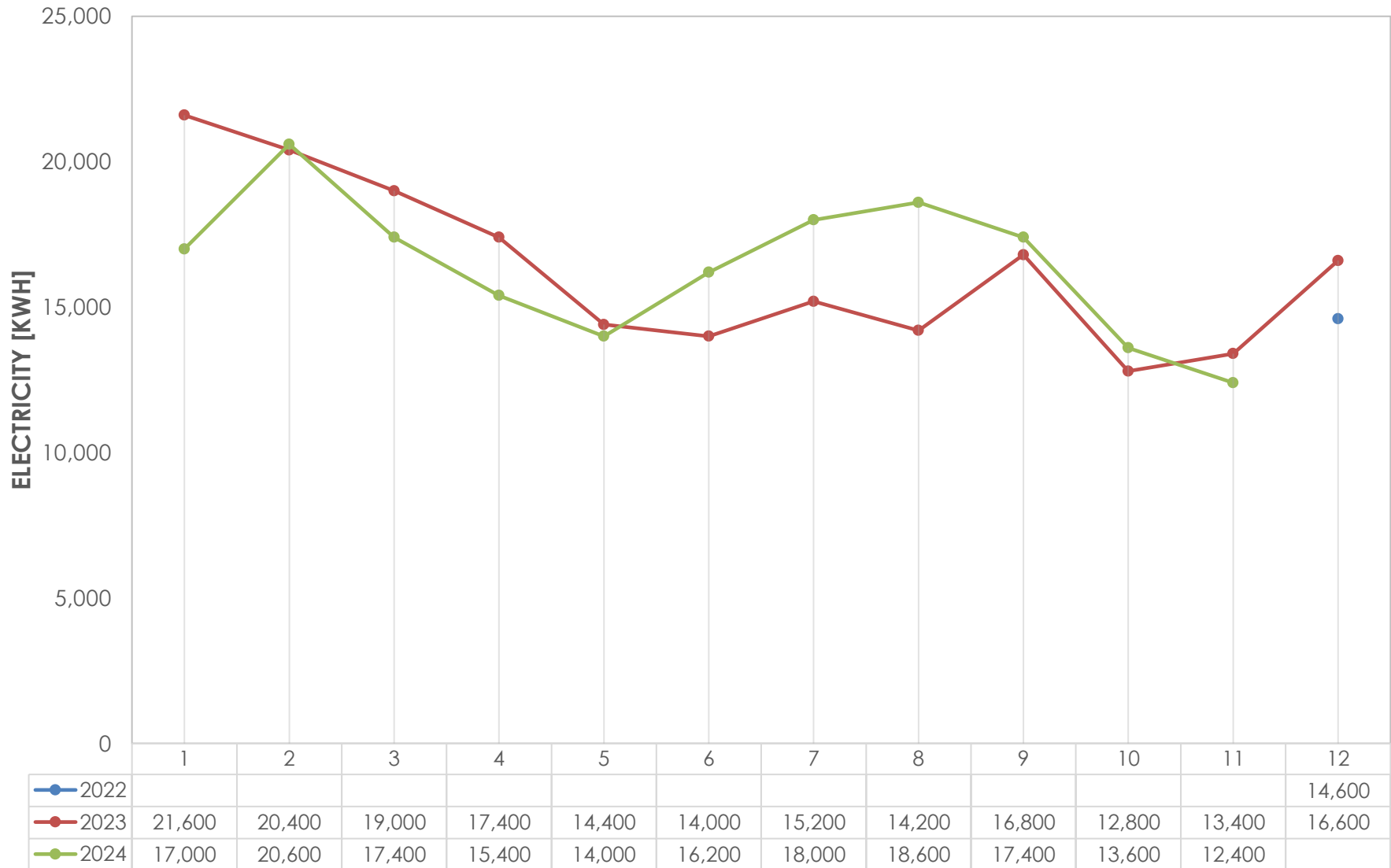
2023 - High Rate	3,000	2,800	1,800	0	0	3,200	12,000	13,000	9,600	0	0	600
2023 - Low Rate	12,800	11,400	10,200	12,000	10,600	13,800	16,800	15,200	19,400	12,200	10,400	12,200
2023 - Reg Rate	12,200	11,800	12,000	13,600	16,400	17,800	10,600	11,800	15,200	18,600	15,800	12,800

ELECTRICITY PERIODS - WATER DEPARTMENT

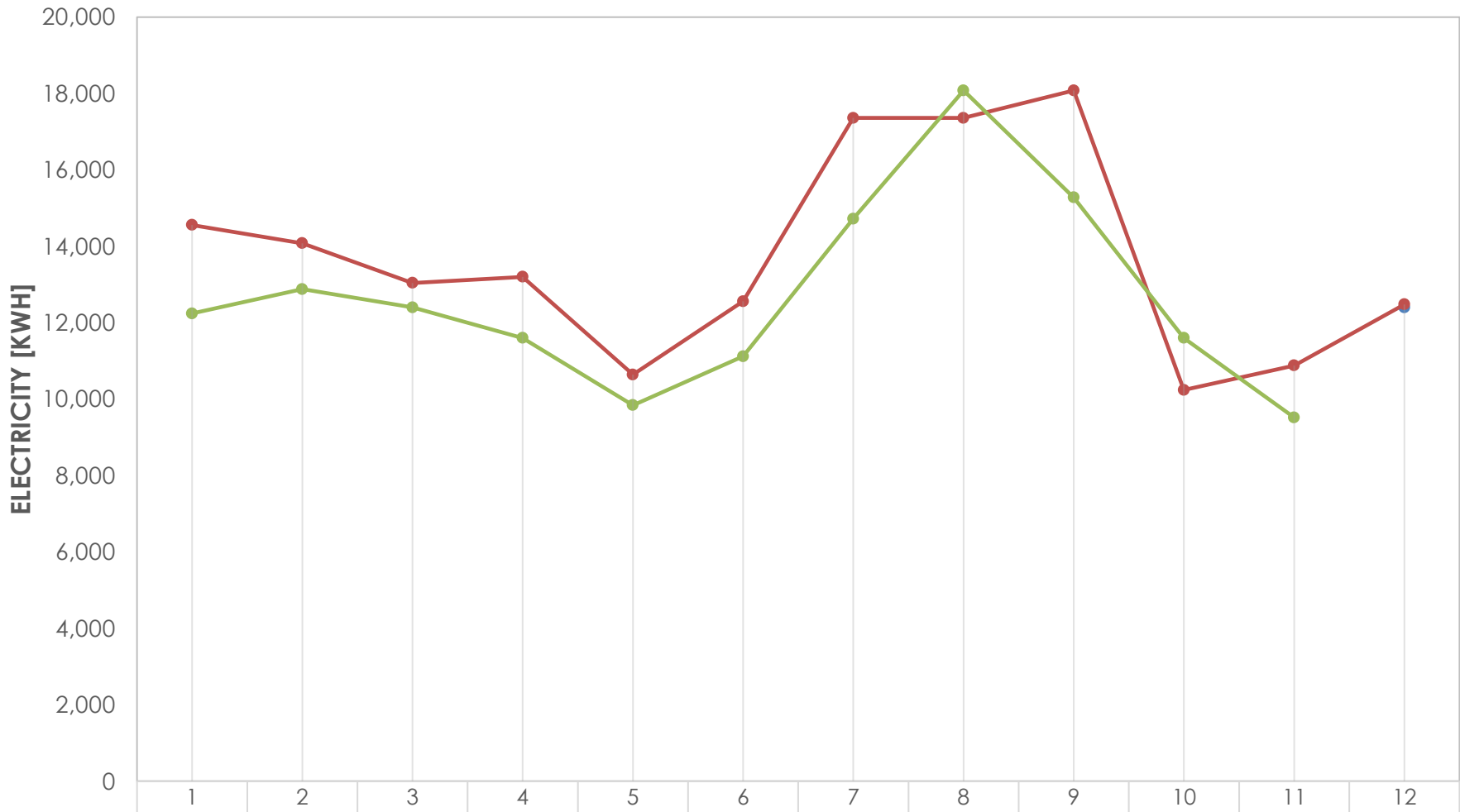


	1	2	3	4	5	6	7	8	9	10	11	12
2023 - High Rate	10,000	8,800	4,800	0	0	11,600	25,600	27,600	14,800	0	0	3,600
2023 - Low Rate	43,200	36,000	37,600	37,600	45,200	46,000	54,800	47,200	46,400	45,600	36,800	37,600
2023 - Reg Rate	37,600	33,200	40,800	45,200	47,600	40,800	27,200	28,800	36,000	47,600	43,200	36,000

ELECTRICITY USE - CITY SERVICES CENTER

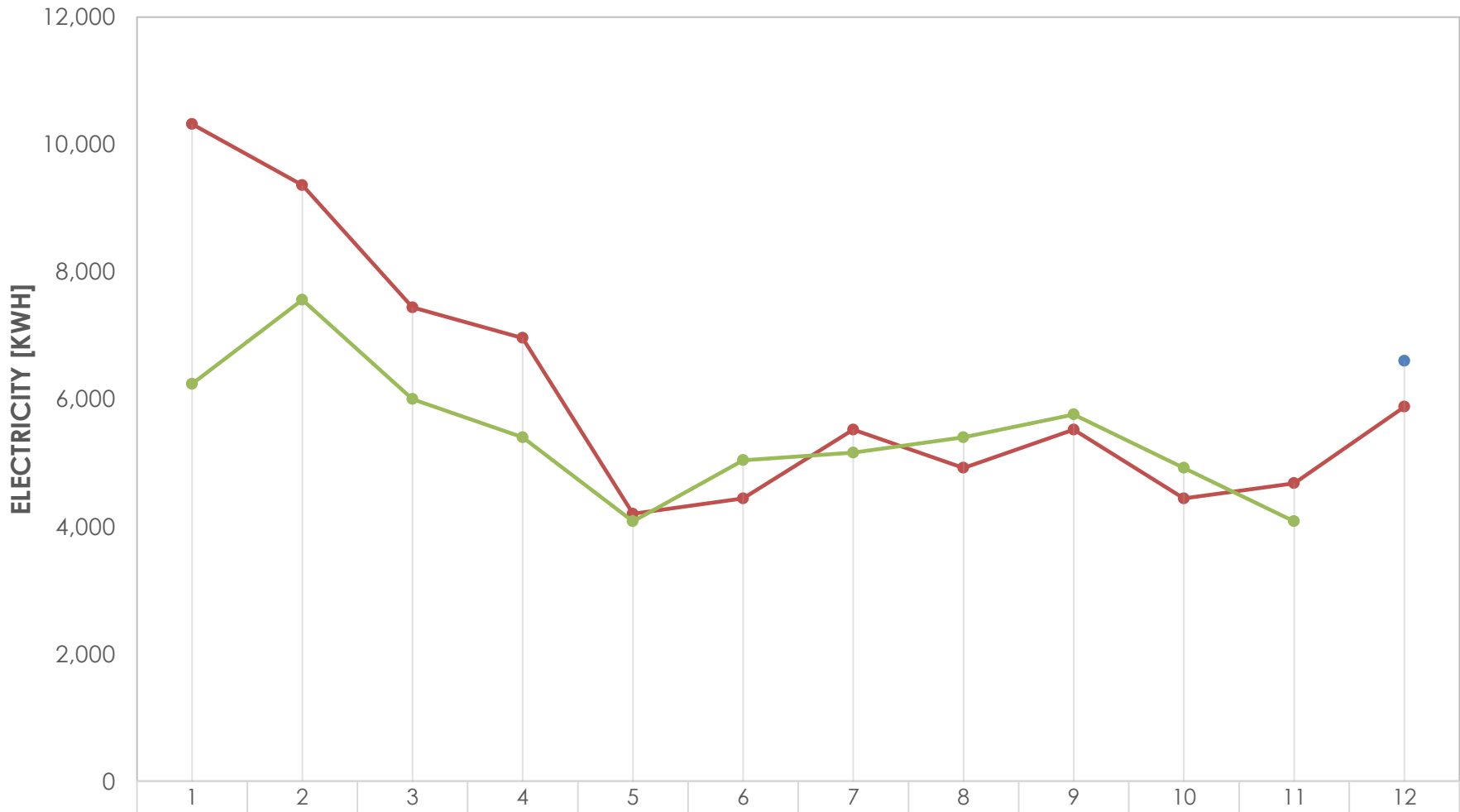


ELECTRICITY USE - CIVIC CENTER



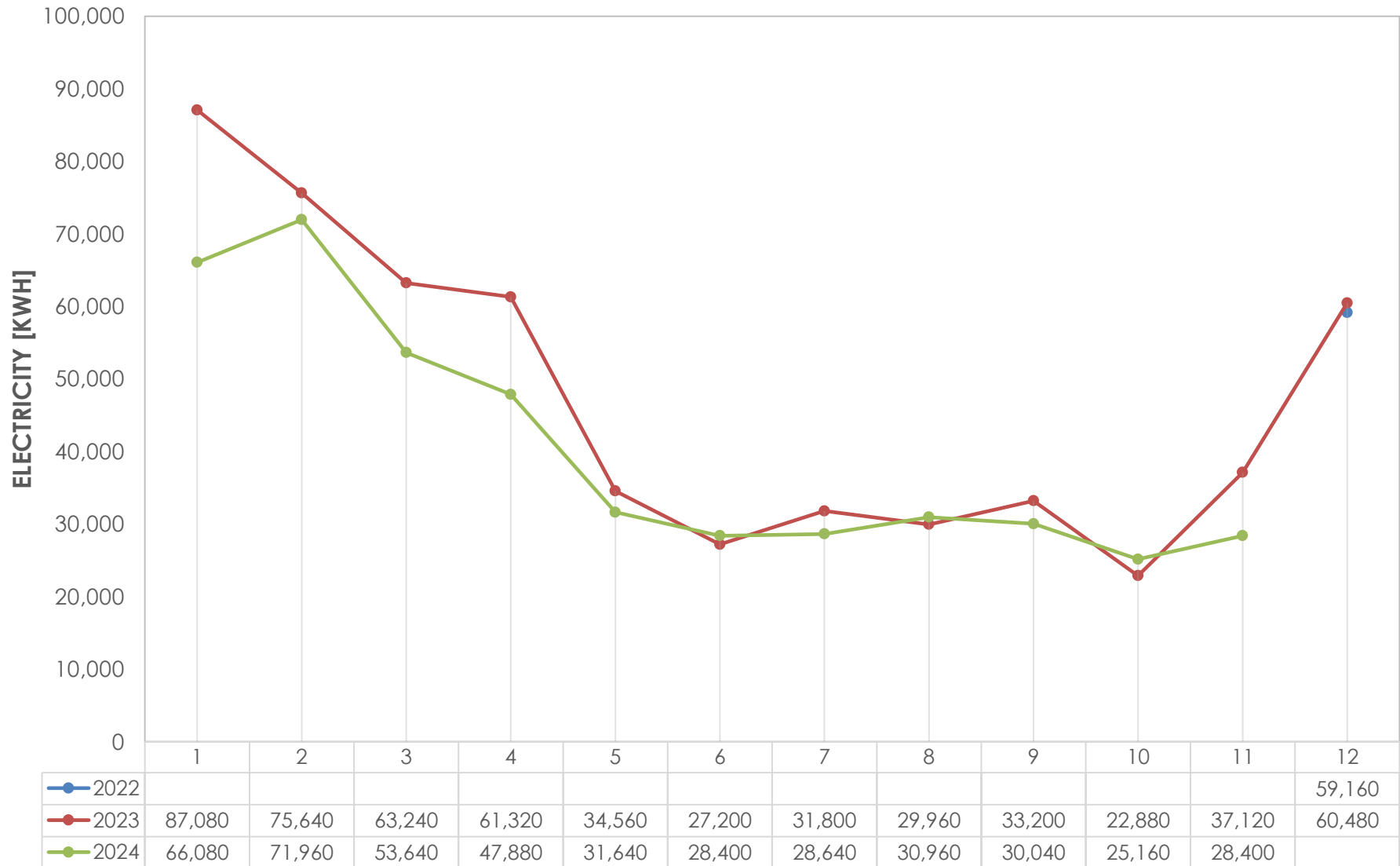
● 2022												12,400
● 2023	14,560	14,080	13,040	13,200	10,640	12,560	17,360	17,360	18,080	10,240	10,880	12,480
● 2024	12,240	12,880	12,400	11,600	9,840	11,120	14,720	18,080	15,280	11,600	9,520	

ELECTRICITY USE - CORSON SQUARE

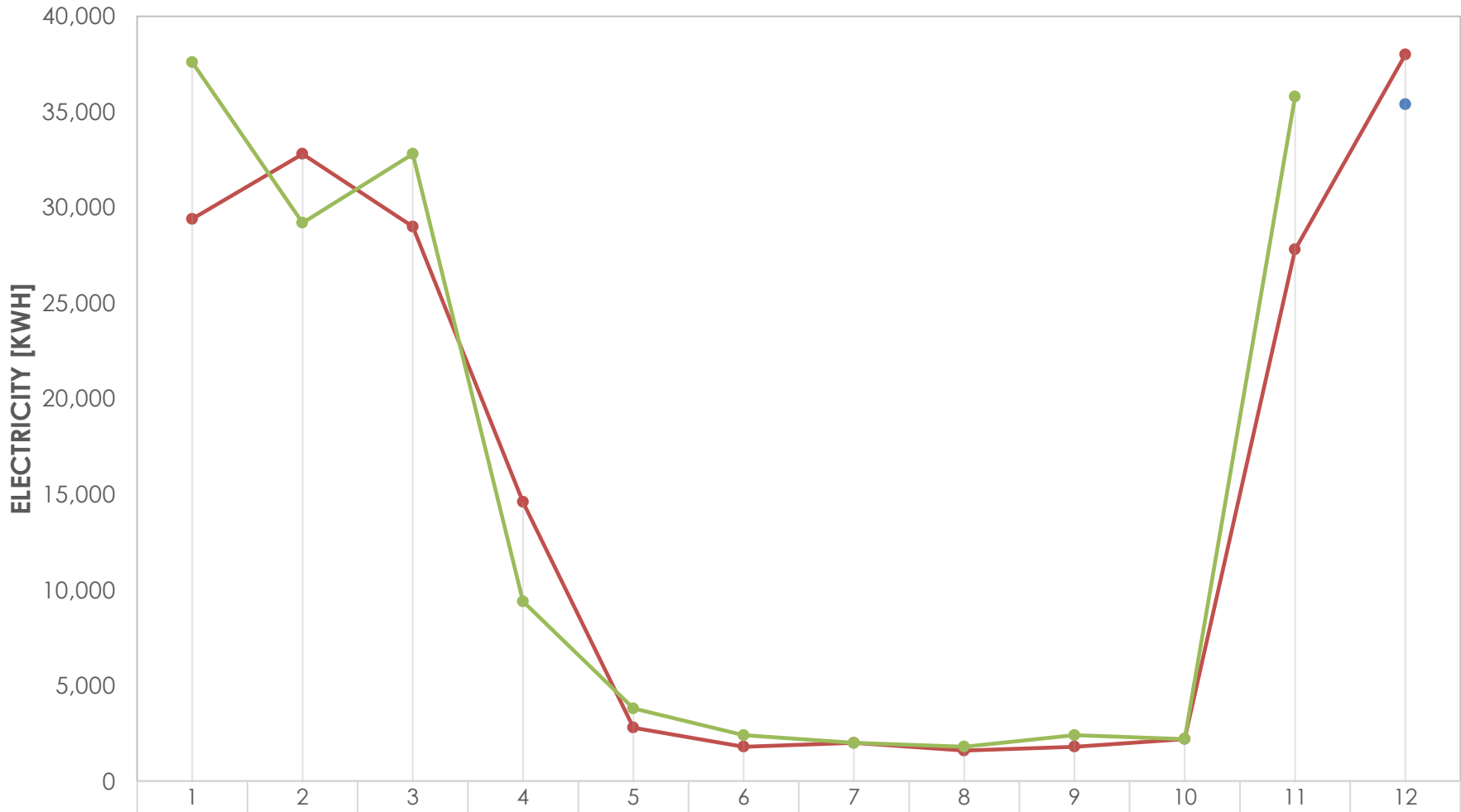


● 2022												6,600
● 2023	10,320	9,360	7,440	6,960	4,200	4,440	5,520	4,920	5,520	4,440	4,680	5,880
● 2024	6,240	7,560	6,000	5,400	4,080	5,040	5,160	5,400	5,760	4,920	4,080	

ELECTRICITY USE - DONAHUE TERRACE

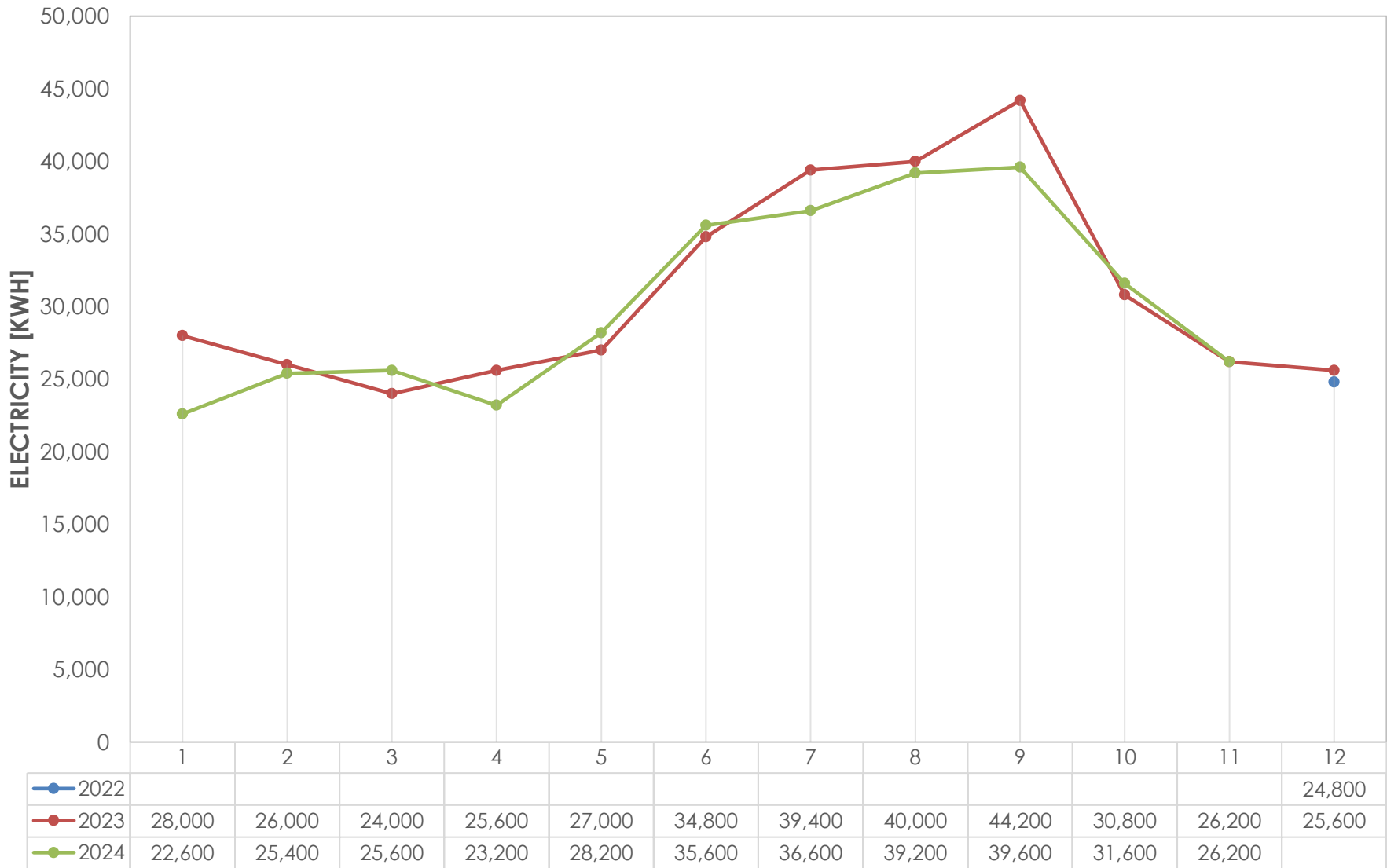


ELECTRICITY USE - HOCKEY PAVILION

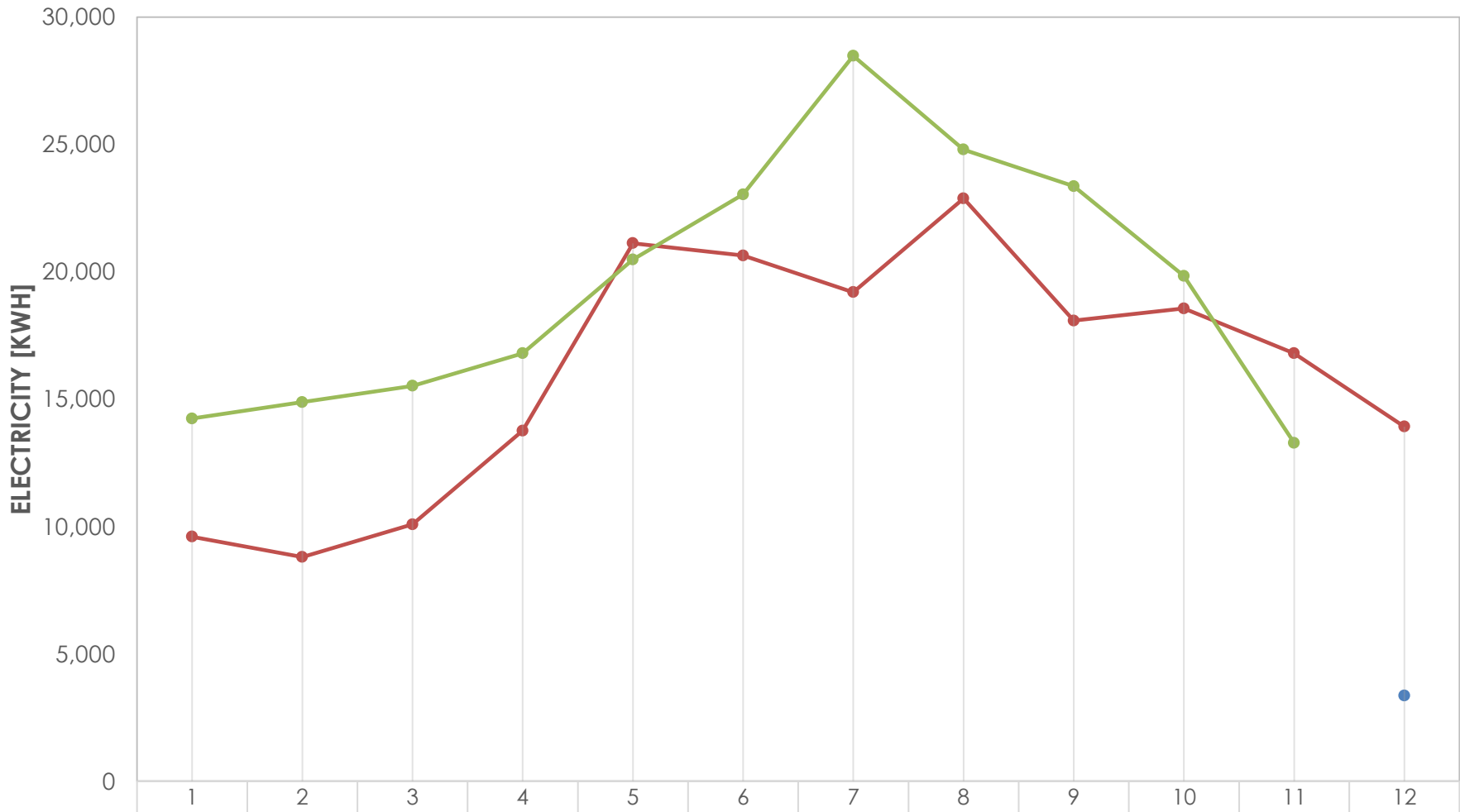


● 2022												35,400
● 2023	29,400	32,800	29,000	14,600	2,800	1,800	2,000	1,600	1,800	2,200	27,800	38,000
● 2024	37,600	29,200	32,800	9,400	3,800	2,400	2,000	1,800	2,400	2,200	35,800	

ELECTRICITY USE - MUNICIPAL BUILDING

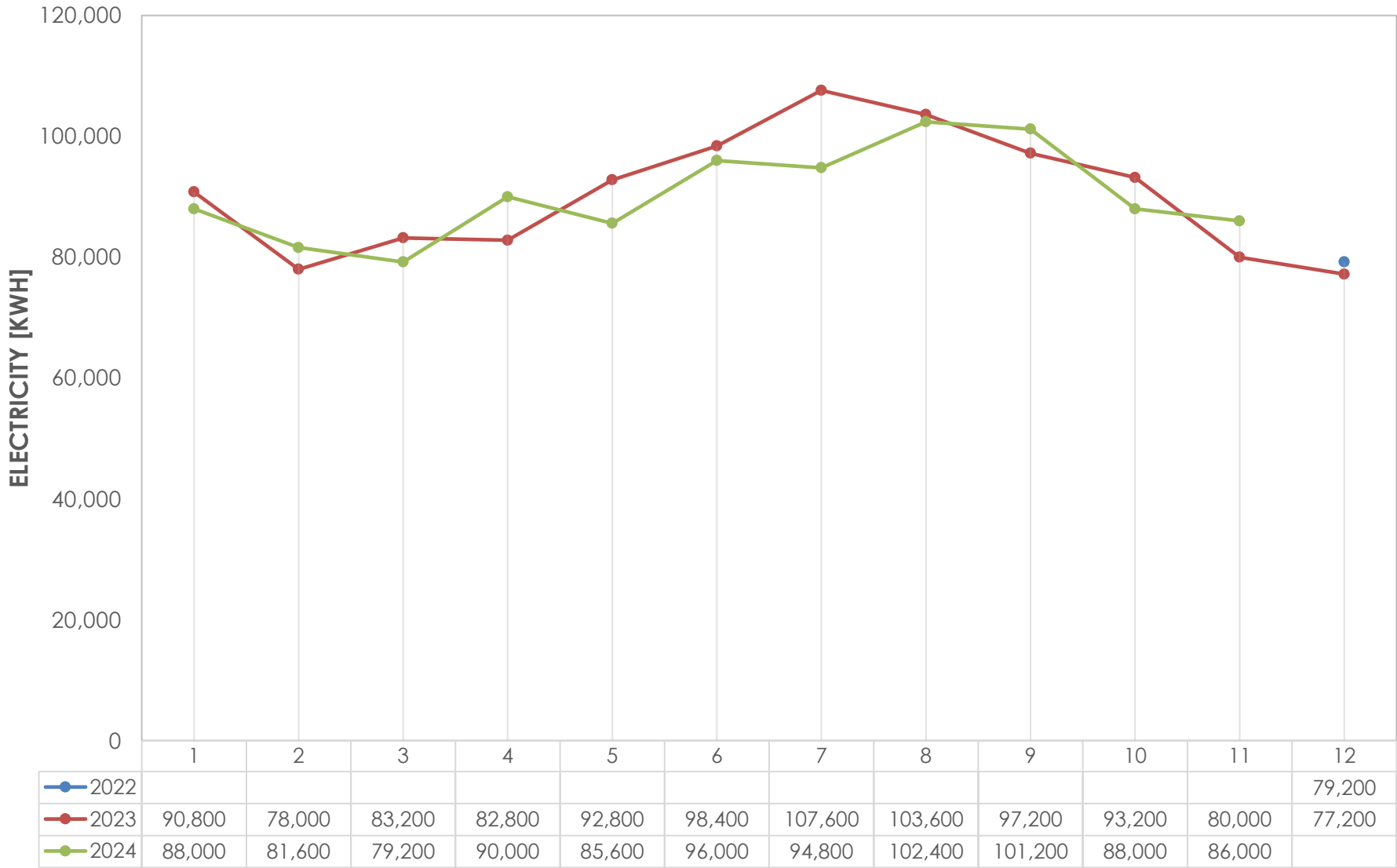


ELECTRICITY USE - PUBLIC LIBRARY

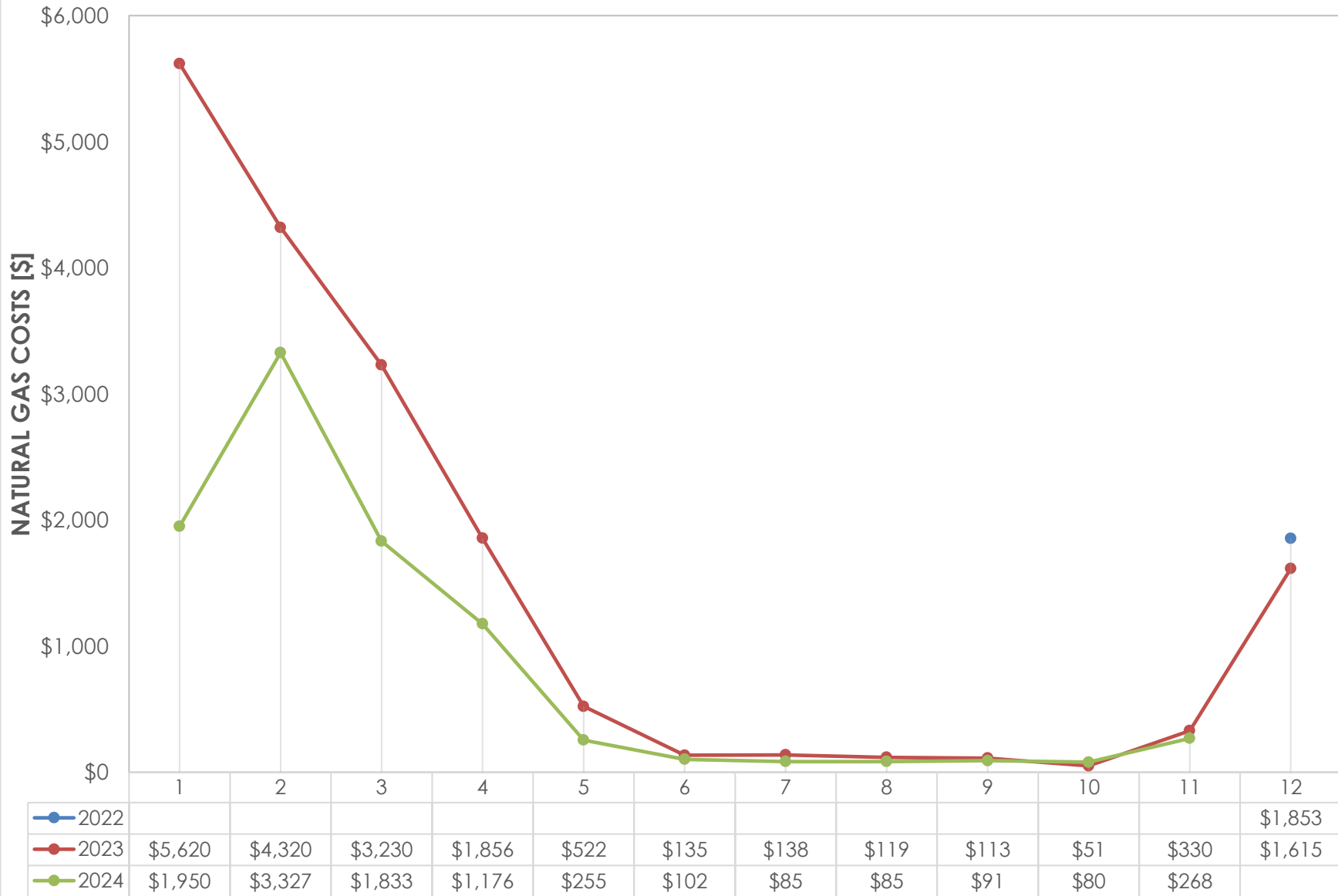


● 2022												3,360
● 2023	9,600	8,800	10,080	13,760	21,120	20,640	19,200	22,880	18,080	18,560	16,800	13,920
● 2024	14,240	14,880	15,520	16,800	20,480	23,040	28,480	24,800	23,360	19,840	13,280	

ELECTRICITY USE - WATER DEPARTMENT



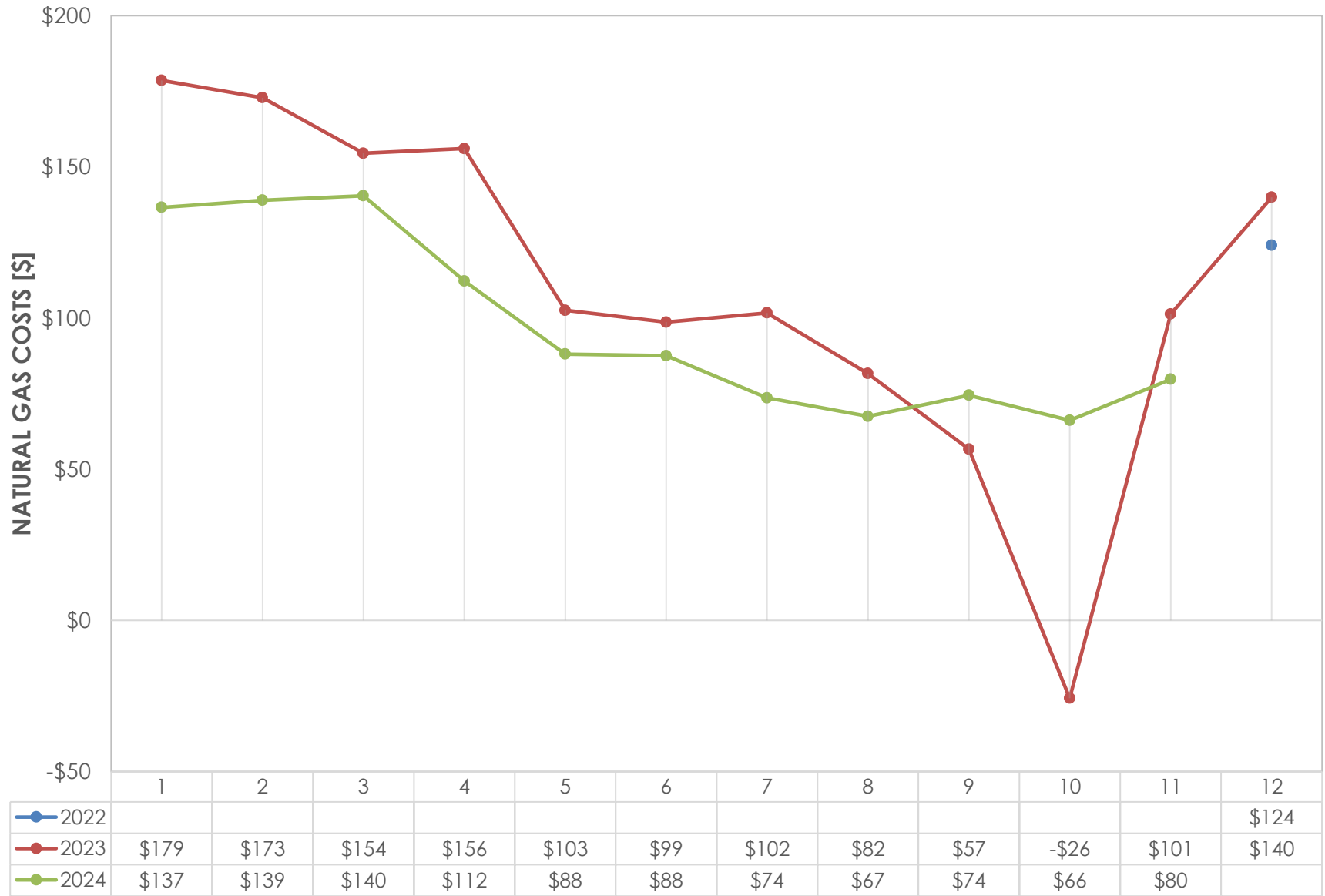
NAT GAS COSTS - CITY SERVICES CENTER



NAT GAS COSTS - CIVIC CENTER



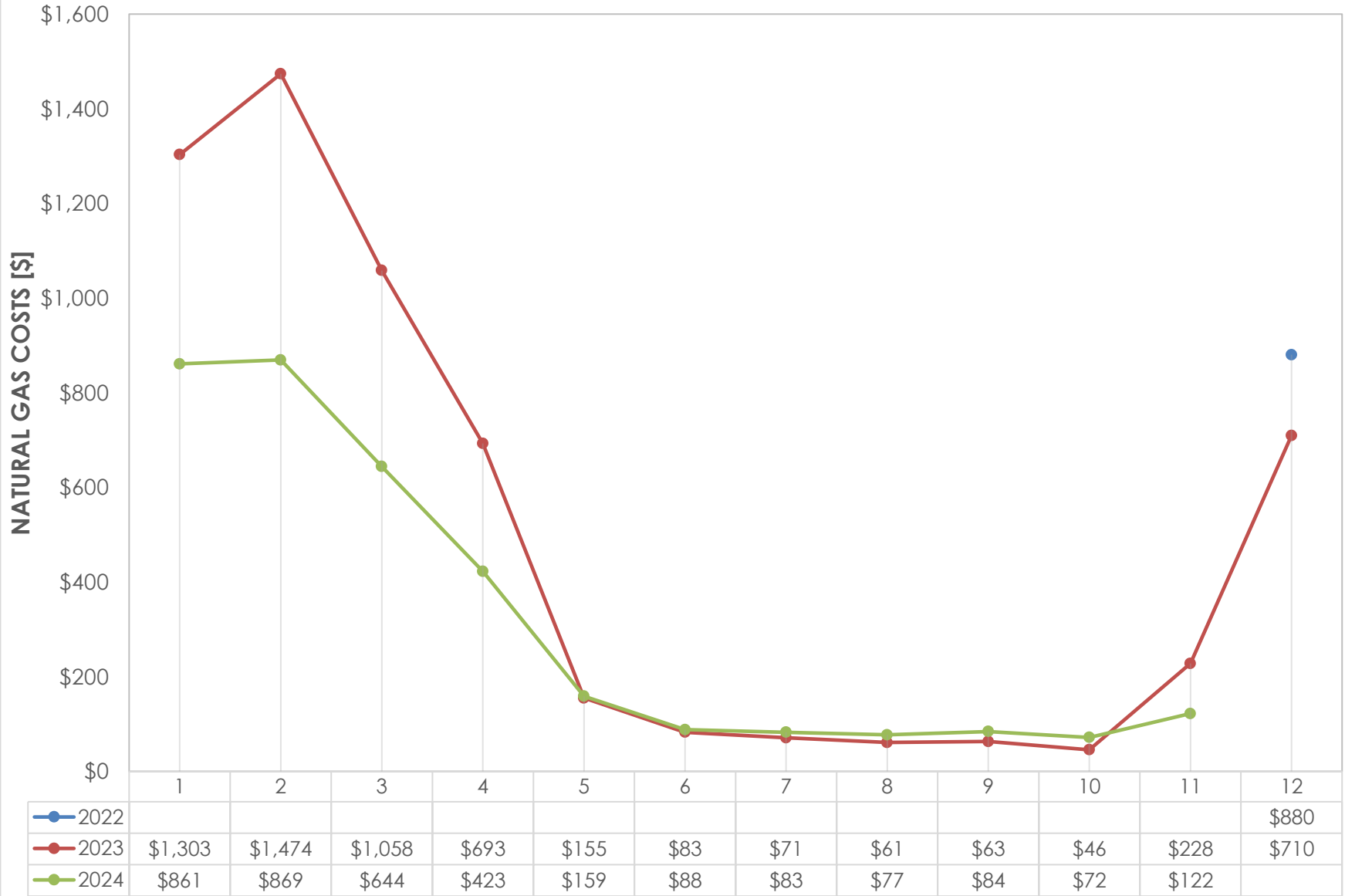
NAT GAS COSTS - CORSON SQUARE



NAT GAS COSTS - DONAHUE TERRACE



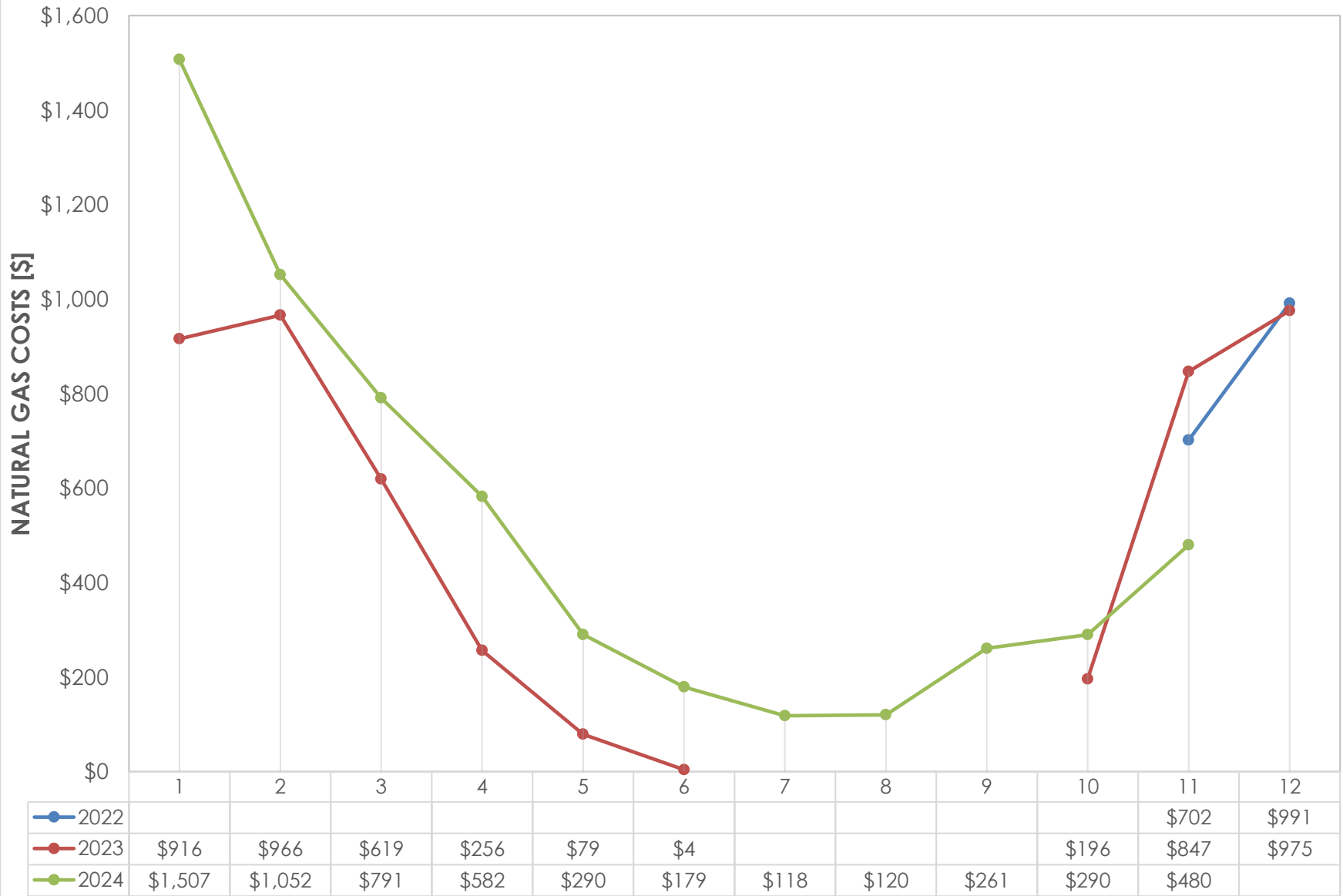
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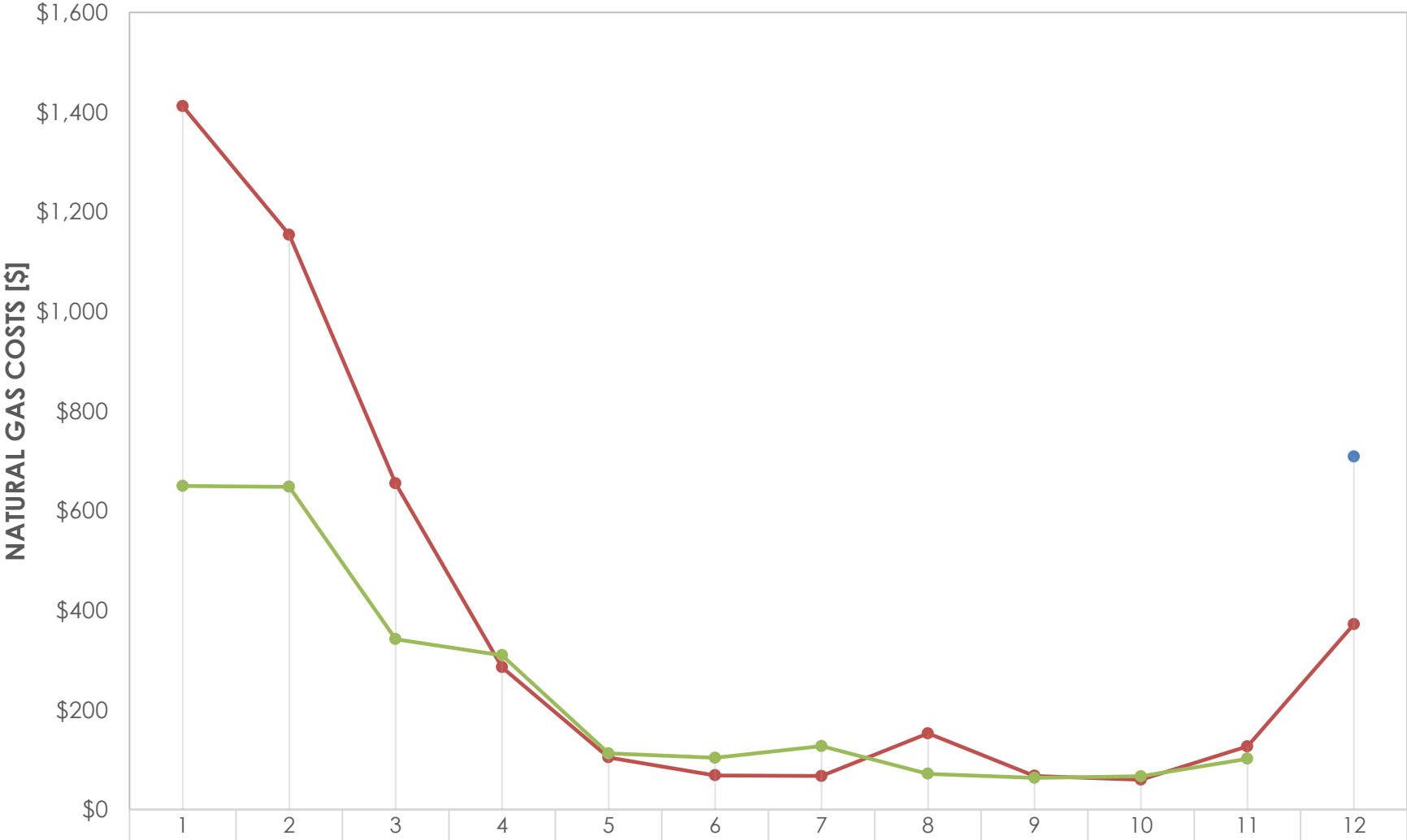
NAT GAS COSTS - MUNICIPAL BUILDING



NAT GAS COSTS - PUBLIC LIBRARY



NAT GAS COSTS - WATER DEPARTMENT

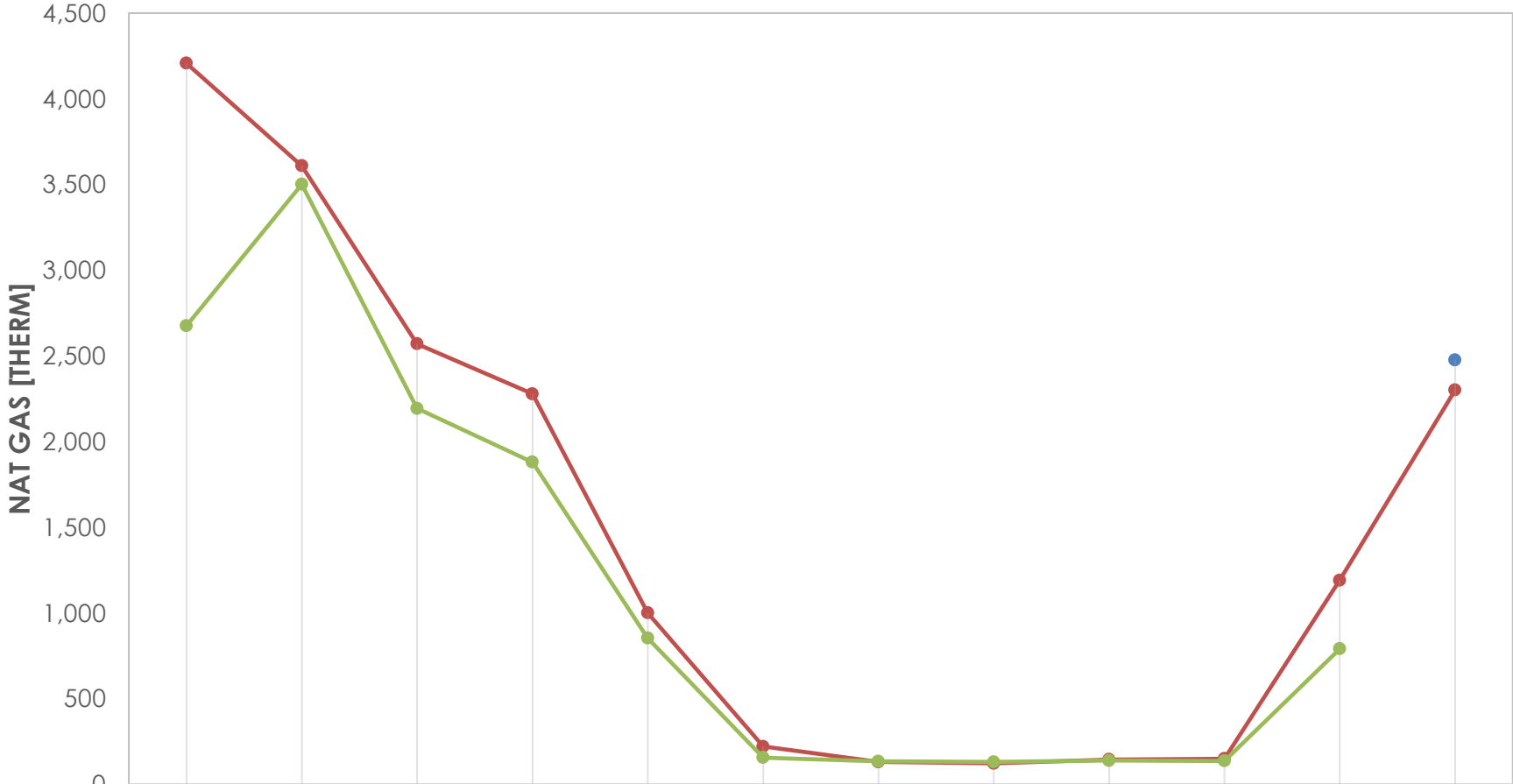


● 2022												\$709
● 2023	\$1,412	\$1,154	\$655	\$286	\$105	\$69	\$67	\$153	\$68	\$60	\$127	\$372
● 2024	\$650	\$648	\$342	\$310	\$113	\$104	\$127	\$72	\$64	\$67	\$102	

NAT GAS USE - CITY SERVICES CENTER

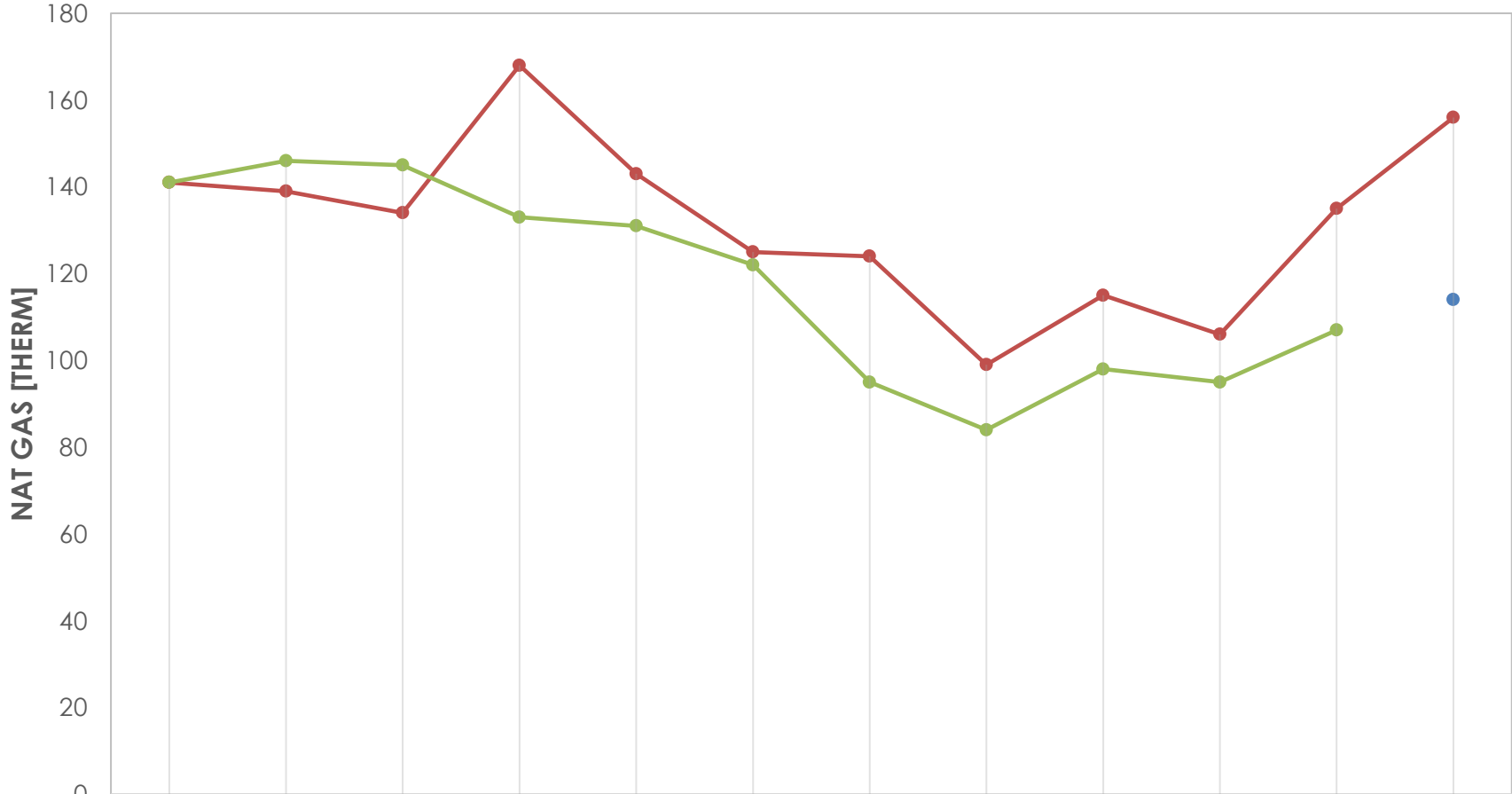


NAT GAS USE - CIVIC CENTER



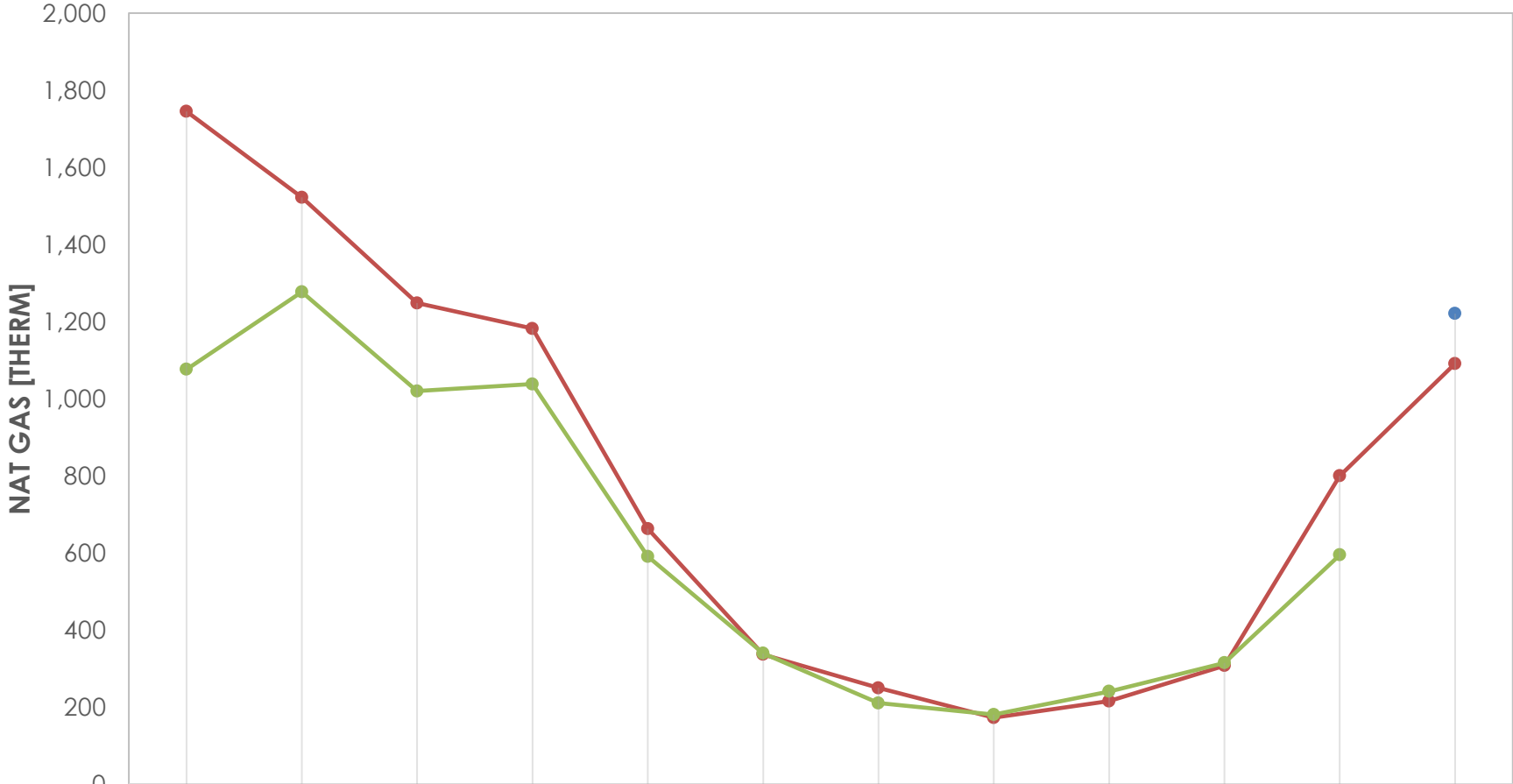
● 2022												2,475
● 2023	4,207	3,609	2,570	2,278	1,000	221	131	123	145	150	1,191	2,300
● 2024	2,676	3,501	2,193	1,880	853	156	134	131	139	137	791	

NAT GAS USE - CORSON SQUARE



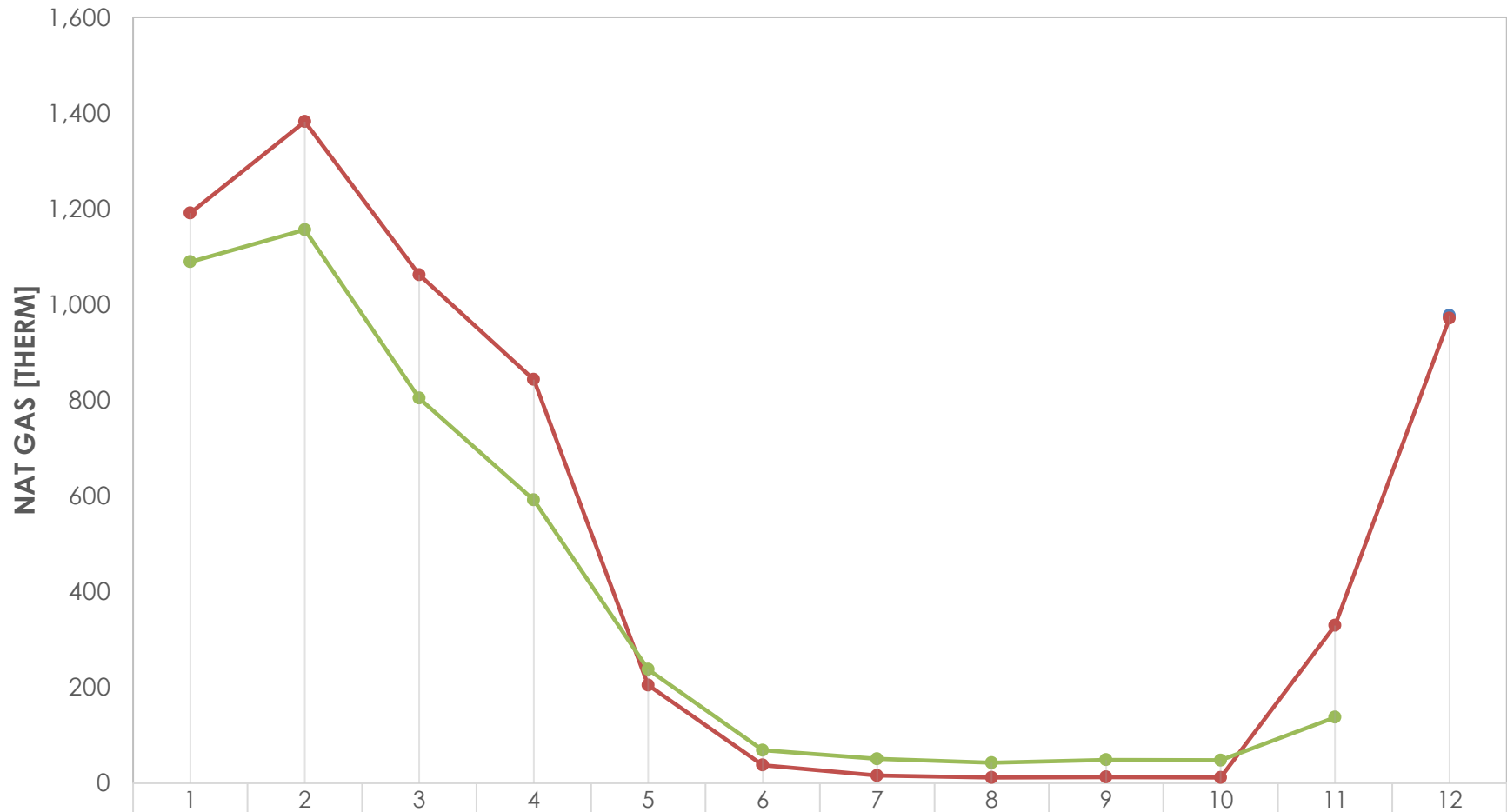
● 2022												114
● 2023	141	139	134	168	143	125	124	99	115	106	135	156
● 2024	141	146	145	133	131	122	95	84	98	95	107	

NAT GAS USE - DONAHUE TERRACE



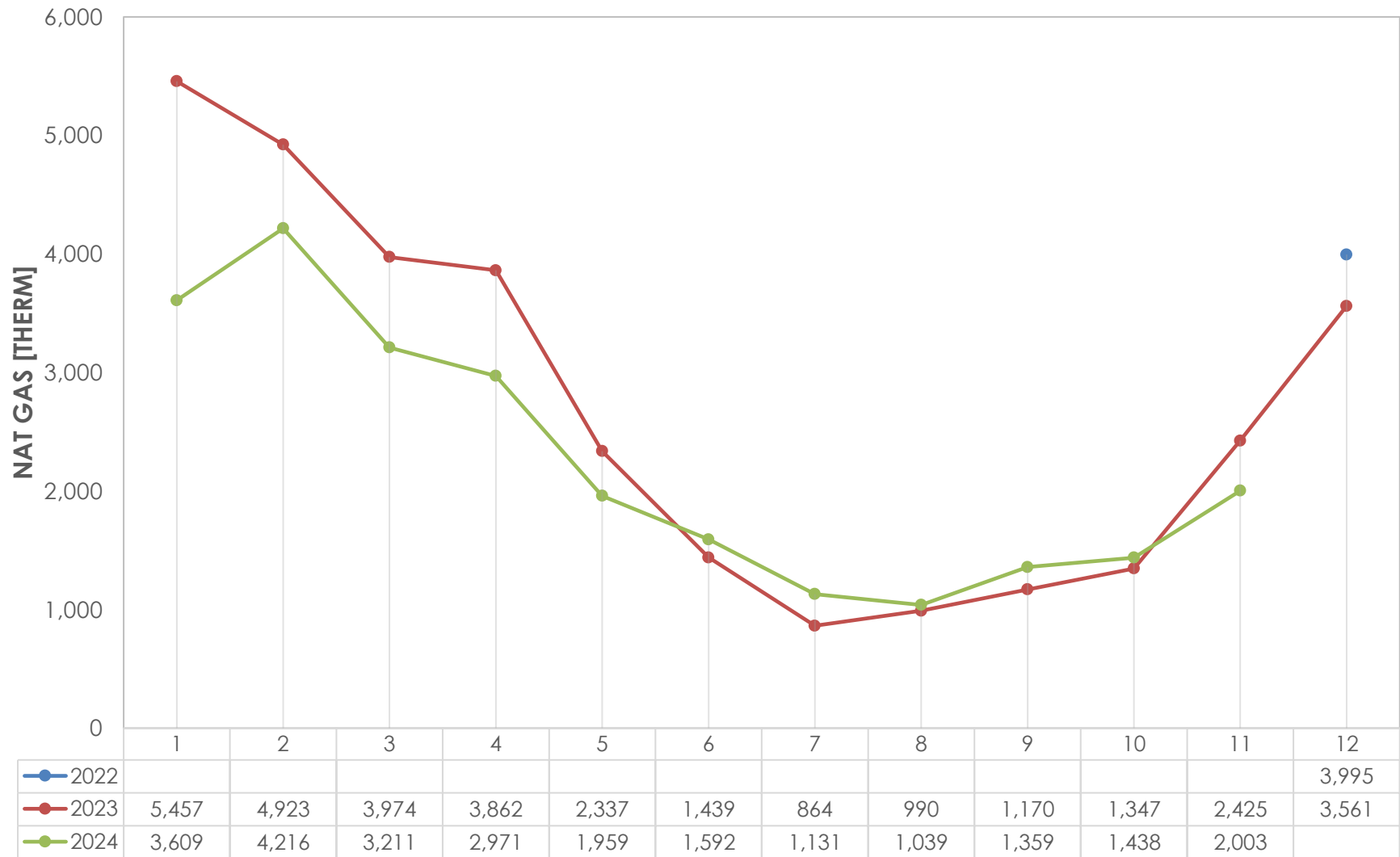
● 2022												1,221
● 2023	1,745	1,522	1,248	1,182	663	337	250	173	216	308	800	1,091
● 2024	1,076	1,277	1,020	1,038	591	340	211	181	241	315	595	

NAT GAS USE - HOCKEY PAVILION

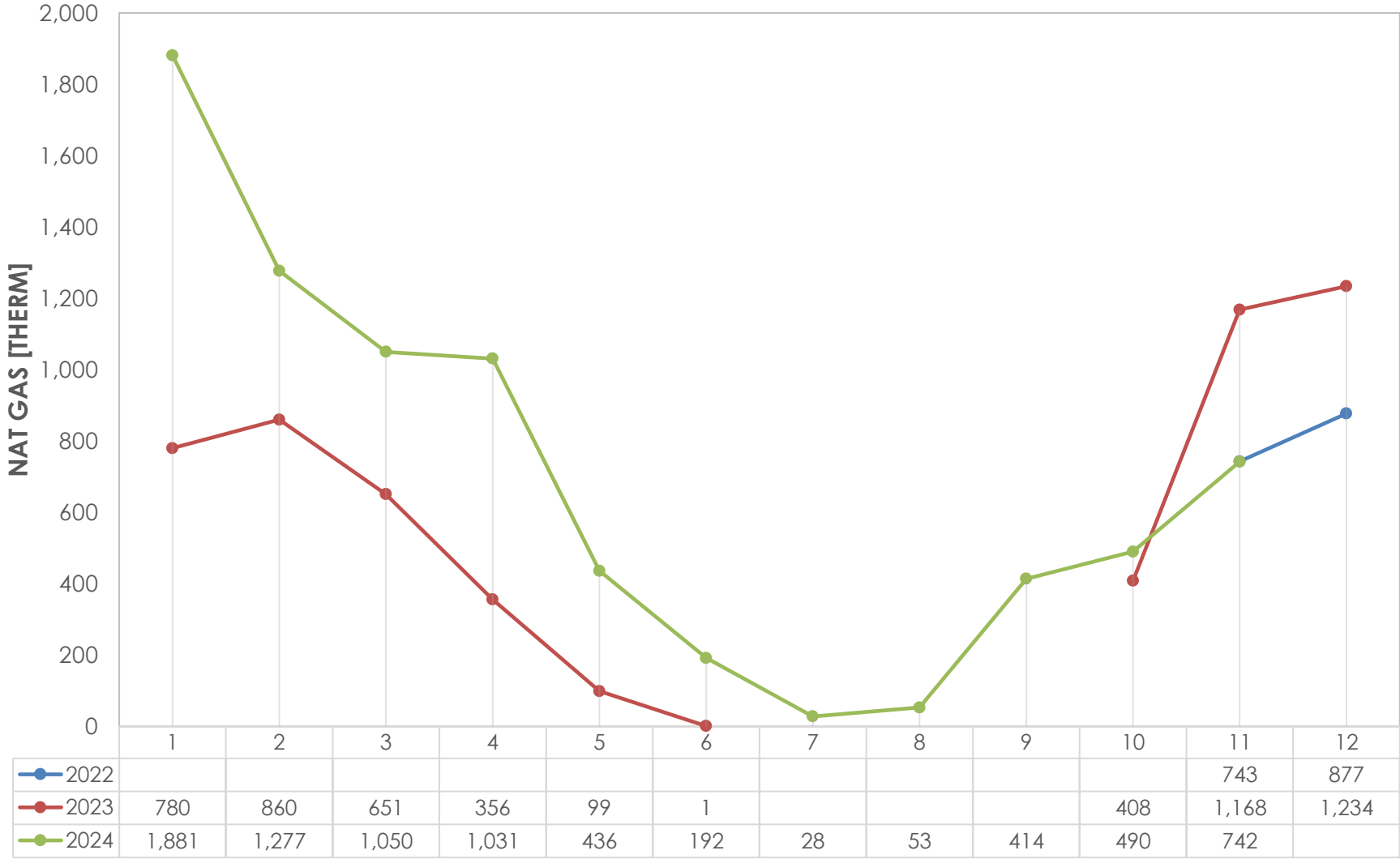


● 2022												977
● 2023	1,191	1,382	1,062	843	204	37	15	11	12	11	329	971
● 2024	1,089	1,156	804	591	237	68	50	42	48	47	137	

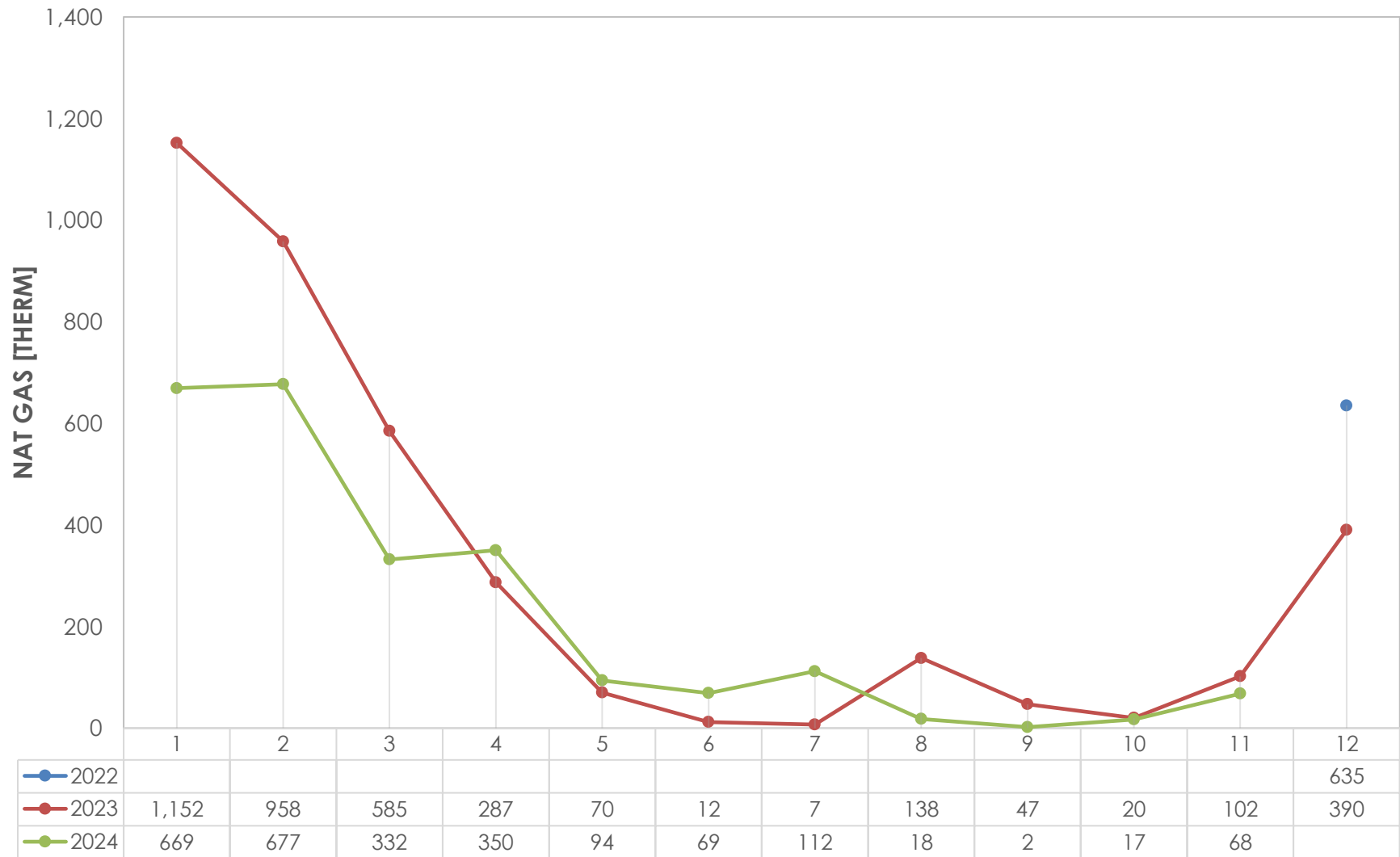
NAT GAS USE - MUNICIPAL BUILDING




NAT GAS USE - PUBLIC LIBRARY



NAT GAS USE - WATER DEPARTMENT





Appendix B
Alliant Energy Rate Summary

Electric rates for commercial and farm customers



In Dec. 2024, the Public Service Commission of Wisconsin approved Alliant Energy’s 2025 Fuel Cost plan (Docket 6680-ER-104). Effective Jan. 1, 2025, your bill will include a \$0.006269/kilowatt-hour (kWh) surcharge to reflect updated fuel costs and Alliant Energy’s previously approved fuel reconciliation adjustment (Docket 6680-FR-2022). The updated fuel adjustment and electric rates effective Jan. 1, 2025 are below.

Effective 1/1/2025		Time-of-use* with water heating (closed)	General service	General service Time-of-use*	General service demand rate	General service nonmetered	Commercial service Time-of-use*	Industrial power at primary or secondary voltage
		Fw-5 (Gw-1)	Gs-1	Gs-3	Gd-1	Gs-4	Cg-2TOD	Cp-1
Daily customer charge (per day)								
Single-phase metering	\$/day	0.4932	0.5589	0.5589	0.5589	0.4089	0.9250	6.2300
Three-phase metering	\$/day		0.8384	0.8384	0.8384		1.1500	
Customer demand charge (per kW) (previous 12 months highest demand)								
Customer demand	\$/kW				2.50		2.95	2.95
Energy charge (per kWh)								
All kWh	\$/kWh		0.13390			0.14400		
High rate	\$/kWh	0.26630		0.23750	0.18450		0.09300	0.07788
Regular rate	\$/kWh	0.18260		0.15450	0.09450		0.06300	0.05325
Low rate	\$/kWh	0.08550		0.07450	0.06850		0.04500	0.04310
Fuel adjustment effective 1/1/2025	\$/kWh	0.006269	0.006269	0.006269	0.006269	0.006269	0.006269	0.006269
Firm demand (per kW)								
On-peak demand: Maximum kW 10 a.m. to 10 p.m.	\$/kW						14.00	17.07
On-peak demand: Maximum kW 10 a.m. to 8 p.m.	\$/kW				9.00			
Other bill components								
Demand energy limiter	\$/kWh limit				0.2200		0.2200	0.2200
Primary service discount								
Primary voltage energy discount	%		2.5%	2.5%	2.5%		2.5%	2.5%
Primary meter customer demand discount	\$/kW				0.23		0.23	0.23
Estimated annual change	% change	3.5%	4.2%	8.4%	9.1%	6.3%	2.7%	4.9%

***Time-of-use weekday energy pricing periods**
High rate: (Summer = Jun. Jul. Aug.) 11 a.m. to 7 p.m.
High rate: (Winter = Dec. Jan. Feb.) 5 p.m. to 9 p.m.
Low rate: Low rate: 11 p.m. to 6 a.m. weeknights; all hours on weekends and holidays
Regular rate: All other hours

Estimated annual change	Traffic signal service	Street lighting service	Decorative lighting service	Area lighting service	Civil defense and fire sirens service	Nonstandard lighting service
	Mz-1	Ms-1	Ms-2	Ms-3	Mz-2	NL-1
% change	6.9%	8.4%	12.6%	1.4%	10.0%	4.3%

Docket 6680-UR-124 final rates. Fuel adjustment reflects Dockets 6680-FR-2022 and 6680-ER-104. To view approved rates, visit alliantenergy.com/wisconsinrates. For rate options Gs-1, Gs-3 and Gd-1, our online rate comparison tool can help you determine the best rate plan based on your previous energy use.

Natural gas rates for commercial and farm customers

In Dec. 2023, the Public Service Commission of Wisconsin (PSCW) approved new natural gas base rates effective Jan. 1, 2025 (Docket 6680-UR-124). The average impact of the adjustment across all customer rate classes is a reduction of approximately 0.1%. Actual costs will vary depending on your rate class and natural gas usage. At Alliant Energy, we continue to make smart investments that create a cleaner, safer and more reliable energy future. Consistent with our long-range strategic plan, these investments will increase customer value and ensure the continued delivery of cost-effective energy for years to come.

Effective 1/1/2025		Gc-1 Small commercial and industrial	Gc-2 Commercial and industrial	Gc-3 Commercial and industrial	Gc-4 Commercial and industrial	Gc-5 Commercial and industrial	Gc-6 Large commercial and industrial	S-1 Seasonal service	S-1 Seasonal service	S-1 Seasonal service
Bill component	Size in therms (thousands)		5-20	20-200	200-1300	1300-7500	>7500	On season and first 1,000 therms off season	Off season next 2,000 therms ²	Off season over 3,000 therms ²
Distribution charge	\$/therm	0.2977	0.1501	0.1287	0.0837	0.0656	0.0483	0.1767	0.1196	0.1000
Gas supply base rate	\$/therm	0.6477	0.6477	0.6477	0.6477	0.6477	0.6477	NA	NA	NA
Gas supply acquisition charge	\$/therm	0.0152	0.0152	0.0141	0.0141	0.0141	0.0141	NA	NA	NA
Customer charge	\$/day	0.4741	1.8902	3.0000	21.3500	36.2500	41.8820	1.8902	1.8902	1.8902
Interruptible option¹										
Gas supply base rate (optional interruptible)	\$/therm	NA	NA	0.4190	0.4190	0.4190	0.4190	0.4190	0.4190	0.4190
Gas supply acquisition charge (optional interruptible)	\$/therm	NA	NA	0.0137	0.0137	0.0137	0.0137	0.0148	0.0148	0.0148
Additional transportation gas service charges										
Administrative charge	\$/day	2.2700	2.2700	2.2700	2.2700	2.2700	2.2700	2.2700	2.2700	2.2700
Remote metering charge	\$/day	1.2400	1.2400	1.2400	1.2400	1.2400	1.2400	1.2400	1.2400	1.2400


Your bill shows separate charges for distribution (what we charge for delivering natural gas) and gas supply (what we pay to acquire natural gas). The gas supply base rate changes monthly with the gas supply market adjustment the PSCW approves.

If you have questions about the approved rates, visit alliantenergy.com/wisconsinrates or call us at 1-800-ALLIANT (1-800-255-4268).

[1] Only interruptible gas service is available to S-1 Seasonal Ag.

[2] Off season rates apply May 5 – January 4.





Appendix C
GHG Emission Factors



Emission Factors for Greenhouse Gas Inventories

Last Modified: January 15, 2025

Blue text indicates an update from the 2024 version of this document.

Typically, greenhouse gas emissions are reported in units of carbon dioxide equivalent (CO₂e). Gases are converted to CO₂e by multiplying by their global warming potential (GWP). In most cases, the emission factors listed in this document generally have not been converted to CO₂e. To do so, multiply the emissions by the corresponding GWP listed in the table below.

Gas	100-Year GWP
CH ₄	28
N ₂ O	265

Source: Intergovernmental Panel on Climate Change (IPCC), Fifth Assessment Report (AR5), 2013. See the source note to Table 1 for further explanation.

Table 1 Stationary Combustion

Fuel Type	Heat Content (HHV) mmBtu per short ton	CO ₂ Factor kg CO ₂ per mmBtu	CH ₄ Factor g CH ₄ per mmBtu	N ₂ O Factor g N ₂ O per mmBtu	CO ₂ Factor kg CO ₂ per short ton	CH ₄ Factor g CH ₄ per short ton	N ₂ O Factor g N ₂ O per short ton
Coal and Coke							
Anthracite	25.09	103.69	11	1.6	2,602	276	40
Bituminous	24.93	93.28	11	1.6	2,325	274	40
Sub-bituminous	17.25	97.17	11	1.6	1,676	190	28
Lignite	14.21	97.72	11	1.6	1,389	156	23
Mixed (Commercial Sector)	21.39	96.27	11	1.6	2,016	235	34
Mixed (Electric Power Sector)	19.73	95.52	11	1.6	1,885	217	32
Mixed (Industrial Coking)	26.28	93.90	11	1.6	2,468	289	42
Mixed (Industrial Sector)	22.35	94.67	11	1.6	2,116	246	36
Coal Coke	24.80	113.67	11	1.6	2,815	273	40
Other Fuels - Solid							
Municipal Solid Waste	9.95	90.70	32	4.2	902	318	42
Petroleum Coke (Solid)	30.00	102.41	32	4.2	3,072	860	128
Plastics	38.00	75.00	32	4.2	2,850	1,216	160
Tires	28.00	85.97	32	4.2	2,407	896	118
Biomass Fuels - Solid							
Agricultural Byproducts	8.25	118.17	32	4.2	975	264	35
Peat	8.00	111.84	32	4.2	895	256	34
Solid Byproducts	10.39	105.51	32	4.2	1,096	332	44
Wood and Wood Residuals	17.48	93.80	7.2	3.6	1,640	126	63
Natural Gas							
Natural Gas	0.001026	53.06	1.0	0.10	0.05444	0.00103	0.00010
Other Fuels - Gaseous							
Blast Furnace Gas	0.000092	274.32	0.022	0.10	0.02524	0.0000202	0.000009
Coke Oven Gas	0.000599	46.85	0.48	0.10	0.02026	0.000268	0.000060
Fuel Gas	0.001388	59.00	3.0	0.60	0.08189	0.004164	0.000833
Propane Gas	0.002516	61.46	3.0	0.60	0.18463	0.007548	0.001510
Biomass Fuels - Gaseous							
Landfill Gas	0.000485	52.07	3.2	0.63	0.02524	0.001552	0.000306
Other Biomass Gases	0.000655	52.07	3.2	0.63	0.034106	0.002096	0.000413
Petroleum Products							
Asphalt and Road Oil	0.158	75.35	3.0	0.60	11.91	0.47	0.09
Aviation Gasoline	0.120	69.25	3.0	0.60	8.31	0.36	0.07
Butane	0.103	64.77	3.0	0.60	6.87	0.31	0.06
Butylene	0.102	69.72	3.0	0.60	7.22	0.32	0.06
Crude Oil	0.139	74.54	3.0	0.60	10.29	0.41	0.08
Distillate Fuel Oil No. 1	0.139	73.25	3.0	0.60	10.18	0.42	0.08
Distillate Fuel Oil No. 2	0.139	73.96	3.0	0.60	10.21	0.41	0.08
Distillate Fuel Oil No. 4	0.146	75.04	3.0	0.60	10.96	0.44	0.09
Ethane	0.068	59.60	3.0	0.60	4.05	0.20	0.04
Ethylene	0.068	65.96	3.0	0.60	3.83	0.17	0.03
Heavy Gas Oils	0.148	74.92	3.0	0.60	11.09	0.44	0.09
Isobutane	0.099	64.94	3.0	0.60	6.43	0.30	0.06
Isobutylene	0.103	66.86	3.0	0.60	7.09	0.31	0.06
Kerosene	0.135	73.20	3.0	0.60	10.15	0.41	0.08
Kerosene-Type Jet Fuel	0.135	72.22	3.0	0.60	9.75	0.41	0.08
Liquefied Petroleum Gases (LPG)	0.092	61.71	3.0	0.60	5.68	0.28	0.06
Lubricants	0.144	74.27	3.0	0.60	10.69	0.43	0.09
Motor Gasoline	0.125	70.22	3.0	0.60	8.78	0.38	0.08
Naphtha (c-401 den F)	0.125	68.02	3.0	0.60	8.50	0.38	0.08
Natural Gasoline	0.110	66.88	3.0	0.60	7.38	0.33	0.07
Other Oil (c-401 den F)	0.139	75.22	3.0	0.60	10.59	0.42	0.08
Pentanes Plus	0.110	70.02	3.0	0.60	7.70	0.33	0.07
Petrochemical Feedstocks	0.125	71.02	3.0	0.60	8.86	0.38	0.08
Propane	0.091	62.97	3.0	0.60	5.72	0.27	0.05
Propylene	0.091	67.77	3.0	0.60	6.17	0.27	0.05
Residual Fuel Oil No. 5	0.140	72.93	3.0	0.60	10.21	0.42	0.08
Residual Fuel Oil No. 6	0.150	75.10	3.0	0.60	11.27	0.45	0.09
Special Naphtha	0.125	72.34	3.0	0.60	9.04	0.38	0.08
Unfinished Oils	0.139	74.54	3.0	0.60	10.36	0.42	0.08
Used Oil	0.138	74.00	3.0	0.60	10.21	0.41	0.08
Biomass Fuels - Liquid							
Biodiesel (100%)	0.128	73.84	1.1	0.11	9.45	0.14	0.01
Ethanol (100%)	0.084	66.44	-1.1	0.11	5.75	0.09	0.01
Rendized Animal Fat	0.125	73.96	1.1	0.11	9.88	0.14	0.01
Vegetable Oil	0.120	81.55	1.1	0.11	9.79	0.13	0.01
Biomass Fuels - Kraft Pulping Liquor, by Wood Furnish							
North American Softwood		84.4	1.9	0.42			
North American Hardwood		83.7	1.9	0.42			
Baobab		95.5	1.9	0.42			
Bamboo		83.7	1.9	0.42			
Slaw		85.1	1.9	0.42			

Source: Federal Register EPA, 40 CFR Part 98; e-CFR, (see link below). Table C-1 and Table C-2 (78 FR 71950, Nov. 29, 2013, as amended at 81 FR 89252, Dec. 9, 2016), Table AA-1 (78 FR 71965, Nov. 29, 2013). <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98>

Notes: Emission factors are per unit of heat content using higher heating values (HHV). If heat content is available from the fuel supplier, it is preferable to use that value. If not, default heat contents are provided. All CO₂ emission factors assume that 100 percent of the carbon content of the fuel is oxidized to CO₂, as is recommended by the Intergovernmental Panel on Climate Change (IPCC).

The CH₄ and N₂O emission factors provided represent emissions in terms of fuel type and by end-use sector (i.e., residential, commercial, industrial, electricity generation). Please see the Center for Corporate Climate Leadership's guidance document on Direct Emissions from Stationary Combustion Sources for guidance on how to include biomass fuels in an organization's greenhouse gas inventory. <https://www.epa.gov/sites/default/files/2020-12/documents/stationaryemissions.pdf>

The factors represented in the table above represent combustion emissions only and do not represent upstream emissions.

Table 2 Mobile Combustion CO₂

Fuel Type	kg CO ₂ per unit	Unit
Aviation Gasoline	8.31	gallon
Biodiesel (100%)	9.45	gallon
Compressed Natural Gas (CNG)	0.05444	scf
Diesel Fuel	10.21	gallon
Ethanol (100%)	5.75	gallon
Kerosene-Type Jet Fuel	9.75	gallon
Liquefied Natural Gas (LNG)	4.59	gallon
Liquefied Petroleum Gases (LPG)	5.68	gallon
Motor Gasoline	8.78	gallon
Residual Fuel Oil	11.27	gallon

Source: Federal Register EPA, 40 CFR Part 98; e-CFR, (see link below), Table C-1 (78 FR 1950, Nov. 23, 2013, as amended at 81 FR 89252, Dec. 9, 2016) <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98>

Notes: LNG: The factor was developed based on the CO₂ factor (kg CO₂ per mmBtu) for Natural Gas from Table 1 and the higher heating value (HHV) LNG fuel density factor (lb/gallon) from the R&D GREET! 2024 Model, Argonne National Laboratory published January 10, 2025 (Fuel_Specs worksheet).

More information on GREET can be found here: <https://greet.anl.gov/>
Please see the Center for Corporate Climate Leadership's guidance document on Direct Emissions from Stationary Combustion Sources for guidance on how to include biomass fuels in an organization's greenhouse gas inventory. <https://www.eca.gov/sites/default/files/2025-12/documents/stationaryemissions.pdf>
The factors represented in the table above represent combustion emissions only (tank-to-wheel) and do not represent upstream emissions or well-to-wheel emissions.

Table 3 Mobile Combustion CH₄ and N₂O for On-Road Gasoline Vehicles

Vehicle Type	Model Year	CH ₄ Factor (g CH ₄ / vehicle-mile)	N ₂ O Factor (g N ₂ O / vehicle-mile)
Gasoline Passenger Cars	1973-1974	0.1595	0.0197
	1975	0.1423	0.0443
	1976-1977	0.1406	0.0458
	1978-1979	0.1389	0.0473
	1980	0.1326	0.0489
	1981	0.0802	0.0626
	1982	0.0795	0.0627
	1983	0.0782	0.0630
	1984-1993	0.0704	0.0647
	1994	0.0617	0.0603
	1995	0.0531	0.0560
	1996	0.0434	0.0503
	1997	0.0337	0.0446
	1998	0.0240	0.0389
	1999	0.0215	0.0355
	2000	0.0175	0.0304
	2001	0.0105	0.0212
	2002	0.0102	0.0207
	2003	0.0095	0.0181
	2004	0.0078	0.0085
	2005	0.0075	0.0067
	2006	0.0078	0.0075
2007	0.0072	0.0052	
2008	0.0072	0.0049	
2009	0.0071	0.0046	
2010	0.0071	0.0046	
2011	0.0071	0.0046	
2012	0.0071	0.0046	
2013	0.0071	0.0046	
2014	0.0071	0.0046	
2015	0.0068	0.0042	
2016	0.0065	0.0038	
2017	0.0054	0.0018	
2018	0.0052	0.0016	
2019	0.0051	0.0015	
2020	0.0050	0.0014	
2021	0.0051	0.0014	
2022	0.0050	0.0014	
Gasoline Light-Duty Trucks (Vans, Pickup Trucks, SUVs)	1973-1974	0.1908	0.0218
	1975	0.1634	0.0513
	1976	0.1594	0.0555
	1977-1978	0.1614	0.0534
	1979-1980	0.1584	0.0555
	1981	0.1479	0.0680
	1982	0.1442	0.0681
	1983	0.1368	0.0722
	1984	0.1294	0.0764
	1985	0.1220	0.0806
	1986	0.1146	0.0848
	1987-1993	0.0813	0.1038
	1994	0.0646	0.0982
	1995	0.0517	0.0908
	1996	0.0452	0.0871
	1997	0.0452	0.0871
	1998	0.0412	0.0787
	1999	0.0333	0.0618
	2000	0.0340	0.0631
	2001	0.0221	0.0379
	2002	0.0242	0.0424
	2003	0.0221	0.0373
2004	0.0115	0.0088	
2005	0.0105	0.0064	
2006	0.0108	0.0080	
2007	0.0103	0.0061	
2008	0.0095	0.0036	
2009	0.0095	0.0036	
2010	0.0095	0.0036	
2011	0.0096	0.0034	
2012	0.0096	0.0033	
2013	0.0095	0.0035	
2014	0.0095	0.0033	
2015	0.0094	0.0031	
2016	0.0091	0.0029	
2017	0.0084	0.0018	
2018	0.0081	0.0015	
2019	0.0080	0.0013	
2020	0.0079	0.0012	
2021	0.0079	0.0012	
2022	0.0079	0.0012	
Gasoline Heavy-Duty Vehicles	†1980	0.4604	0.0497
	1981-1984	0.4492	0.0538
	1985-1986	0.4090	0.0515
	1987	0.3675	0.0849
	1988-1989	0.3492	0.0933
	1990-1995	0.3246	0.1142
	1996	0.1278	0.1680
	1997	0.0924	0.1726
	1998	0.0855	0.1750
	1999	0.0648	0.1724
	2000	0.0630	0.1660
	2001	0.0577	0.1498
	2002	0.0634	0.1673
	2003	0.0602	0.1553
	2004	0.0288	0.0164
	2005	0.0297	0.0083
	2006	0.0299	0.0241
	2007	0.0322	0.0015
	2008	0.0340	0.0015
	2009	0.0339	0.0015
	2010	0.0320	0.0015
	2011	0.0304	0.0015
2012	0.0313	0.0015	
2013	0.0313	0.0015	
2014	0.0315	0.0015	
2015	0.0322	0.0021	
2016	0.0321	0.0061	
2017	0.0329	0.0084	
2018	0.0326	0.0082	
2019	0.0330	0.0081	
2020	0.0332	0.0100	
2021	0.0332	0.0100	
2022	0.0332	0.0100	
Gasoline Motorcycles	1960-1995	0.0030	0.0000
	1996-2005	0.0070	0.0070
2006-2022	0.0160	0.0460	

Source: EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022 (Annexes). All values are calculated from Tables A-79 through A-83. <https://www.epa.gov/gheissions/inventory-us-greenhouse-gas-emissions-and-sinks>

Notes: The factors represented in the table above represent combustion emissions only (tank-to-wheel) and do not represent upstream emissions or well-to-wheel emissions.

Table 4 Mobile Combustion CH₄ and N₂O for On-Road Diesel and Alternative Fuel Vehicles

Vehicle Type	Fuel Type	Model Year	CH ₄ Factor (g CH ₄ / vehicle-mile)	N ₂ O Factor (g N ₂ O / vehicle-mile)	
Passenger Cars	Diesel	1960-1982	0.0006	0.0012	
		1983-2006	0.0005	0.0010	
		2007-2022	0.0002	0.0002	
Light-Duty Trucks	Diesel	1960-1982	0.0011	0.0017	
		1983-2006	0.0009	0.0014	
		2007-2022	0.0004	0.0004	
Medium- and Heavy-Duty Vehicles	Diesel	1960-2006	0.0061	0.0048	
		2007-2022	0.0095	0.0431	
			0.0120	0.0040	
Light-Duty Cars	Ethanol		0.0120	0.0040	
		CNG		0.1200	0.0040
			LPG	0.0120	0.0040
Light-Duty Trucks	Biodiesel		0.0120	0.0010	
		Ethanol		0.0130	0.0050
			CNG	0.1300	0.0050
Medium-Duty Trucks	LPG		0.0130	0.0050	
		LNG		0.1300	0.0050
			Biodiesel	0.0540	0.0010
Heavy-Duty Trucks	CNG		1.7880	0.0030	
		LPG		1.7880	0.0030
			Biodiesel	0.0030	0.0050
Buses	Methanol		0.0720	0.0250	
		Ethanol		0.0720	0.0250
			CNG	0.9210	0.0170
Buses	LPG		0.0920	0.0170	
		LNG		0.9210	0.0170
			Biodiesel	0.0090	0.0020
Buses	Methanol		0.1300	0.0290	
		Ethanol		0.1300	0.0170
			CNG	2.7190	0.0170
Buses	LPG		0.2720	0.0170	
		LNG		2.7190	0.0170
			Biodiesel	0.0090	0.0030

Source: EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022 (Annexes). All values are calculated from Tables A-84 through A-85. <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks>

Notes:

The factors represented in the table above represent combustion emissions only (tank-to-wheel) and do not represent upstream emissions or well-to-wheel emissions.

Table 5 Mobile Combustion CH₄ and N₂O for Non-Road Vehicles

Vehicle Type	Fuel Type	CH ₄ Factor (g CH ₄ / gallon)	N ₂ O Factor (g N ₂ O / gallon)
Ships and Boats	Residual Fuel Oil	1.10	0.31
	Gasoline (2 stroke)	4.67	0.08
	Gasoline (4 stroke)	2.27	0.01
Locomotives	Diesel	6.51	0.17
	Diesel	0.80	0.26
Aircraft	Jet Fuel	0	0.30
	Aviation Gasoline	7.06	0.11
Agricultural Equipment ^a	Gasoline (2 stroke)	6.50	0.47
	Gasoline (4 stroke)	1.93	0.20
	Gasoline Off-Road Trucks	1.93	1.20
Construction/Mining Equipment ^b	Diesel Equipment	1.26	1.07
	Diesel Off-Road Trucks	0.93	0.56
	LPG	0.33	0.84
Lawn and Garden Equipment	Gasoline (2 stroke)	6.00	0.12
	Gasoline (4 stroke)	2.88	1.48
	Gasoline Off-Road Trucks	2.88	1.48
Airport Equipment	Diesel Equipment	1.01	0.94
	Diesel Off-Road Trucks	0.55	0.56
	LPG	0.69	0.50
Industrial/Commercial Equipment	Gasoline (2 stroke)	7.34	0.31
	Gasoline (4 stroke)	3.02	1.50
	Diesel	0.67	0.49
Logging Equipment	LPG	0.37	0.83
	Gasoline	1.07	1.12
	Diesel	1.58	1.24
Railroad Equipment	LPG	0.37	0.83
	Gasoline (2 stroke)	7.30	0.51
	Gasoline (4 stroke)	2.81	1.57
Recreational Equipment	Diesel	0.93	0.82
	LPG	0.66	0.66
	Gasoline (2 stroke)	6.62	0
Recreational Equipment	Gasoline (4 stroke)	3.22	2.05
	Diesel	0.49	1.26
	Gasoline	3.32	1.86
Recreational Equipment	Diesel	1.41	0.01
	LPG	2.05	0.01
	Gasoline (2 stroke)	6.86	0.11
Recreational Equipment	Gasoline (4 stroke)	2.74	1.48
	Diesel	0.73	0.66
	LPG	0.41	0.81

Source: EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022 (Annexes). All values are calculated from Tables A-86 and A-87. <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks>

Notes:

The factors represented in the table above represent combustion emissions only (tank-to-wheel) and do not represent upstream emissions or well-to-wheel emissions.

^a includes equipment, such as tractors and combines, as well as fuel consumption from trucks that are used off-road in agriculture.

^b includes equipment, such as cranes, dumpers, and excavators, as well as fuel consumption from trucks that are used off-road in construction.

Table 6 Electricity

eGRID Subregion Acronym	eGRID Subregion Name	Total Output Emission Factors			Non-Base-load Emission Factors			Grid Gross Loss (%)
		CO ₂ Factor (lb CO ₂ / MWh)	CH ₄ Factor (lb CH ₄ / MWh)	N ₂ O Factor (lb N ₂ O / MWh)	CO ₂ Factor (lb CO ₂ / MWh)	CH ₄ Factor (lb CH ₄ / MWh)	N ₂ O Factor (lb N ₂ O / MWh)	
AKGD	ASCC Alaska Grid	899.0	0.008	0.012	1.0771	0.116	0.016	4.1%
AKMS	ASCC Miscellaneous	519.4	0.026	0.004	1.548.6	0.067	0.012	4.1%
AZNM	WECC Southwest	749.8	0.041	0.006	1.260.4	0.067	0.009	4.1%
CAMX	WECC California	436.7	0.025	0.003	1.034.0	0.051	0.007	4.1%
ERCT	ERCOG All	736.9	0.043	0.006	1.264.8	0.076	0.010	4.2%
FRCC	FRCC All	891.9	0.042	0.005	1.034.0	0.045	0.006	4.2%
HMS	HCC Miscellaneous	1,122.1	0.146	0.022	1,586.4	0.170	0.027	4.2%
HDA	HCC Ohio	1,489.4	0.154	0.021	1,753.4	0.159	0.025	4.2%
MROE	MRO East	1,402.0	0.116	0.017	1,713.8	0.161	0.023	4.2%
MROW	MRO West	920.0	0.067	0.014	1,776.6	0.180	0.026	4.2%
NEWE	NPCC New England	537.2	0.003	0.008	885.2	0.087	0.009	4.2%
NWPP	WECC Northwest	631.2	0.054	0.008	1,613.4	0.146	0.021	4.1%
NYCW	NPCC NYC/Weichester	874.7	0.025	0.003	1,008.9	0.020	0.002	4.2%
NYLI	NPCC Long Island	1,180.7	0.140	0.018	1,316.6	0.050	0.006	4.2%
NYUP	NPCC Upstate NY	241.0	0.011	0.001	899.1	0.041	0.005	4.2%
PRMS	Puerto Rico Miscellaneous	1,543.0	0.077	0.012	1,638.7	0.072	0.012	4.2%
RFC E	RFC East	584.7	0.036	0.005	1,175.5	0.077	0.010	4.2%
RFCW	RFC Michigan	962.1	0.082	0.011	1,508.1	0.144	0.020	4.2%
RFCW	RFC West	911.3	0.071	0.010	1,757.5	0.161	0.023	4.2%
RMPA	WECC Rockies	1,036.0	0.080	0.013	1,620.6	0.124	0.018	4.1%
SPNO	SPP North	861.9	0.087	0.012	1,832.1	0.188	0.027	4.2%
SPSO	SPP South	891.1	0.055	0.008	1,508.4	0.095	0.013	4.2%
SRMV	SERC Mississippi Valley	739.4	0.032	0.004	1,145.5	0.061	0.008	4.2%
SRMW	SERC Midwest	1,238.3	0.132	0.019	1,818.6	0.180	0.027	4.2%
SRSO	SERC South	849.8	0.055	0.008	1,388.0	0.096	0.014	4.2%
SRTV	SERC Tennessee Valley	895.7	0.079	0.011	1,665.6	0.154	0.022	4.2%
SRVC	SERC Virginia/Carolina	590.2	0.045	0.006	1,286.8	0.100	0.014	4.2%
US Average	US Average	771.5	0.067	0.008	1,383.7	0.104	0.015	4.2%

Source: EPA eGRID2023, January 2025 (Summary Tables - Table 1. Subregion Output Emission Rates) https://www.epa.gov/system/files/documents/2025-01/eGRID2023_summary_tables.xlsx

Notes:

Total output emission factors can be used as default factors for estimating GHG emissions from electricity use when developing a carbon footprint or emissions inventory.

Annual non-base-load output emission factors should not be used when developing a carbon footprint or emissions inventory, but can be used to estimate GHG emissions reductions on the grid from changes in electricity use.

Grid gross loss % factors provide the Transmission & Distribution loss rates for electricity only, and should not be applied to scope 2 emissions for an end-user. They can assist in calculating one component of Scope 3 Fuel- and Energy-Related Activities emissions, Activity C.

For technical information, reference the EPA's eGRID Technical Guide: https://www.epa.gov/system/files/documents/2025-01/eGRID2023_technical_guide.pdf

The factors represented in the table above represent combustion emissions only (tank-to-wheel) and do not represent upstream emissions or well-to-wheel emissions.

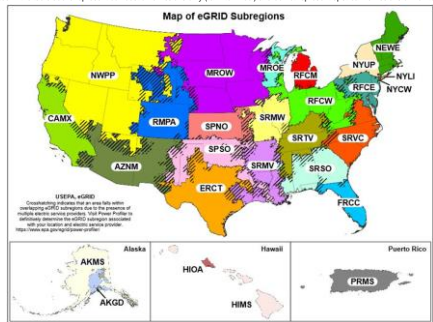


Table 7 Steam and Heat

	CO ₂ Factor (kg CO ₂ / mmBtu)	CH ₄ Factor (g CH ₄ / mmBtu)	N ₂ O Factor (g N ₂ O / mmBtu)
Steam and Heat	66.33	1.250	0.125

Notes:
Emission factors are per mmBtu of steam or heat purchased. These factors assume natural gas fuel is used to generate steam or heat at 80 percent thermal efficiency. The factors represented in the table above represent combustion emissions only (tank-to-wheel) and do not represent upstream emissions or well-to-wheel emissions.

Scope 3 Emission Factors

Scope 3 emission factors provided below are aligned with the Greenhouse Gas Protocol Technical Guidance for Calculating Scope 3 Emissions, version 1.0 (Scope 3 Calculation Guidance). Where applicable, the specific calculation method is referenced. Refer to the Scope 3 Calculation Guidance for more information:
<http://www.ghaprotocol.org/scope-3-technical-calculation-guidance>

Table 8 Scope 3 Category 4: Upstream Transportation and Distribution and Category 9: Downstream Transportation and Distribution

These factors are intended for use in the distance-based method defined in the Scope 3 Calculation Guidance. If fuel data are available, then the fuel-based method should be used, with factors from Tables 2 through 5.

Vehicle Type	CO ₂ Factor (kg CO ₂ / unit)	CH ₄ Factor (g CH ₄ / unit)	N ₂ O Factor (g N ₂ O / unit)	Units
Medium- and Heavy-Duty Truck	1.248	0.0115	0.0378	vehicle-mile
Passenger Car ^A	0.297	0.0059	0.0053	vehicle-mile
Light-Duty Truck ^B	0.354	0.0105	0.0088	vehicle-mile
Medium- and Heavy-Duty Truck ^C	0.186	0.0016	0.0054	short ton-mile
Rail	0.021	0.0015	0.0005	short ton-mile
Waterborne Craft	0.077	0.0310	0.0030	short ton-mile
Aircraft	1.088	0	0.0334	short ton-mile

Source:
CO₂, CH₄, and N₂O emissions data for on-road vehicles are from Table 2-13 of the EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022.
Vehicle-mile data for on-road vehicles are from Tables A-71- A-73 of the EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022 (Annexes).
CO₂e emissions data for non-road vehicles are based on Table A-93 of the EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022 (Annexes), which are distributed into CO₂, CH₄, and N₂O emissions based on fuel/vehicle emission factors. Freight ton-mile data are from Table 1-50 of the Bureau of Transportation Statistics, National Transportation Statistics (2024); 2022 data.
Notes:
Vehicle-mile factors are appropriate to use when the entire vehicle is dedicated to transporting the reporting company's product. Ton-mile factors are appropriate when the vehicle is shared with products from other companies. The factors represented in the table above represent combustion emissions only (tank-to-wheel) and do not represent upstream emissions or well-to-wheel emissions.
^A Passenger cars are automobiles used primarily to transport 12 people or less for personal travel, and are less than 8,500 lbs. in gross vehicle weight.
^B Light-duty trucks are vehicles that primarily transport passengers such as sport utility vehicles (SUVs) and minivans. This category also includes vehicles used for transporting light-weight cargo which are equipped with special features such as four-wheel drive for off-road operation. The gross vehicle weight normally ranges around 8,500 pounds or less.
^C Medium- and heavy-duty trucks are vehicles with a gross vehicle weight of more than around 8,500 pounds, such as single unit trucks, combination trucks, tractor-trailers, and box trucks used for freight transportation. In addition, this category includes some vehicles that are not typically used for freight movement such as service and utility trucks.

Table 9 Scope 3 Category 5: Waste Generated in Operations and Category 12: End-of-Life Treatment of Sold Products

These factors are intended for use in the waste-type-specific method or the average-data method defined in the Scope 3 Calculation Guidance for category 5 and category 12. Choose the appropriate material and disposal method from the table below. For the average-data method, use one of the mixed material types, such as mixed MSW.

Material	Metric Tons CO ₂ e / Short Ton Material					
	Recycled ^A	Landfilled ^B	Combusted ^C	Composted ^D	Anaerobically Digested (Dry Digestate with Curing)	Anaerobically Digested (Wet Digestate with Curing)
Aluminum Cans	0.06	0.02	0.01	NA	NA	NA
Aluminum Ingot	0.04	0.02	0.01	NA	NA	NA
Steel Cans	0.32	0.02	0.01	NA	NA	NA
Copper Wire	0.18	0.02	0.01	NA	NA	NA
Glass	0.05	0.02	0.01	NA	NA	NA
HDPE	0.21	0.02	2.80	NA	NA	NA
LDPE	NA	0.02	2.80	NA	NA	NA
PET	0.23	0.02	2.05	NA	NA	NA
LDPE	NA	0.02	2.80	NA	NA	NA
PP	0.20	0.02	2.80	NA	NA	NA
PS	NA	0.02	3.02	NA	NA	NA
PVC	NA	0.02	1.26	NA	NA	NA
PLA	NA	0.02	0.01	0.13	NA	NA
Corrugated Containers	0.11	1.00	0.05	NA	NA	NA
Magazines/Third-class mail	0.02	0.46	0.05	NA	NA	NA
Newspaper	0.02	0.39	0.05	NA	NA	NA
Office Paper	0.02	1.41	0.05	NA	NA	NA
Phonebooks	0.04	0.39	0.05	NA	NA	NA
Textbooks	0.04	1.41	0.05	NA	NA	NA
Dimensional Lumber	NA	0.17	0.05	NA	NA	NA
Medium-density Fiberboard	NA	0.07	0.05	NA	NA	NA
Food Waste (non-meat)	NA	0.87	0.05	0.11	0.14	0.11
Food Waste (meat only)	NA	0.69	0.05	0.11	0.14	0.11
Beef	NA	0.64	0.05	0.11	0.14	0.11
Butlry	NA	0.73	0.05	0.11	0.14	0.11
Grains	NA	2.08	0.05	0.11	0.14	0.11
Bread	NA	1.49	0.05	0.11	0.14	0.11
Fruits and Vegetables	NA	0.28	0.05	0.11	0.14	0.11
Dairy Products	NA	0.72	0.05	0.11	0.14	0.11
Yard Trimmings	NA	0.36	0.05	0.14	0.11	NA
Grass	NA	0.28	0.05	0.14	0.09	NA
Leaves	NA	0.28	0.05	0.14	0.12	NA
Branches	NA	0.58	0.05	0.14	0.15	NA
Mixed Paper (general)	0.07	0.89	0.05	NA	NA	NA
Mixed Paper (primarily residential)	0.07	0.86	0.05	NA	NA	NA
Mixed Paper (primarily from offices)	0.03	0.84	0.05	NA	NA	NA
Mixed Metals	0.23	0.02	0.01	NA	NA	NA
Mixed Plastics	0.22	0.02	2.34	NA	NA	NA
Mixed Recyclables	0.09	0.75	0.11	NA	NA	NA
Food Waste	NA	0.68	0.05	0.11	0.14	NA
Mixed Organics	NA	0.54	0.05	0.13	0.14	NA
Mixed MSW	NA	0.58	0.43	NA	NA	NA
Carpet	NA	0.02	1.68	NA	NA	NA
Desktop CPU	0.01	0.02	0.40	NA	NA	NA
Portable Electronic Devices	0.02	0.02	0.88	NA	NA	NA
Flat-panel Displays	0.02	0.02	0.74	NA	NA	NA
CRT Displays	NA	0.02	0.64	NA	NA	NA
Electronic Peripherals	0.05	0.02	2.23	NA	NA	NA
Hard-copy Devices	0.01	0.02	1.92	NA	NA	NA
Mixed Electronics	0.02	0.02	0.96	NA	NA	NA
Clay Bricks	NA	0.02	NA	NA	NA	NA
Concrete	0.01	0.02	NA	NA	NA	NA
Fly Ash	0.01	0.02	NA	NA	NA	NA
Tires	0.10	0.02	2.21	NA	NA	NA
Asphalt Concrete	0.04	0.02	NA	NA	NA	NA
Asphalt Shingles	0.03	0.02	0.70	NA	NA	NA
Drywall	NA	0.02	NA	NA	NA	NA
Fiberglass Insulation	0.05	0.02	NA	NA	NA	NA
Structural Steel	0.04	0.02	NA	NA	NA	NA
Vinyl Flooring	NA	0.02	0.29	NA	NA	NA
Wood Flooring	NA	0.18	0.08	NA	NA	NA

Source:
U.S. Environmental Protection Agency, Office of Resource Conservation and Recovery (December 2023) Documentation for Greenhouse Gas Emission and Energy Factors used in the Waste Reduction Model (WARM). Factors from tables provided in the Management Practices Chapters and Background Chapters.

Notes:
These factors do not include avoided emissions impact from any of the disposal methods. This exclusion is an adjustment to the life-cycle factors in the WARM tool. Thus the waste factors presented above will not directly match the factors published in the WARM tool. All the factors presented above include transportation emissions, which are optional in the Scope 3 Calculation Guidance, with an assumed average distance traveled to the processing facility.
ARI GHG values are used to convert all waste emission factors into CO₂e.
Short ton = 2000 lbs.
^A Recycling emissions do not include avoided emissions associated with process energy, transportation energy, process non-energy, or forest carbon storage. Recycling emissions include transport to recycling facility and sorting of recycled materials at material recovery facility.
^B Landfilling emissions do not include avoided emissions associated with energy recovery or landfill carbon sequestration. Landfilling emissions include transport to landfill, equipment use at landfill, and landfill CH₄ emissions from anaerobic decomposition of biogenic carbon compounds. Landfill CH₄ is based on typical landfill gas collection practices, average landfill moisture conditions, and U.S.-average non-baseload electricity grid mix.
^C Combustion emissions do not include avoided emissions associated with displaced electric utility generation or decreased energy requirements for production processes using recycled inputs. Combustion emissions include transport to waste-to-energy facility and combustion-related non-biogenic CO₂ and N₂O.
^D Composting emissions do not include avoided emissions associated with fertilizer offset or soil carbon storage. Composting emissions include transport to compost facility, equipment use at compost facility, and CH₄ and N₂O emissions during composting.
^E Anaerobically Digested (Dry and Wet Digestate with Curing) emissions do not include avoided emissions associated with displaced electric utility generation, soil carbon storage, or avoided fertilizer application. Anaerobically Digested (Dry and Wet Digestate with Curing) emissions include transport to the anaerobic digester facility, equipment use at the anaerobic digester facility, biogas leakage at the digester, emissions released during the curing and land application process, and fugitive emissions during the curing and after land application.

Table 10 Scope 3 Category 6: Business Travel and Category 7: Employee Commuting

These factors are intended for use in the distance-based method defined in the Scope 3 Calculation Guidance. If fuel data are available, then the fuel-based method should be used, with factors from Tables 2 through 5.

Vehicle Type	CO ₂ Factor (kg CO ₂ / unit)	CH ₄ Factor (g CH ₄ / unit)	N ₂ O Factor (g N ₂ O / unit)	Units
Passenger Car ^a	0.257	0.0059	0.0053	vehicle-mile
Light-Duty Truck ^b	0.384	0.0109	0.0108	vehicle-mile
Motorcycle	0.388	0.0888	0.0188	vehicle-mile
Intercity Rail - Northeast Corridor ^c	0.023	0.0010	0.0001	passenger-mile
Intercity Rail - Other Routes ^c	0.149	0.0120	0.0040	passenger-mile
Intercity Rail - National Average ^c	0.098	0.0060	0.0020	passenger-mile
Commuter Rail ^d	0.153	0.0105	0.0026	passenger-mile
Transit Rail (i.e. Subway, Tram) ^e	0.083	0.0075	0.0010	passenger-mile
Bus	0.066	0.0046	0.0019	passenger-mile
Air Travel - Short Haul (< 300 miles)	0.207	0.0064	0.0066	passenger-mile
Air Travel - Medium Haul (>= 300 miles, < 2300 miles)	0.129	0.0006	0.0041	passenger-mile
Air Travel - Long Haul (>= 2300 miles)	0.163	0.0006	0.0052	passenger-mile

Source:

CO₂, CH₄, and N₂O emissions data for highway vehicles are from Table 2-13 of the EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022. Vehicle-miles data for on-road vehicles are from Tables A-71 - A-73 of the EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022 (Annexes). Passenger-miles data for buses are from Table MA.1 of the Federal Highway Administration Highway Statistics (2024): 2022 data. Fuel consumption data and passenger-miles data for rail are from Tables A.14 - A.16, 10-10, and 7.3 - 7.4 of the Transportation Energy Data Book: Edition 40 (2022): 2019 data. Fuel consumption was converted to emissions by using fuel and electricity emission factors presented in the tables above. Intercity Rail factors from communication with Amtrak, December 2024, based on 2023 data. Air Travel factors from 2022 Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting, Version 2.0 June 2022. Defra air travel emission factors held constant from 2022 release (2018 activity data) to more accurately reflect the current state of business travel as the 2023 and 2024 Defra release reflects significantly reduced load factors during COVID-19.

Notes:

- The factors represented in the table above represent combustion emissions only (tank-to-wheel) and do not represent upstream emissions or well-to-wheel emissions.
- ^a Passenger cars are automobiles used primarily to transport 12 people or less for personal travel, and are less than 8,500 lbs in gross vehicle weight.
- ^b Light-duty trucks are vehicles that primarily transport passengers such as sport utility vehicles (SUVs) and minivans. This category also includes vehicles used for transporting light-weight cargo which are equipped with special features such as four-wheel drive for off-road operation. The gross vehicle weight normally ranges around 8,500 pounds or less.
- ^c Intercity rail: Amtrak long-distance rail between major cities. Northeast Corridor extends from Boston to Washington D.C. Other Routes are all routes outside the Northeast Corridor.
- ^d Commuter rail: rail service between a central city and adjacent suburbs (also called regional rail or suburban rail).
- ^e Transit rail: rail typically within an urban center, such as subways, elevated railways, metropolitan railways (metro), streetcars, trolley cars, and tramsways.

Global Warming Potential

Table 11 Global Warming Potential (GWP)

Industrial Designation or Common Name	Chemical Formula	100-Year GWP
Carbon dioxide	CO ₂	1
Methane	CH ₄	28
Nitrous oxide	N ₂ O	265
HFC-23	CHF ₃	12,400
HFC-32	CH ₂ F ₂	677
HFC-41	CH ₃ F	116
HFC-125	CHF ₂ CF ₃	3,170
HFC-134	CHF ₂ CH ₂ F	1,120
HFC-134a	CH ₂ FCF ₂	1,300
HFC-143	CH ₂ CHF ₂	328
HFC-143a	CH ₃ CF ₃	4,800
HFC-152	CH ₂ CH ₂ F ₂	16
HFC-152a	CH ₂ CHF ₂	138
HFC-191	CH ₃ CH ₂ F	4
HFC-227aa	CF ₃ CH ₂ CF ₃	3,300
HFC-236cb	CH ₂ CF ₂ CF ₃	1,210
HFC-236ea	CHF ₂ CH ₂ CF ₃	1,330
HFC-236fa	CF ₃ CH ₂ CF ₃	8,060
HFC-245ca	CH ₂ FCF ₂ CH ₂ F	716
HFC-245fa	CHF ₂ CH ₂ CF ₃	858
HFC-365mle	CH ₂ CF ₂ CH ₂ CF ₃	804
HFC-43-10mea	CF ₃ CH ₂ CH ₂ CF ₂ CF ₃	1,850
Sulfur hexafluoride	SF ₆	23,500
Nitrogen trifluoride	NF ₃	16,100
PFC-14	CF ₄	6,630
PFC-116	C ₂ F ₆	11,100
PFC-218	C ₃ F ₈	8,900
PFC-318	c-C ₃ F ₈	9,540
PFC-4110	C ₄ F ₁₀	9,200
PFC-4112	C ₄ F ₁₂	8,550
PFC-61-14	C ₆ F ₁₄	7,910
PFC-61-18	C ₆ F ₁₈	7,190

Source:


100-year GWP values from IPCC Fifth Assessment Report (AR5), 2013, Chapter 8, Table A.8.1, Lifetimes, Radiative Efficiencies and Metric Values. IPCC AR5 was published in 2013 and is among the most current and comprehensive peer-reviewed assessments of climate change. AR5 provides revised GWP values of several GHGs relative to the values provided in previous assessment reports, following advances in scientific knowledge on the radiative efficiencies and atmospheric lifetimes of these GHGs.

Table 12 Global Warming Potential (GWP) for Blended Refrigerants

ASHRAE #	100-year GWP	Blend Composition
R-401A	18	53% HCFC-22, 34% HCFC-124, 13% HFC-152a
R-401B	15	51% HCFC-22, 28% HCFC-124, 11% HFC-152a
R-401C	21	33% HCFC-22, 52% HCFC-124, 15% HFC-152a
R-402A	1,902	38% HCFC-22, 60% HFC-125, 2% propane
R-402B	1,208	50% HCFC-22, 38% HFC-125, 2% propane
R-403B	3,471	56% HCFC-22, 38% PFC-218, 5% propane
R-404A	3,943	44% HFC-125, 4% HFC-134a, 52% HFC-143a
R-406A	0	50% HFC-22, 41% HFC-142b, 4% isobutane
R-407A	1,923	20% HFC-32, 40% HFC-125, 40% HFC-134a
R-407B	2,547	10% HFC-32, 70% HFC-125, 20% HFC-134a
R-407C	1,624	23% HFC-32, 25% HFC-125, 52% HFC-134a
R-407D	1,487	15% HFC-32, 15% HFC-125, 70% HFC-134a
R-408A	2,430	47% HCFC-22, 7% HFC-125, 46% HFC-143a
R-409A	0	60% HCFC-22, 25% HCFC-124, 15% HCFC-142b
R-410A	1,924	50% HFC-32, 50% HFC-125
R-410B	2,048	45% HFC-32, 55% HFC-125
R-411A	15	87.5% HCFC-22, 11% HFC-152a, 1.5% pentafluoroethane
R-411B	4	84% HCFC-22, 3% HFC-152a, 3% propylene
R-414A	0	51% HCFC-22, 28.5% HCFC-124, 16.5% HCFC-142b, 4% isobutane
R-414B	0	50% HCFC-22, 39% HCFC-124, 9.5% HCFC-142b, 1.5% isobutane
R-417A	2,127	46.6% HFC-125, 50% HFC-134a, 3.4% butane
R-422A	2,847	85.1% HFC-125, 11.5% HFC-134a, 3.4% isobutane
R-422D	2,473	85.1% HFC-125, 31.5% HFC-134a, 3.4% isobutane
R-424A	3,104	50.5% HFC-125, 47% HFC-134a, 1% butane, 0.9% isobutane, 0.6% isopentane
R-426A	1,371	5.1% HFC-125, 83% HFC-134a, 1.3% butane, 0.6% isobutane
R-428A	3,417	17.5% HFC-125, 20% HFC-143a, 1.8% isobutane, 0.6% propane
R-434A	3,075	63.2% HFC-125, 16% HFC-134a, 18% HFC-143a, 2.8% isobutane
R-507A	3,985	50% HFC-125, 50% HFC-143a
R-508A	11,607	30% HFC-23, 61% PFC-116
R-508B	11,698	46% HFC-23, 54% PFC-116

Source:

100-year GWP values from IPCC Fifth Assessment Report (AR5), 2013, Chapter 8, Table A.8.1, Lifetimes, Radiative Efficiencies and Metric Values. GWP values of blended refrigerants are based only on their HFC and PFC constituents, which are based on data from <https://www.epa.gov/snaps/compositions-refrigerant-blends>.



Appendix B
Asset Score Reports

BUILDING INFORMATION

Baraboo - City Services
450 Roundhouse Ct
Baraboo, WI 53913

Building Type: **Mixed Use**
Gross Floor Area: **66,392 ft²**
Climate Zone: **6A**
Year Built: **2001**

Score Date: **06/05/2025**
Building ID #: **32673**
Climate Description: **Cold - Humid**
Software Release: **2025.0.0.746**

Estimated Annual Site Energy Use Intensity and Greenhouse Gas Intensity

	Site EUI (kBtu/ft ² /yr)	GHGI (kg CO ₂ e/ft ² /yr)
Current	51	6.65
Upgraded	48	5.83

Estimated annual site energy savings: 5.88%

Energy Use Intensity by Fuel Type

Current Building: Site Energy Use (kBtu/ft²/yr)



Upgraded Building: Site Energy Use (kBtu/ft²/yr)



Fuel Type Site EUI (kBtu/ft²) [Current, Upgraded]

- Natural Gas [23.5, 25.8]
- Electricity [27.3, 22.6]
- District Hot Water [0.0, 0.0]
- District Steam [0.0, 0.0]
- Fuel Oil [0.0, 0.0]
- Propane [0.0, 0.0]
- District Chilled Water [0.0, 0.0]

Building Use Types

Warehouse non-refrigerated: **54,172 ft²**
Office: **7,275 ft²**

This report includes a Score for the entire building as well as individual Scores for each of the separate use types.

The **Building Energy Asset Score** is a national rating system developed by the U.S. Department of Energy. The **Score** reflects the energy efficiency of a building based on the building's structure, heating, cooling, ventilation, and hot water systems. The building's **Structure and Systems** are individually evaluated and ranked. The **Upgrade Opportunities** page provides recommendations for how to improve the building's energy efficiency, increase the building's Asset Score, and save money.

³ The energy savings range reflects the expected incremental savings for the overall building associated with the specific efficiency upgrade opportunity assuming all other recommended upgrades have already been implemented. This assumption is made to avoid double counting of savings. The ranges reflect site energy savings and are based on standard operating assumptions, unless actual operating conditions are provided by the user.

⁴ The costs are based on Advanced Energy Retrofit Guide and RS Means. The costs are replacement costs, not incremental costs. The costs do not include local incentives. Costs are shown as a range (\$ = low cost, \$\$ = medium cost, \$\$\$ = high cost).

[†] User-selected energy efficiency measure

Building Name: **Baraboo - City Services**

Gross Floor Area: **61,447 ft²**

Selected Upgrade Opportunities

Energy Savings ³

Cost⁴

Building Envelope

No opportunities identified.

Lighting Systems

No opportunities identified.

HVAC Systems and Controls

- | | | |
|---|--------|-------------|
| <ul style="list-style-type: none"> • Add Variable Frequency Drive (VFD) to Air-handler Supply Fans for Air Loop in blocks Block 3-Office and Block 1-Vehicle Maint for Air Handler.[†] - Learn More | Medium | \$\$-\$\$\$ |
| <ul style="list-style-type: none"> • Replace Existing Packaged Rooftop AC with High-performance Packaged Rooftop AC in blocks Block 3-Office and Block 1-Vehicle Maint for Air Handler.[†] - Learn More | Medium | \$\$-\$\$\$ |

Service Hot Water Systems

No opportunities identified.

³ The energy savings range reflects the expected incremental savings for the overall building associated with the specific efficiency upgrade opportunity assuming all other recommended upgrades have already been implemented. This assumption is made to avoid double counting of savings. The ranges reflect site energy savings and are based on standard operating assumptions, unless actual operating conditions are provided by the user.

⁴ The costs are based on Advanced Energy Retrofit Guide and RS Means. The costs are replacement costs, not incremental costs. The costs do not include local incentives. Costs are shown as a range (\$ = low cost, \$\$ = medium cost, \$\$\$ = high cost).

[†] User-selected energy efficiency measure

Building Name: **Baraboo - City Services**

Gross Floor Area: **61,447 ft²**

Health and Safety Impact of Upgrade Opportunities

Building Envelope

Health and Safety Impact

No opportunities identified.

Lighting Systems

No opportunities identified.

HVAC Systems and Controls

- Add Variable Frequency Drive (VFD) to Air-handler Supply Fans for Air Loop in blocks Block 3-Office and Block 1-Vehicle Maint for Air Handler.†

This measure is not expected to directly impact occupant health and safety. However, it provides smoother HVAC and temperature control. Follow commissioning, operation and maintenance, and performance monitoring best practices to enable efficient operation.

- Replace Existing Packaged Rooftop AC with High-performance Packaged Rooftop AC in blocks Block 3-Office and Block 1-Vehicle Maint for Air Handler.†

Many existing HVAC systems are not providing proper ventilation, filtration, heating, cooling, dehumidification, and are inefficient. HVAC replacement can improve thermal comfort and potentially reduce background noise by selecting equipment that meets the sound specification and with proper installation. In addition, dedicated outdoor air ventilation systems can improve indoor air quality by meeting the minimum outside air ventilation rates and better control of indoor humidity.

Service Hot Water Systems

No opportunities identified.

Building Name: **Baraboo - City Services**

Gross Floor Area: **61,447 ft²**

ABOUT THE BUILDING SYSTEMS

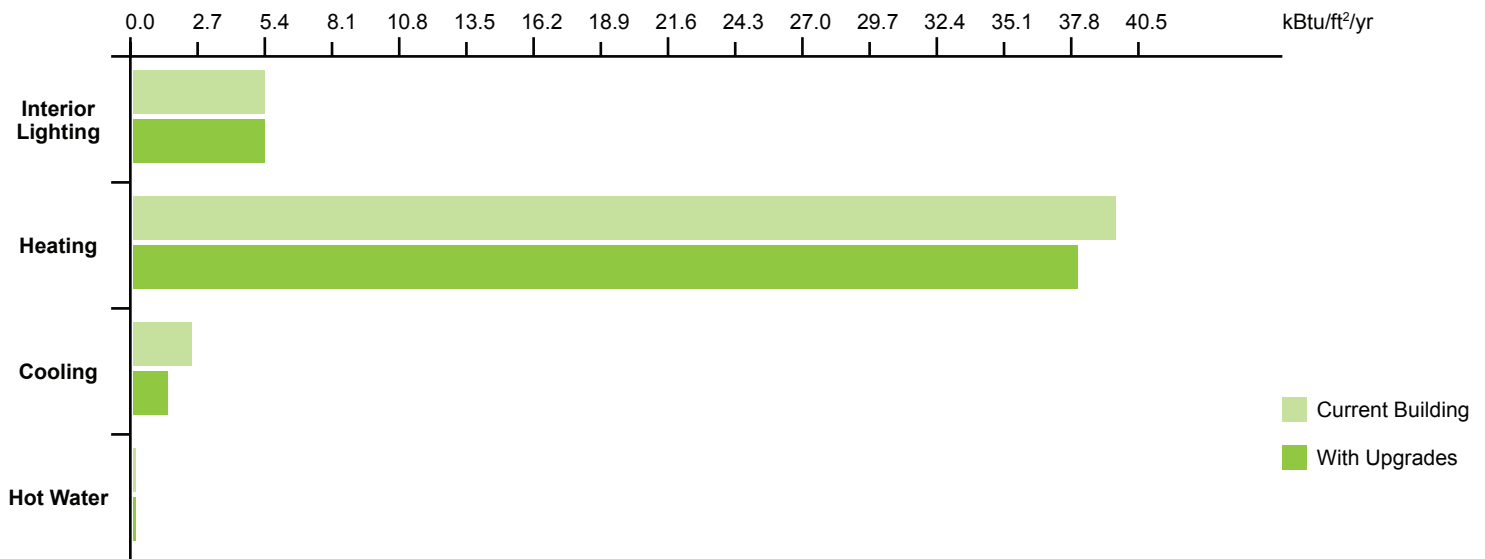
	Ranking ⁵
Interior Lighting	Superior
Whole Building HVAC System TSPR	Superior
Air Handler	N/A

ABOUT THE BUILDING ENVELOPE

	Ranking ⁵
Roof U-Value, Non-Attic (Btu/ft ² ·h·°F)	Fair
Walls U-Value, Framed (Btu/ft ² ·h·°F)	Good
Windows U-Value (Btu/ft ² ·h·°F)	Fair
Walls + Windows U-Value (Btu/ft ² ·h·°F)	Good
Window Solar Heat Gain Coefficient	Fair

*System evaluation is not based on a verified TSPR

SITE ENERGY USE INTENSITY BY END USE



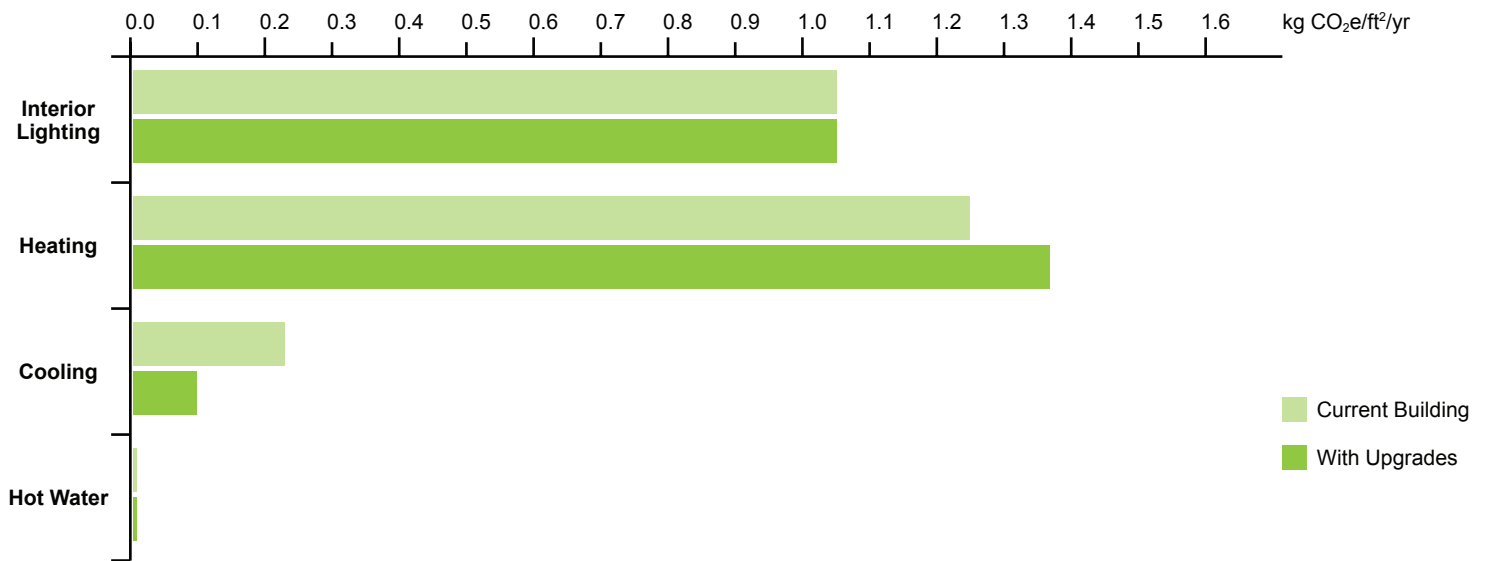
⁵ Ranking Range:

Fair: Building Envelope or Building Systems are less efficient than a typical building built to the AHSRAE 90.1-2004 energy code.
Superior: Building Envelope is more efficient than a typical building built to the AHSRAE 90.1-2013 energy code. Building Systems exceed the highest efficiency levels with market viable technologies.
Good: Building Envelope or Building Systems are between Fair and Superior.
N/A: The building does not have a heating or a cooling system, or the loads are too low for the system to be effectively ranked.

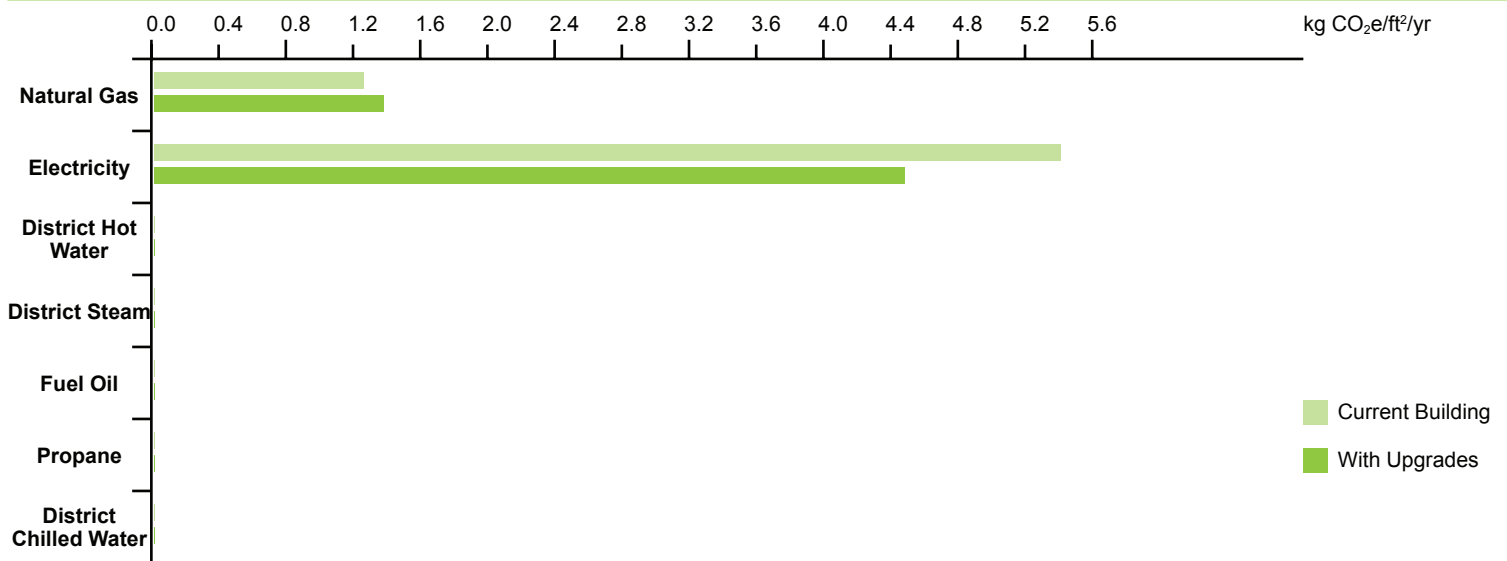
Building Name: **Baraboo - City Services**

Gross Floor Area: **61,447 ft²**

CARBON EMISSIONS BY END USE⁶



CARBON EMISSIONS BY FUEL TYPE⁶



⁶ Carbon dioxide equivalent (CO₂e) greenhouse gas annual emission rates are calculated by multiplying the annual energy use rates for each end use and fuel type by emission factors that are specific to each fuel type and then by dividing by the total floor area for the affected blocks. The emission factors for electricity are provided by U.S. EPA Power Profiler v9.1 and are specific to the eGRID subregions that are assigned to the ZIP code for the building. The emissions factors for electricity do not include gross grid loss (line loss).

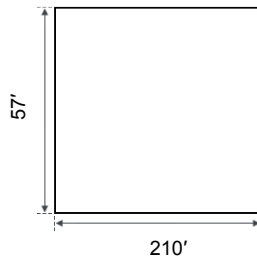
Building Name: **Baraboo - City Services**

Gross Floor Area: **61,447 ft²**

Block 1-Vehicle Maint CHARACTERISTICS SUMMARY

Geometry

Above Ground: 1 floor
Below Ground: 0 floors
Floor-to-Floor Height: 29.50 ft
Floor-to-Ceiling: 28.00 ft
Height:
Orientation: 0.0° from North
Use Type: Warehouse non-refrigerated



Current Building

Roof

Roof	Roof 1-Flat
Roof Type	Built-up w/ metal deck
Roof Insulation Thickness	3.0 in

Skylights

No Skylights

Floor

Floor	Floor 1
Floor Type	Slab-on-Grade
Slab Insulation	Vertical Insulation
Floor R-value	7.5 °F·ft ² ·h/Btu

Walls and Windows

All Surfaces

Wall	Wall 2-Metal
Wall Type	Metal panel/Curtain Wall
Wall Insulation Thickness	6.0 in

No Windows

Infiltration

Energy code the building complies with	Estimated ¹
--	------------------------

Current Building

Lighting

Lighting Power Density	0.52 W/ft ²
Fixture	Fixture 1-LED
Lighting Type	LED
Mounting Type	Pendant
Lamp Wattage	20 W/lamp
Lamps per Fixture	2
Percent Served	100.0%
Occupancy Controls	

Heating/Cooling

Thermal Zone Layout	Single zone
Primary Heating/Cooling System	Air Handler
System Type	Pkgd AC
Cooling Equipment	
Cooling Source	Central DX
Efficiency	Estimated ¹

Heating Equipment

Heating Source	Central Furnace
Fuel Type	Natural Gas
Thermal Efficiency	Estimated ¹

Distribution

Distribution Type	Single Zone
-------------------	-------------

Fan Systems

Total System Fan Power	Default ³
Fan Control	Constant Volume

Service Water Heating

No Water Heater

Operations

Operation	Using Standard Operations ²
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Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
² Window includes all vertical fenestration, including curtainwall and storefront.
³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

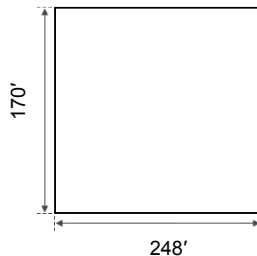
Building Name: **Baraboo - City Services**

Gross Floor Area: **61,447 ft²**

Block 2-Vehicle Storage CHARACTERISTICS SUMMARY

Geometry

Above Ground: 1 floor
 Below Ground: 0 floors
 Floor-to-Floor Height: 23.50 ft
 Floor-to-Ceiling: 21.00 ft
 Height:
 Orientation: 0.0° from North
 Use Type: Warehouse non-refrigerated



Current Building

Roof

Roof	Roof 1-Flat
Roof Type	Built-up w/ metal deck
Roof Insulation Thickness	3.0 in

Skylights

No Skylights

Floor

Floor	Floor 1
Floor Type	Slab-on-Grade
Slab Insulation	Vertical Insulation
Floor R-value	7.5 °F·ft ² ·h/Btu

Walls and Windows

All Surfaces

Wall	Wall 1-CMU
Wall Type	Brick/Stone on masonry
Wall Insulation Thickness	1.0 in
Window	Window 1
Window Framing Type	Metal w/ Thermal Breaks
Window Glass Type	Double Pane
Window Gas Fill Type	Default ³
Intended Occupancy Type	Non-Residential

Current Building

Window SHGC	Estimated ¹
Window VT	Estimated ¹
Window Layout	Discrete
Number of Windows	3
Window Width	4.659999847412109 ft
Window Height	6.0 ft
Exterior Shading Type	No Shading

Infiltration

Energy code the building complies with	Estimated ¹
--	------------------------

Lighting

Lighting Power Density	0.52 W/ft ²
------------------------	------------------------

Fixture

Fixture	Fixture 1-LED
Lighting Type	LED
Mounting Type	Pendant
Lamp Wattage	20 W/lamp
Lamps per Fixture	2
Percent Served	100.0%

Occupancy Controls

Heating/Cooling

Thermal Zone Layout	Single zone
---------------------	-------------

Primary Heating/Cooling System

System Type	Warm Air Furnace
-------------	------------------

Cooling Equipment

Cooling Source	No Cooling
----------------	------------

Heating Equipment

Heating Source	Central Furnace
Fuel Type	Natural Gas
Thermal Efficiency	Estimated ¹

Distribution

Distribution Type	Single Zone
-------------------	-------------

Notes:

- ¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
- ² Window includes all vertical fenestration, including curtainwall and storefront.
- ³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

Building Name: **Baraboo - City Services**

Gross Floor Area: **61,447 ft²**

Current Building

Fan Systems

Total System Fan Power	Default ^{***}
Fan Control	Constant Volume

Service Water Heating

No Water Heater

Operations

Operation	Using Standard Operations ^{**}
-----------	---

Notes:

- ¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
- ² Window includes all vertical fenestration, including curtainwall and storefront.
- ³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

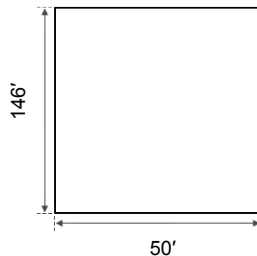
Building Name: **Baraboo - City Services**

Gross Floor Area: **61,447 ft²**

Block 3-Office CHARACTERISTICS SUMMARY

Geometry

Above Ground: 1 floor
Below Ground: 0 floors
Floor-to-Floor Height: 14.00 ft
Floor-to-Ceiling Height: 10.00 ft
Orientation: 0.0° from North
Use Type: Office



Current Building

Roof

Roof	Roof 1-Flat
Roof Type	Built-up w/ metal deck
Roof Insulation Thickness	3.0 in

Skylights

No Skylights

Floor

Floor	Floor 1
Floor Type	Slab-on-Grade
Slab Insulation	Vertical Insulation
Floor R-value	7.5 °F·ft ² ·h/Btu

Walls and Windows

Surface 1

Wall	Wall 1-CMU
Wall Type	Brick/Stone on masonry
Wall Insulation Thickness	1.0 in
Window	Window 1
Window Framing Type	Metal w/ Thermal Breaks
Window Glass Type	Double Pane
Window Gas Fill Type	Default ^{***}
Intended Occupancy Type	Non-Residential
Window SHGC	Estimated [†]

Window VT	Estimated [†]
Window Layout	Discrete
Number of Windows	3
Window Width	4.659999847412109 ft
Window Height	6.0 ft
Exterior Shading Type	No Shading

Surface 2

Wall	Wall 1-CMU
Wall Type	Brick/Stone on masonry
Wall Insulation Thickness	1.0 in
Window	Window 1
Window Framing Type	Metal w/ Thermal Breaks
Window Glass Type	Double Pane
Window Gas Fill Type	Default ^{***}
Intended Occupancy Type	Non-Residential

Window SHGC	Estimated [†]
Window VT	Estimated [†]
Window Layout	Discrete
Number of Windows	3
Window Width	4.659999847412109 ft
Window Height	6.0 ft
Exterior Shading Type	No Shading

Surface 3

Wall	Wall 1-CMU
Wall Type	Brick/Stone on masonry
Wall Insulation Thickness	1.0 in
Window	Window 1
Window Framing Type	Metal w/ Thermal Breaks
Window Glass Type	Double Pane
Window Gas Fill Type	Default ^{***}
Intended Occupancy Type	Non-Residential
Window SHGC	Estimated [†]

Notes:

- [†] Total Gross Wall Area[†] includes both opaque and glazed wall area.
- ² Window includes all vertical fenestration, including curtainwall and storefront.
- ³ Total Gross Roof Area[†] includes both opaque and glazed roof area.

Building Name: **Baraboo - City Services**

Gross Floor Area: **61,447 ft²**

	Current Building		Current Building
Window VT	Estimated ¹	Percent Served	100.0%
Window Layout	Discrete	Heating/Cooling	
Number of Windows	2	Thermal Zone Layout	Perimeter and core
Window Width	4.659999847412109 ft	Perimeter Zone Depth	15.0 ft
Window Height	6.0 ft	Primary Heating/Cooling System	Air Handler
Exterior Shading Type	No Shading	System Type	Pkgd AC
Surface 4		Cooling Equipment	
Wall	Wall 1-CMU	Cooling Source	Central DX
Wall Type	Brick/Stone on masonry	Efficiency	Estimated ¹
Wall Insulation Thickness	1.0 in	Heating Equipment	
Window	Window 1	Heating Source	Central Furnace
Window Framing Type	Metal w/ Thermal Breaks	Fuel Type	Natural Gas
Window Glass Type	Double Pane	Thermal Efficiency	Estimated ¹
Window Gas Fill Type	Default ³	Distribution	
Intended Occupancy Type	Non-Residential	Distribution Type	Single Zone
Window SHGC	Estimated ¹	Fan Systems	
Window VT	Estimated ¹	Total System Fan Power	Default ³
Window Layout	Discrete	Fan Control	Constant Volume
Number of Windows	2	Service Water Heating	
Window Width	4.659999847412109 ft	Water Heater	Natural Gas
Window Height	6.0 ft	Fuel Type	Natural Gas
Exterior Shading Type	No Shading	Water Heater Efficiency	80.00 Et
Infiltration		Operations	
Energy code the building complies with	Estimated ¹	Operation	Using Standard Operations ²
Lighting			
Lighting Power Density	0.57 W/ft ²		
Fixture	Fixture 1-LED		
Lighting Type	LED		
Mounting Type	Pendant		
Lamp Wattage	20 W/lamp		
Lamps per Fixture	2		

Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

Building Name: **Baraboo - City Services**

Gross Floor Area: **61,447 ft²**

BUILDING ENVELOPE INFORMATION

Total Gross Above Grade Wall Area ¹	27636.0 ft ²
Total Window Area ²	615.0 ft ²
Building Window to Wall Ratio	2%
Total Below Grade Wall Area	0.0 ft ²
Total Gross Roof Area ³	65714.0 ft ²
Total Skylight Area	0.0 ft ²
Total Conditioned Floor Area	Not Available
Total Footprint Area	Not Available

Areas by Orientation

NORTH

Gross Wall Area 7788.0 ft²

Window Area 167.4 ft²

SOUTH

Gross Wall Area 7788.0 ft²

Window Area 223.5 ft²

EAST

Gross Wall Area 6030.0 ft²

Window Area 139.9 ft²

WEST

Gross Wall Area 6030.0 ft²

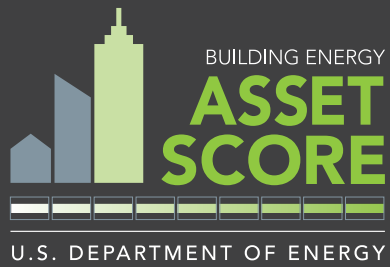
Window Area 83.8 ft²

Notes:

¹ 'Total Gross Wall Area' includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ 'Total Gross Roof Area' includes both opaque and glazed roof area.



Building Assessment Tool Report

Software Provenance

Building Name: **Baraboo - City Services**

Gross Floor Area: **61,447 ft²**

SOFTWARE PROVENANCE

Asset Score/Audit Template	Version: 2025.0.0.746 Build: master_746
Open Studio	3.7.0;
Energy-Plus	23.2;
Asset Score Open Studio Web Service	Asset Score Open Studio Web Service, Version 3.0.9197.20730, Friday, March 7, 2025 11:31:00 AM
Open Studio Simulation	Release_7.1.24_20250428.0

BUILDING INFORMATION

Baraboo - Civic Center
124 2nd St
Baraboo, WI 53913

Building Type: **Mixed Use**
Gross Floor Area: **52,903 ft²**
Climate Zone: **6A**
Year Built: **2012**

Score Date: **06/05/2025**
Building ID #: **32466**
Climate Description: **Cold - Humid**
Software Release: **2025.0.0.746**

Estimated Annual Site Energy Use Intensity and Greenhouse Gas Intensity

	Site EUI (kBtu/ft ² /yr)	GHGI (kg CO ₂ e/ft ² /yr)
Current	59	10.49
Upgraded	43	8.57

Estimated annual site energy savings: 27.12%

Energy Use Intensity by Fuel Type

Current Building: Site Energy Use (kBtu/ft²)



Upgraded Building: Site Energy Use (kBtu/ft²)



Fuel Type Site EUI (kBtu/ft²) [Current, Upgraded]

- Natural Gas [7.8, 0.0]
- Electricity [51.0, 43.3]
- District Hot Water [0.0, 0.0]
- District Steam [0.0, 0.0]
- Fuel Oil [0.0, 0.0]
- Propane [0.0, 0.0]
- District Chilled Water [0.0, 0.0]

Building Use Types

Community Center:	7,020 ft²
Office:	4,950 ft²
Senior Center:	41,200 ft²

This report includes a Score for the entire building as well as individual Scores for each of the separate use types.

The **Building Energy Asset Score** is a national rating system developed by the U.S. Department of Energy. The **Score** reflects the energy efficiency of a building based on the building's structure, heating, cooling, ventilation, and hot water systems. The building's **Structure and Systems** are individually evaluated and ranked. The **Upgrade Opportunities** page provides recommendations for how to improve the building's energy efficiency, increase the building's Asset Score, and save money.

³ The energy savings range reflects the expected incremental savings for the overall building associated with the specific efficiency upgrade opportunity assuming all other recommended upgrades have already been implemented. This assumption is made to avoid double counting of savings. The ranges reflect site energy savings and are based on standard operating assumptions, unless actual operating conditions are provided by the user.

⁴ The costs are based on Advanced Energy Retrofit Guide and RS Means. The costs are replacement costs, not incremental costs. The costs do not include local incentives. Costs are shown as a range (\$ = low cost, \$\$ = medium cost, \$\$\$ = high cost).

[†] User-selected energy efficiency measure

Building Name: **Baraboo - Civic Center**

Gross Floor Area: **53,170 ft²**

Selected Upgrade Opportunities	Energy Savings ³	Cost ⁴
--------------------------------	-----------------------------	-------------------

Building Envelope

• Seal Building Envelope to Reduce Air Infiltration [†] - Learn More	Low	\$\$
---	-----	------

Lighting Systems

• Add Occupancy Sensors for Interior Lighting Control to Lighting Fixture in block for Fixture 1. [†] - Learn More	Low	\$\$
---	-----	------

HVAC Systems and Controls

• Replace HVAC with High-performance Packaged Rooftop Heat Pump and a DOAS in blocks Civic Center, Club, and Basement - Gym for Unit Ventilators. [†] - Learn More	Medium	\$\$-\$\$\$
---	--------	-------------

Service Hot Water Systems

No opportunities identified.

³ The energy savings range reflects the expected incremental savings for the overall building associated with the specific efficiency upgrade opportunity assuming all other recommended upgrades have already been implemented. This assumption is made to avoid double counting of savings. The ranges reflect site energy savings and are based on standard operating assumptions, unless actual operating conditions are provided by the user.

⁴ The costs are based on Advanced Energy Retrofit Guide and RS Means. The costs are replacement costs, not incremental costs. The costs do not include local incentives. Costs are shown as a range (\$ = low cost, \$\$ = medium cost, \$\$\$ = high cost).

[†] User-selected energy efficiency measure

Building Name: **Baraboo - Civic Center**

Gross Floor Area: **53,170 ft²**

Health and Safety Impact of Upgrade Opportunities

Building Envelope

Health and Safety Impact

- Seal Building Envelope to Reduce Air Infiltration[†]

Air sealing can improve thermal comfort by reducing cold drafts, and reduce occupant exposure to outdoor air pollutants, such as vehicle exhaust. It may also help with moisture and pest control by eliminating entry points. But with less outside air being provided by air infiltration, it is important to make sure that the building has sufficient ventilation after air sealing, such as by HVAC commissioning, otherwise indoor air quality may deteriorate.

Lighting Systems

- Add Occupancy Sensors for Interior Lighting Control to Lighting Fixture in block for Fixture 1.[†]

Automated controls have the benefits that they are adjust more often than people would otherwise do manually. Lighting controls need to provide simple override for occupants to make adjustments when needed.

HVAC Systems and Controls

- Replace HVAC with High-performance Packaged Rooftop Heat Pump and a DOAS in blocks Civic Center, Club, and Basement - Gym for Unit Ventilators.[†]

Many existing HVAC systems are not providing proper ventilation, filtration, heating, cooling, dehumidification, and are inefficient. HVAC replacement can improve thermal comfort and potentially reduce background noise by selecting equipment that meets the sound specification and with proper installation. In addition, dedicated outdoor air ventilation systems can improve indoor air quality by meeting the minimum outside air ventilation rates and better control of indoor humidity.

Service Hot Water Systems

No opportunities identified.

Building Name: **Baraboo - Civic Center**

Gross Floor Area: **53,170 ft²**

ABOUT THE BUILDING SYSTEMS

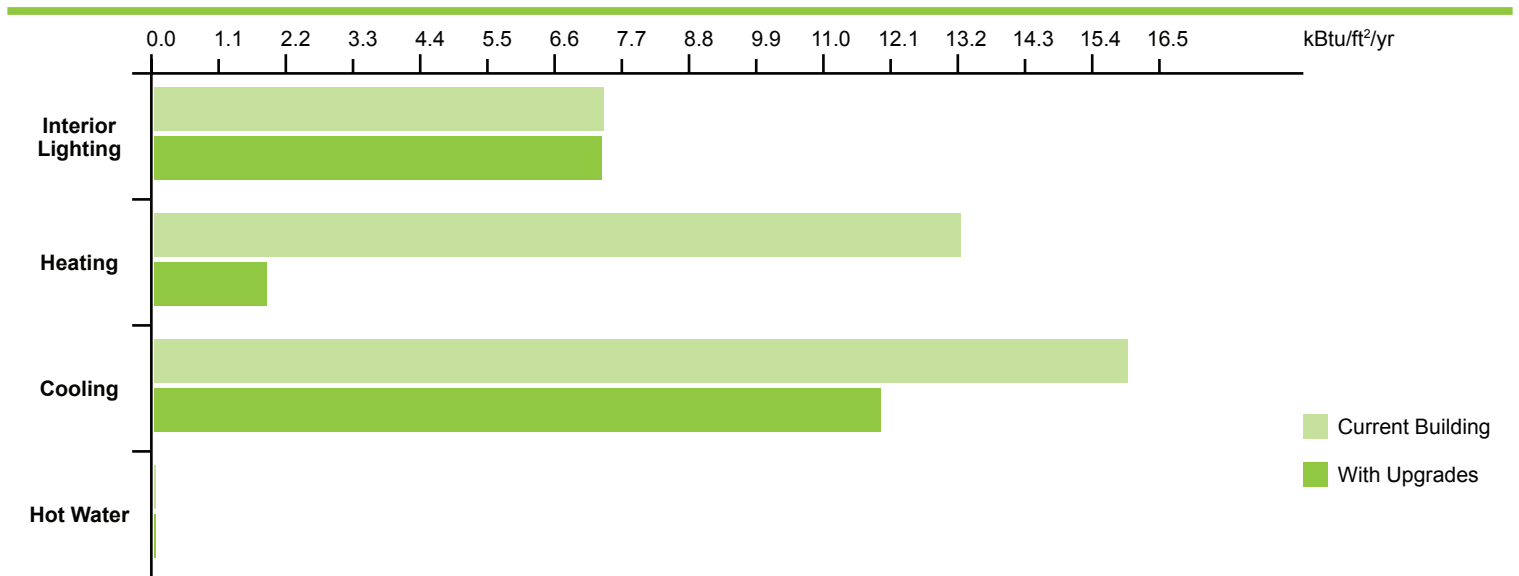
	Ranking ⁵
Interior Lighting	Superior
Whole Building HVAC System TSPR	Fair
Unit Ventilators	Fair

ABOUT THE BUILDING ENVELOPE

	Ranking ⁵
Roof U-Value, Non-Attic (Btu/ft ² ·h·°F)	Good
Walls U-Value, Framed (Btu/ft ² ·h·°F)	Superior
Windows U-Value (Btu/ft ² ·h·°F)	Fair
Walls + Windows U-Value (Btu/ft ² ·h·°F)	Fair
Window Solar Heat Gain Coefficient	Fair

*System evaluation is not based on a verified TSPR

SITE ENERGY USE INTENSITY BY END USE



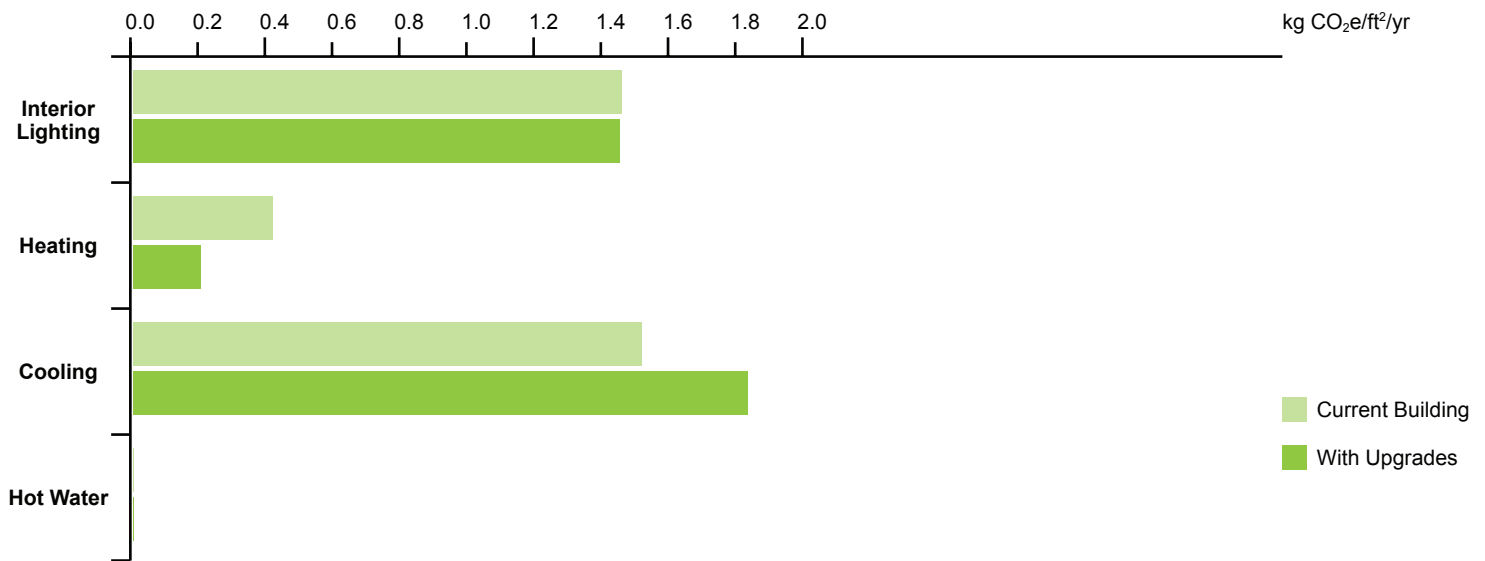
⁵ Ranking Range:

Fair: Building Envelope or Building Systems are less efficient than a typical building built to the AHSRAE 90.1-2004 energy code.
Superior: Building Envelope is more efficient than a typical building built to the AHSRAE 90.1-2013 energy code. Building Systems exceed the highest efficiency levels with market viable technologies.
Good: Building Envelope or Building Systems are between Fair and Superior.
NA: The building does not have a heating or a cooling system, or the loads are too low for the system to be effectively ranked.

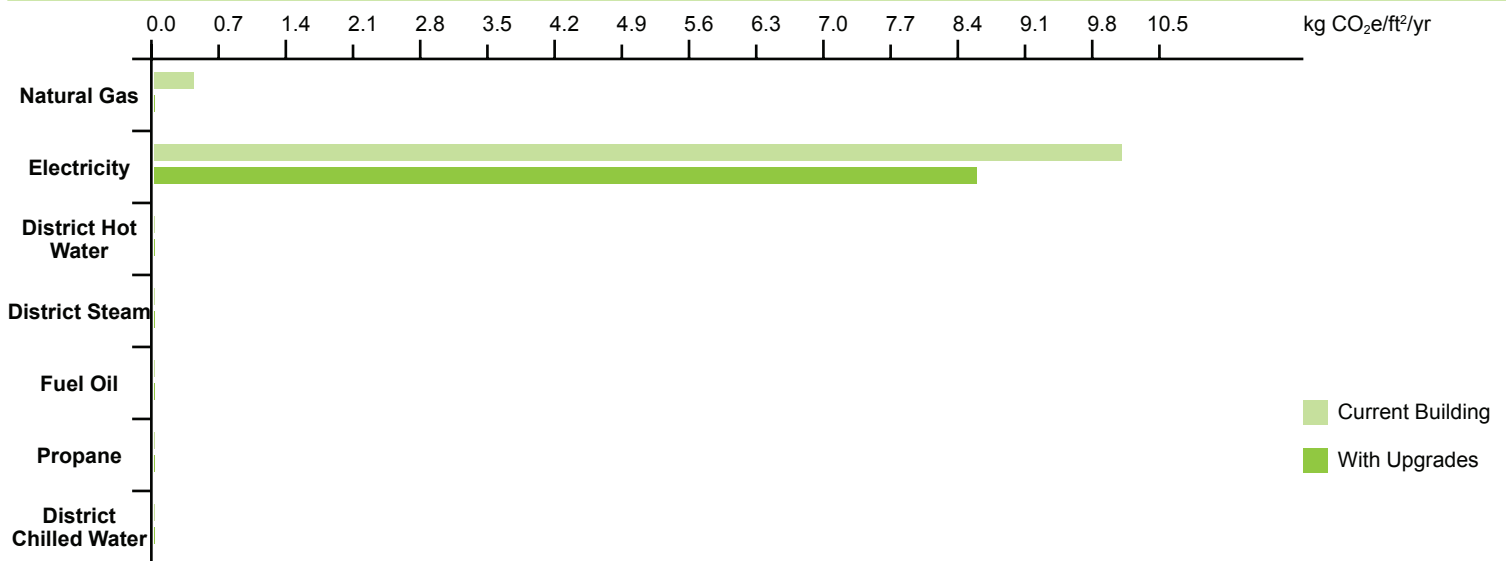
Building Name: **Baraboo - Civic Center**

Gross Floor Area: **53,170 ft²**

CARBON EMISSIONS BY END USE⁶



CARBON EMISSIONS BY FUEL TYPE⁶



⁶ Carbon dioxide equivalent (CO₂e) greenhouse gas annual emission rates are calculated by multiplying the annual energy use rates for each end use and fuel type by emission factors that are specific to each fuel type and then by dividing by the total floor area for the affected blocks. The emission factors for electricity are provided by U.S. EPA Power Profiler v9.1 and are specific to the eGRID subregions that are assigned to the ZIP code for the building. The emissions factors for electricity do not include gross grid loss (line loss).

Building Name: **Baraboo - Civic Center**

Gross Floor Area: **53,170 ft²**

BUILDING CHARACTERISTICS SUMMARY

Plants

Boiler Plant Loop

Plant Loop Type	Heating Loop
Boiler Pump Control	Constant Primary: Variable Secondary
Primary Pump Power	36.4 W/gpm
Secondary Pump Power	Default ¹
Equipment Type	Boiler
Fuel Type	Natural Gas
Draft Type	Mechanical
Year of Manufacture	2011
Thermal Efficiency	80.0% Et

Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

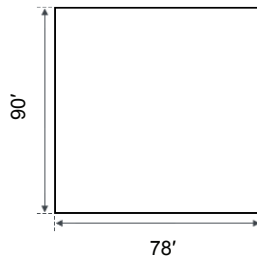
Building Name: **Baraboo - Civic Center**

Gross Floor Area: **53,170 ft²**

Basement - Gym CHARACTERISTICS SUMMARY

Geometry

Above Ground: 1 floor
Below Ground: 0 floors
Floor-to-Floor Height: 26.00 ft
Floor-to-Ceiling Height: 14.50 ft
Orientation: 90.0° from North
Use Type: Community Center



Current Building

Roof

Roof	Roof 1
Roof Type	Built-up w/ metal deck
Intended Occupancy Type	Non-Residential

Skylights

No Skylights

Floor

Floor	Floor 1
Floor Type	Concrete
Intended Occupancy Type	Non-Residential

Walls and Windows

All Surfaces

Wall	Wall 1
Wall Type	Brick/Stone on masonry
Intended Occupancy Type	Non-Residential

No Windows

Infiltration

Energy code the building complies with Estimated¹

Lighting

Lighting Power Density	0.6 W/ft ²
------------------------	-----------------------

Current Building

Fixture	Fixture 1
Lighting Type	LED
Mounting Type	Surface
Lamp Wattage	20 W/lamp
Lamps per Fixture	2
Percent Served	100.0%

Heating/Cooling

Thermal Zone Layout	Single zone
Primary Heating/Cooling System	Unit Ventilators
Cooling Equipment	
Cooling Source	Central DX
Year of Manufacture	2011
# Pieces of Equipment	1
Efficiency	3.40 COP
Heating Equipment	
Heating Source	Plant
Plant Loop	Boiler Plant Loop - Heating Loop - Boiler

Distribution

Distribution Type	Single Zone
-------------------	-------------

Fan Systems

Total System Fan Power	0.66 W/CFM
Fan Motor Efficiency	70.0%
Fan Mechanical Efficiency	60.0%
Fan Control	Constant Volume

Service Water Heating

Water Heater	Natural Gas
Fuel Type	Natural Gas
Water Heater Efficiency	80.00 Et

Operations

Operation	Using Standard Operations ²
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Notes:

¹ Total Gross Wall Area³ includes both opaque and glazed wall area.
² Window includes all vertical fenestration, including curtainwall and storefront.
³ Total Gross Roof Area³ includes both opaque and glazed roof area.

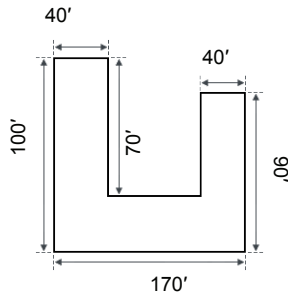
Building Name: **Baraboo - Civic Center**

Gross Floor Area: **53,170 ft²**

Civic Center CHARACTERISTICS SUMMARY

Geometry

Above Ground: 4 floors
Below Ground: 0 floors
Floor-to-Floor Height: 13.00 ft
Floor-to-Ceiling Height: 11.50 ft
Orientation: 0.0° from North
Use Type: Senior Center



Current Building

Current Building

Window Layout	Continuous
Window-to-Wall Ratio	0.2
Edge Offset	3.0 ft
Sill Height	2.3299999237060547 ft
Exterior Shading Type	No Shading

Infiltration

Energy code the building complies with Estimated¹

Lighting

Lighting Power Density	0.6 W/ft ²
Fixture	Fixture 1
Lighting Type	LED
Mounting Type	Surface
Lamp Wattage	20 W/lamp
Lamps per Fixture	2
Percent Served	100.0%

Heating/Cooling

Thermal Zone Layout	Perimeter and core
Perimeter Zone Depth	10.0 ft
Primary Heating/Cooling System	Unit Ventilators

Cooling Equipment

Cooling Source	Central DX
Year of Manufacture	2011
# Pieces of Equipment	1
Efficiency	3.40 COP

Heating Equipment

Heating Source	Plant
Plant Loop	Boiler Plant Loop - Heating Loop - Boiler

Distribution

Distribution Type	Single Zone
-------------------	-------------

Fan Systems

Roof

Roof	Roof 1
Roof Type	Built-up w/ metal deck
Intended Occupancy Type	Non-Residential

Skylights

No Skylights

Floor

Floor	Floor 1
Floor Type	Concrete
Intended Occupancy Type	Non-Residential

Walls and Windows

All Surfaces

Wall	Wall 1
Wall Type	Brick/Stone on masonry
Intended Occupancy Type	Non-Residential
Window	Window 1
Window Framing Type	Metal
Window Glass Type	Double Pane
Window Gas Fill Type	Default ²
Intended Occupancy Type	Non-Residential
Window SHGC	Estimated ³
Window VT	Estimated ³

Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

Building Name: **Baraboo - Civic Center**

Gross Floor Area: **53,170 ft²**

Current Building

Total System Fan Power	0.66 W/CFM
Fan Motor Efficiency	70.0%
Fan Mechanical Efficiency	60.0%
Fan Control	Constant Volume

Service Water Heating

No Water Heater

Operations

Operation	Using Standard Operations**
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Notes:
¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
² Window includes all vertical fenestration, including curtainwall and storefront.
³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

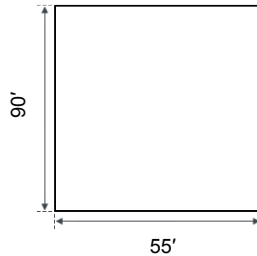
Building Name: **Baraboo - Civic Center**

Gross Floor Area: **53,170 ft²**

Club CHARACTERISTICS SUMMARY

Geometry

Above Ground: 1 floor
Below Ground: 0 floors
Floor-to-Floor Height: 26.00 ft
Floor-to-Ceiling Height: 24.50 ft
Orientation: 90.0° from North
Use Type: Office



Current Building

Roof

Roof: Roof 1
Roof Type: Built-up w/ metal deck
Intended Occupancy Type: Non-Residential

Skylights

No Skylights

Floor

Interior surface marking project boundary

Walls and Windows

All Surfaces

Wall: Wall 1
Wall Type: Brick/Stone on masonry
Intended Occupancy Type: Non-Residential

No Windows

Infiltration

Energy code the building complies with Estimated¹

Lighting

Lighting Power Density: 0.61 W/ft²

Fixture: Fixture 1

Lighting Type: LED

Current Building

Mounting Type: Surface
Lamp Wattage: 20 W/lamp
Lamps per Fixture: 2
Percent Served: 100.0%

Heating/Cooling

Thermal Zone Layout: Single zone
Primary Heating/Cooling System: Unit Ventilators

Cooling Equipment

Cooling Source: Central DX
Year of Manufacture: 2011
Pieces of Equipment: 1
Efficiency: 3.40 COP

Heating Equipment

Heating Source: Plant
Plant Loop: Boiler Plant Loop - Heating Loop - Boiler

Distribution

Distribution Type: Single Zone

Fan Systems

Total System Fan Power: 0.66 W/CFM
Fan Motor Efficiency: 70.0%
Fan Mechanical Efficiency: 60.0%
Fan Control: Constant Volume

Service Water Heating

No Water Heater

Operations

Operation: Using Standard Operations²

Notes:

¹ Total Gross Wall Area³ includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ Total Gross Roof Area³ includes both opaque and glazed roof area.

Building Name: **Baraboo - Civic Center**

Gross Floor Area: **53,170 ft²**

BUILDING ENVELOPE INFORMATION

Total Gross Above Grade Wall Area ¹	28756.0 ft ²
Total Window Area ²	4680.0 ft ²
Building Window to Wall Ratio	16%
Total Below Grade Wall Area	0.0 ft ²
Total Gross Roof Area ³	17320.0 ft ²
Total Skylight Area	0.0 ft ²
Total Conditioned Floor Area	Not Available
Total Footprint Area	Not Available

Areas by Orientation

NORTH

Gross Wall Area 8840.0 ft²

Window Area 831.8 ft²

SOUTH

Gross Wall Area 8840.0 ft²

Window Area 1768.0 ft²

EAST

Gross Wall Area 5538.0 ft²

Window Area 1014.0 ft²

WEST

Gross Wall Area 5538.0 ft²

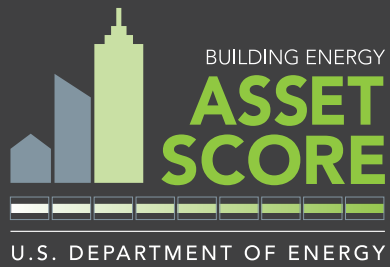
Window Area 1066.1 ft²

Notes:

¹ 'Total Gross Wall Area' includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ 'Total Gross Roof Area' includes both opaque and glazed roof area.



Building Assessment Tool Report

Software Provenance

Building Name: **Baraboo - Civic Center**

Gross Floor Area: **53,170 ft²**

SOFTWARE PROVENANCE

Asset Score/Audit Template	Version: 2025.0.0.746 Build: master_746
Open Studio	3.7.0;
Energy-Plus	23.2;
Asset Score Open Studio Web Service	Asset Score Open Studio Web Service, Version 3.0.9197.20730, Friday, March 7, 2025 11:31:00 AM
Open Studio Simulation	Release_7.1.24_20250428.0

BUILDING INFORMATION

Baraboo - Corson Square

Building Type:

**Multi-family
(fewer than 4
floors)**

Score Date:

06/05/2025

920 10th St
Baraboo, WI 53913

Gross Floor Area:

30,681 ft²

Building ID #:

32862

Climate Zone:

6A

Climate Description:

Cold - Humid

Year Built:

1983

Software Release:

2025.0.0.746

Estimated Annual Site Energy Use Intensity and Greenhouse Gas Intensity

	Site EUI (kBtu/ft ² /yr)	GHGI (kg CO ₂ e/ft ² /yr)
Current	71	11.61
Upgraded	44	6.25

Estimated annual site energy savings: 38.03%

Energy Use Intensity by Fuel Type

Current Building: Site Energy Use (kBtu/ft²/yr)



Upgraded Building: Site Energy Use (kBtu/ft²/yr)



Fuel Type Site EUI (kBtu/ft²) [Current, Upgraded]

Natural Gas	[16.5, 16.3]
Electricity	[54.3, 27.2]
District Hot Water	[0.0, 0.0]
District Steam	[0.0, 0.0]
Fuel Oil	[0.0, 0.0]
Propane	[0.0, 0.0]
District Chilled Water	[0.0, 0.0]

Standard Occupancy and Operating Conditions

Number of Assumed Occupants	56
Hours of Operation	115.0 hrs/wk
Cooling Set Point	75° F
Heating Set Point	72° F
Misc. Energy Loads	0.91 W/ft ²

The **Building Energy Asset Score** is a national rating system developed by the U.S. Department of Energy. The **Score** reflects the energy efficiency of a building based on the building's structure, heating, cooling, ventilation, and hot water systems. The building's **Structure and Systems** are individually evaluated and ranked. The **Upgrade Opportunities** page provides recommendations for how to improve the building's energy efficiency, increase the building's Asset Score, and save money.

³ The energy savings range reflects the expected incremental savings for the overall building associated with the specific efficiency upgrade opportunity assuming all other recommended upgrades have already been implemented. This assumption is made to avoid double counting of savings. The ranges reflect site energy savings and are based on standard operating assumptions, unless actual operating conditions are provided by the user.

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[†] User-selected energy efficiency measure

Building Name: **Baraboo - Corson Square**

Gross Floor Area: **33,858 ft²**

Selected Upgrade Opportunities	Energy Savings ³	Cost ⁴
--------------------------------	-----------------------------	-------------------

Building Envelope

- | | | |
|---|-----|------|
| • Seal Building Envelope to Reduce Air Infiltration [†] - Learn More | Low | \$\$ |
|---|-----|------|

Lighting Systems

- | | | |
|--|--------|----|
| • Upgrade to LED Fixtures for Lighting Fixture in block Block 1 for Fixture 1. [†] - Learn More | Medium | \$ |
|--|--------|----|

HVAC Systems and Controls

- | | | |
|---|--------|-------------|
| • Replace HVAC with High-performance Packaged Rooftop Heat Pump and a DOAS in block Block 1 for Baseboards. [†] - Learn More | Medium | \$\$-\$\$\$ |
|---|--------|-------------|

Service Hot Water Systems

No opportunities identified.

³ The energy savings range reflects the expected incremental savings for the overall building associated with the specific efficiency upgrade opportunity assuming all other recommended upgrades have already been implemented. This assumption is made to avoid double counting of savings. The ranges reflect site energy savings and are based on standard operating assumptions, unless actual operating conditions are provided by the user.

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[†] User-selected energy efficiency measure

Building Name: **Baraboo - Corson Square**

Gross Floor Area: **33,858 ft²**

Health and Safety Impact of Upgrade Opportunities

Building Envelope

Health and Safety Impact

- Seal Building Envelope to Reduce Air Infiltration[†]

Air sealing can improve thermal comfort by reducing cold drafts, and reduce occupant exposure to outdoor air pollutants, such as vehicle exhaust. It may also help with moisture and pest control by eliminating entry points. But with less outside air being provided by air infiltration, it is important to make sure that the building has sufficient ventilation after air sealing, such as by HVAC commissioning, otherwise indoor air quality may deteriorate.

Lighting Systems

- Upgrade to LED Fixtures for Lighting Fixture in block Block 1 for Fixture 1.[†]

Indoor lighting retrofit has the potential to improve lighting quality and occupant satisfaction. Retrofits that also allow occupants to have more lighting control can provide greater flexibility to adapt and respond to changing needs.

HVAC Systems and Controls

- Replace HVAC with High-performance Packaged Rooftop Heat Pump and a DOAS in block Block 1 for Baseboards.[†]

Many existing HVAC systems are not providing proper ventilation, filtration, heating, cooling, dehumidification, and are inefficient. HVAC replacement can improve thermal comfort and potentially reduce background noise by selecting equipment that meets the sound specification and with proper installation. In addition, dedicated outdoor air ventilation systems can improve indoor air quality by meeting the minimum outside air ventilation rates and better control of indoor humidity.

Service Hot Water Systems

No opportunities identified.

Building Name: **Baraboo - Corson Square**

Gross Floor Area: **33,858 ft²**

ABOUT THE BUILDING SYSTEMS

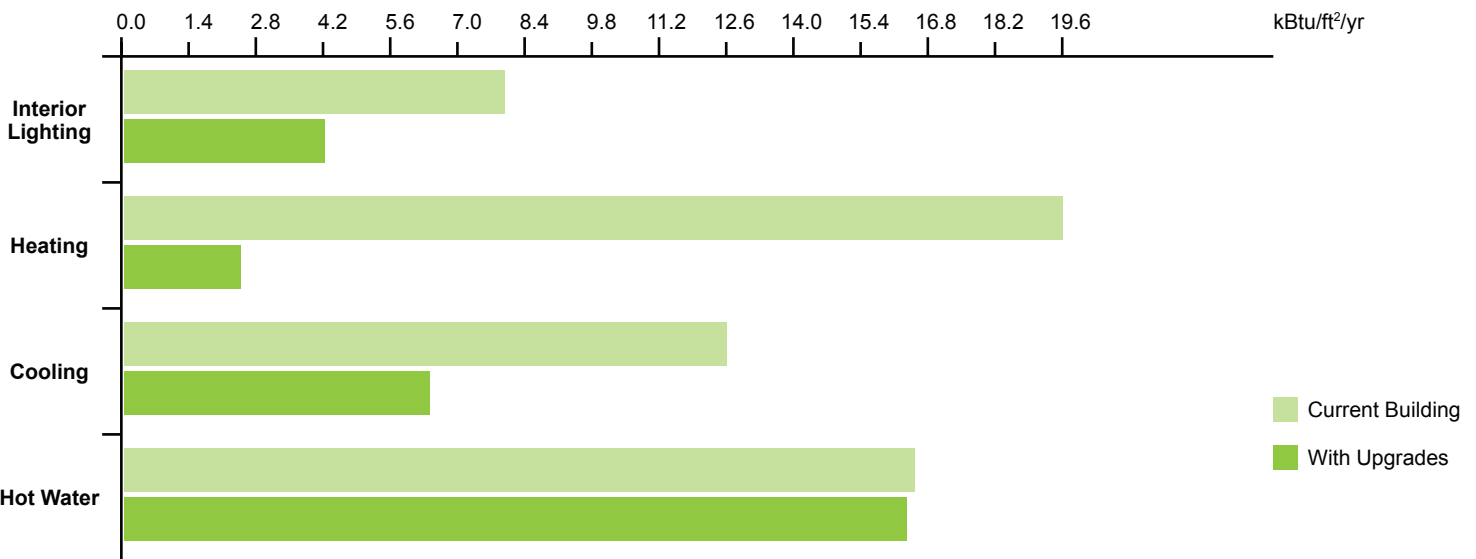
	Ranking ⁵
Interior Lighting	Fair
Whole Building HVAC System TSPR	Fair
Baseboards	Fair

ABOUT THE BUILDING ENVELOPE

	Ranking ⁵
Roof U-Value, Non-Attic (Btu/ft ² ·h·°F)	Superior
Walls U-Value, Framed (Btu/ft ² ·h·°F)	Good
Windows U-Value (Btu/ft ² ·h·°F)	Fair
Walls + Windows U-Value (Btu/ft ² ·h·°F)	Good
Window Solar Heat Gain Coefficient	Fair

*System evaluation is not based on a verified TSPR

SITE ENERGY USE INTENSITY BY END USE



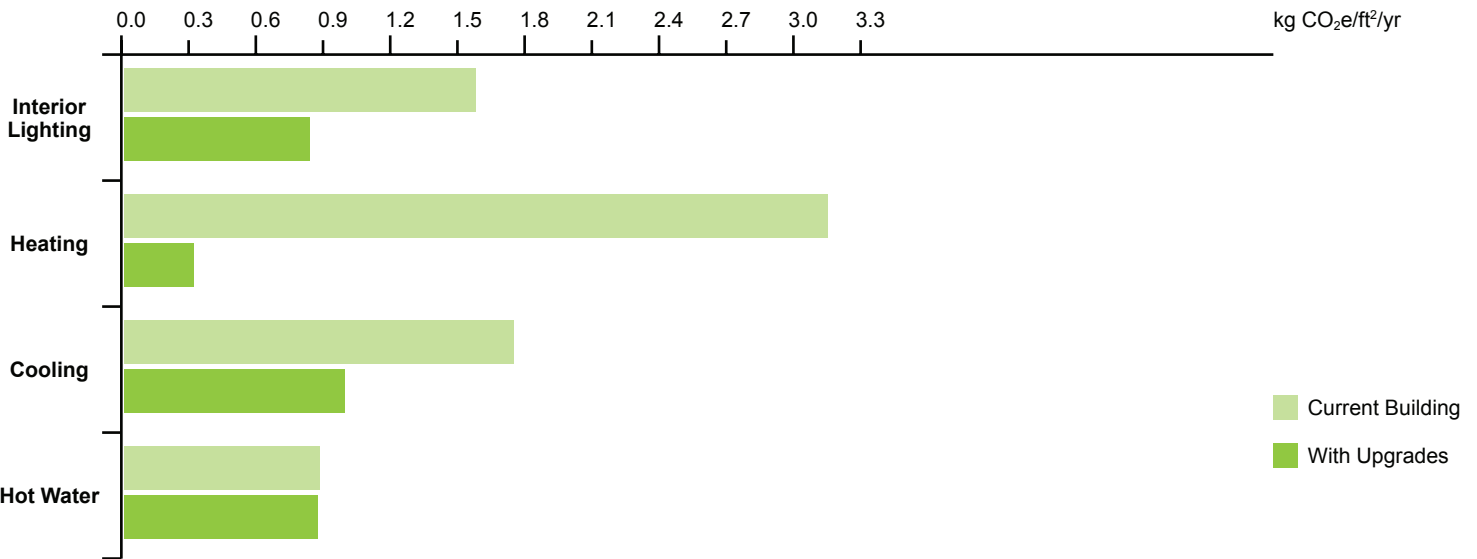
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N/A: The building does not have a heating or a cooling system, or the loads are too low for the system to be effectively ranked.

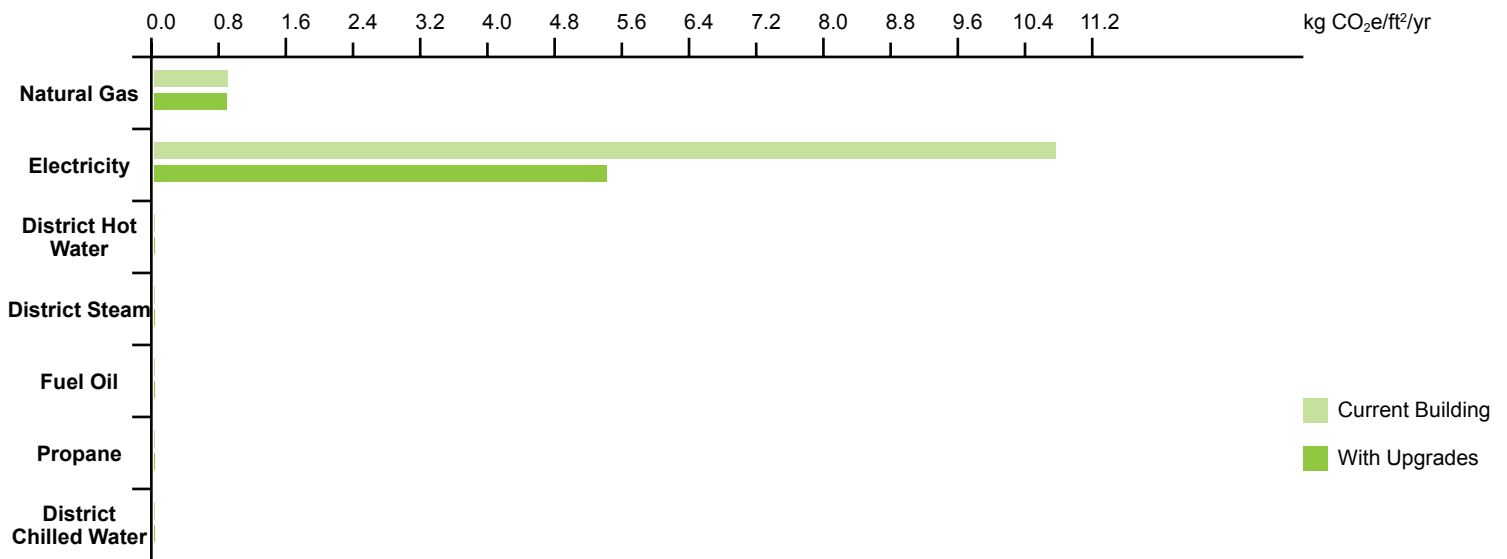
Building Name: **Baraboo - Corson Square**

Gross Floor Area: **33,858 ft²**

CARBON EMISSIONS BY END USE⁶



CARBON EMISSIONS BY FUEL TYPE⁶



⁶ Carbon dioxide equivalent (CO₂e) greenhouse gas annual emission rates are calculated by multiplying the annual energy use rates for each end use and fuel type by emission factors that are specific to each fuel type and then by dividing by the total floor area for the affected blocks. The emission factors for electricity are provided by U.S. EPA Power Profiler v9.1 and are specific to the eGRID subregions that are assigned to the ZIP code for the building. The emissions factors for electricity do not include gross grid loss (line loss).

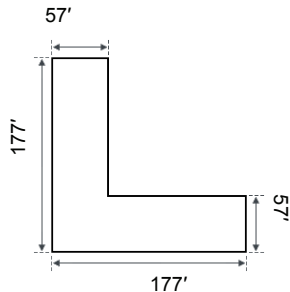
Building Name: **Baraboo - Corson Square**

Gross Floor Area: **33,858 ft²**

Block 1 CHARACTERISTICS SUMMARY

Geometry

Above Ground: 2 floors
 Below Ground: 0 floors
 Floor-to-Floor Height: 9.50 ft
 Floor-to-Ceiling Height: 8.00 ft
 Orientation: 90.0° from North
 Use Type: Multi-family (fewer than 4 floors)



Current Building

Roof

Roof: Roof 1
 Roof Type: Shingles/Shakes
 Roof Insulation Thickness: 12.0 in

Skylights

No Skylights

Floor

Floor: Floor 1
 Floor Type: Slab-on-Grade
 Slab Insulation: Vertical Insulation
 Floor R-value: 5.0 °F·ft²·h/Btu

Walls and Windows

All Surfaces

Wall: Wall 1
 Wall Type: Siding on wood frame
 Wall Insulation Thickness: 3.5 in
 Window: Window 1
 Window Framing Type: Metal
 Window Glass Type: Double Pane
 Window Gas Fill Type: Default³

Current Building

Intended Occupancy Type: Residential
 Window SHGC: Estimated¹
 Window VT: Estimated¹
 Window Layout: Discrete
 Number of Windows: 14
 Window Width: 4.0 ft
 Window Height: 3.0 ft
 Exterior Shading Type: No Shading

Infiltration

Energy code the building complies with: Estimated¹

Lighting

Lighting Power Density: 0.81 W/ft²
 Fixture: Fixture 1
 Lighting Type: Fluorescent T8
 Mounting Type: Surface
 Lamp Wattage: 60 W/lamp
 Lamps per Fixture: 1
 Percent Served: 100.0%

Heating/Cooling

Thermal Zone Layout: Perimeter and core
 Perimeter Zone Depth: 20.0 ft
 Primary Heating/Cooling System: Baseboards
 System Type: Pkgd Heat Pump

Cooling Equipment

Cooling Source: Central DX
 Year of Manufacture: 1983
 # Pieces of Equipment: 1
 Efficiency: 2.00 COP

Heating Equipment

Heating Source: Heat Pump

Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
² Window includes all vertical fenestration, including curtainwall and storefront.
³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

Building Name: **Baraboo - Corson Square**

Gross Floor Area: **33,858 ft²**

Current Building

Fuel Type	Electricity
Condenser Type	Air
Year of Manufacture	1983
# Pieces of Equipment	1
Thermal Efficiency	1.01 COP

Fan Systems

Total System Fan Power	0.5 W/CFM
Fan Motor Efficiency	60.0%
Fan Mechanical Efficiency	60.0%
Fan Control	Constant Volume

Service Water Heating

Water Heater	Natural Gas
Fuel Type	Natural Gas
Water Heater Efficiency	80.00 Et

Operations

Operation	Using Standard Operations ²
------------------	--

Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

Building Name: **Baraboo - Corson Square**

Gross Floor Area: **33,858 ft²**

BUILDING ENVELOPE INFORMATION

Total Gross Above Grade Wall Area ¹	13452.0 ft ²
Total Window Area ²	1008.0 ft ²
Building Window to Wall Ratio	7%
Total Below Grade Wall Area	0.0 ft ²
Total Gross Roof Area ³	16929.0 ft ²
Total Skylight Area	0.0 ft ²
Total Conditioned Floor Area	Not Available
Total Footprint Area	Not Available

Areas by Orientation

NORTH

Gross Wall Area 3363.0 ft²

Window Area 168.2 ft²

SOUTH

Gross Wall Area 3363.0 ft²

Window Area 336.0 ft²

EAST

Gross Wall Area 3363.0 ft²

Window Area 336.0 ft²

WEST

Gross Wall Area 3363.0 ft²

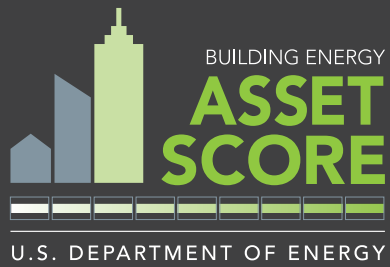
Window Area 168.2 ft²

Notes:

¹ 'Total Gross Wall Area' includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ 'Total Gross Roof Area' includes both opaque and glazed roof area.



Building Assessment Tool Report

Software Provenance

Building Name: **Baraboo - Corson Square**

Gross Floor Area: **33,858 ft²**

SOFTWARE PROVENANCE

Asset Score/Audit Template	Version: 2025.0.0.746 Build: master_746
Open Studio	3.7.0;
Energy-Plus	23.2;
Asset Score Open Studio Web Service	Asset Score Open Studio Web Service, Version 3.0.9197.20730, Friday, March 7, 2025 11:31:00 AM
Open Studio Simulation	Release_7.1.24_20250428.0

BUILDING INFORMATION

Baraboo - CSMPL
230 4th Ave
Baraboo, WI 53913

Building Type: **Library**
Gross Floor Area: **31,877 ft²**
Climate Zone: **6A**
Year Built: **2024**

Score Date: **06/05/2025**
Building ID #: **32506**
Climate Description: **Cold - Humid**
Software Release: **2025.0.0.746**

Estimated Annual Site Energy Use Intensity and Greenhouse Gas Intensity

	Site EUI (kBtu/ft ² /yr)	GHGI (kg CO ₂ e/ft ² /yr)
Current	57	9.73
Upgraded	52	9.49

Estimated annual site energy savings: 8.77%

Energy Use Intensity by Fuel Type

Current Building: Site Energy Use (kBtu/ft²/yr)



Upgraded Building: Site Energy Use (kBtu/ft²/yr)



Fuel Type Site EUI (kBtu/ft²) [Current, Upgraded]

Natural Gas	[10.3, 5.8]
Electricity	[46.4, 46.4]
District Hot Water	[0.0, 0.0]
District Steam	[0.0, 0.0]
Fuel Oil	[0.0, 0.0]
Propane	[0.0, 0.0]
District Chilled Water	[0.0, 0.0]

Standard Occupancy and Operating Conditions

Number of Assumed Occupants	310
Hours of Operation	46.0 hrs/wk
Cooling Set Point	75° F
Heating Set Point	70° F
Misc. Energy Loads	1.50 W/ft ²

The **Building Energy Asset Score** is a national rating system developed by the U.S. Department of Energy. The **Score** reflects the energy efficiency of a building based on the building's structure, heating, cooling, ventilation, and hot water systems. The building's **Structure and Systems** are individually evaluated and ranked. The **Upgrade Opportunities** page provides recommendations for how to improve the building's energy efficiency, increase the building's Asset Score, and save money.

³ The energy savings range reflects the expected incremental savings for the overall building associated with the specific efficiency upgrade opportunity assuming all other recommended upgrades have already been implemented. This assumption is made to avoid double counting of savings. The ranges reflect site energy savings and are based on standard operating assumptions, unless actual operating conditions are provided by the user.

⁴ The costs are based on Advanced Energy Retrofit Guide and RS Means. The costs are replacement costs, not incremental costs. The costs do not include local incentives. Costs are shown as a range (\$ = low cost, \$\$ = medium cost, \$\$\$ = high cost).

[†] User-selected energy efficiency measure

Building Name: **Baraboo - CSMPL**

Gross Floor Area: **31,050 ft²**

Selected Upgrade Opportunities	Energy Savings ³	Cost ⁴
--------------------------------	-----------------------------	-------------------

Building Envelope

- | | | |
|---|-----|------|
| • Seal Building Envelope to Reduce Air Infiltration [†] - Learn More | Low | \$\$ |
|---|-----|------|

Lighting Systems

No opportunities identified.

HVAC Systems and Controls

- | | | |
|--|--------|-------------|
| • Implement Supply Air Temperature Reset on Air Loop in block Block 1 - Exist for Air Handler 1. [†] - Learn More | Medium | \$\$-\$\$\$ |
| • Implement Supply Air Temperature Reset on Air Loop in block Block 2 - New Floor 1 for Air Handler 2. [†] - Learn More | Medium | \$\$-\$\$\$ |

Service Hot Water Systems

No opportunities identified.

³ The energy savings range reflects the expected incremental savings for the overall building associated with the specific efficiency upgrade opportunity assuming all other recommended upgrades have already been implemented. This assumption is made to avoid double counting of savings. The ranges reflect site energy savings and are based on standard operating assumptions, unless actual operating conditions are provided by the user.

⁴ The costs are based on Advanced Energy Retrofit Guide and RS Means. The costs are replacement costs, not incremental costs. The costs do not include local incentives. Costs are shown as a range (\$ = low cost, \$\$ = medium cost, \$\$\$ = high cost).

[†] User-selected energy efficiency measure

Building Name: **Baraboo - CSMPL**

Gross Floor Area: **31,050 ft²**

Health and Safety Impact of Upgrade Opportunities

Building Envelope

Health and Safety Impact

- Seal Building Envelope to Reduce Air Infiltration[†]

Air sealing can improve thermal comfort by reducing cold drafts, and reduce occupant exposure to outdoor air pollutants, such as vehicle exhaust. It may also help with moisture and pest control by eliminating entry points. But with less outside air being provided by air infiltration, it is important to make sure that the building has sufficient ventilation after air sealing, such as by HVAC commissioning, otherwise indoor air quality may deteriorate.

Lighting Systems

No opportunities identified.

HVAC Systems and Controls

- Implement Supply Air Temperature Reset on Air Loop in block Block 1 - Exist for Air Handler 1.[†]
- Implement Supply Air Temperature Reset on Air Loop in block Block 2 - New Floor 1 for Air Handler 2.[†]

Adjustment of HVAC system control can affect thermal comfort. Monitor indoor temperature, relative humidity, and supply air flow, or conduct occupancy survey, to check for potential impact.

Adjustment of HVAC system control can affect thermal comfort. Monitor indoor temperature, relative humidity, and supply air flow, or conduct occupancy survey, to check for potential impact.

Service Hot Water Systems

No opportunities identified.

Building Name: **Baraboo - CSMPL**

Gross Floor Area: **31,050 ft²**

ABOUT THE BUILDING SYSTEMS

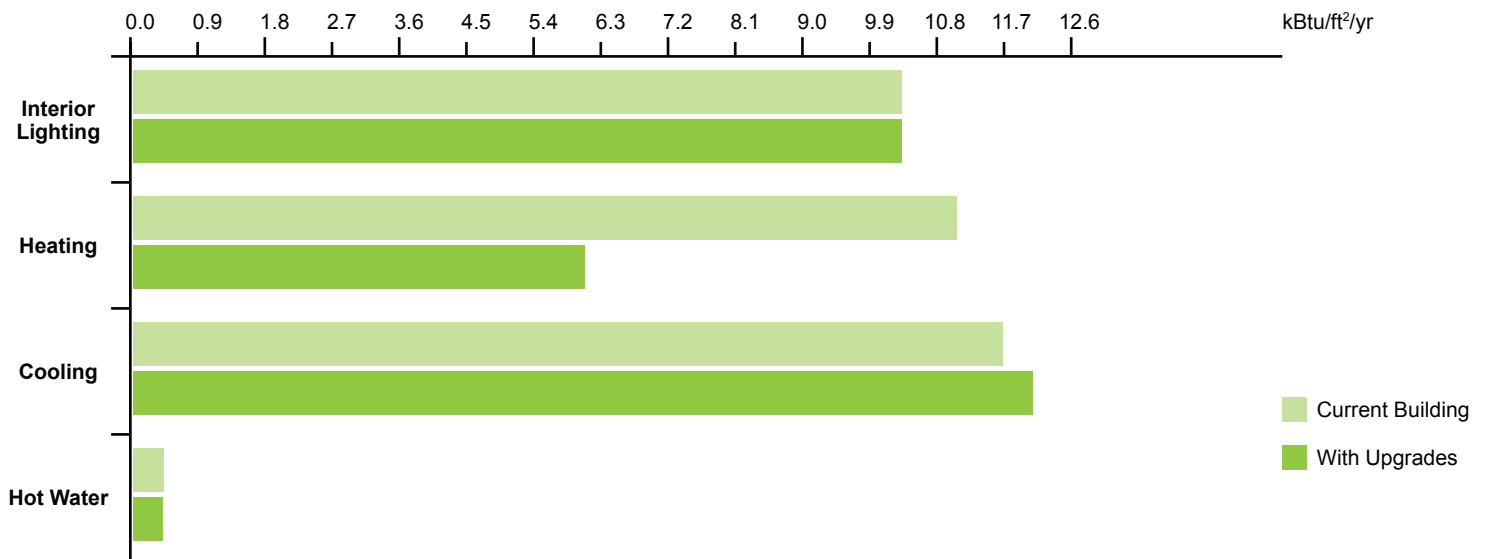
	Ranking ⁵
Interior Lighting	Superior
Whole Building HVAC System TSPR	Good
Air Handler 1	Good
Air Handler 2	Good
Air Handler 3	Fair

ABOUT THE BUILDING ENVELOPE

	Ranking ⁵
Roof U-Value, Non-Attic (Btu/ft ² ·h·°F)	Superior
Walls U-Value, Framed (Btu/ft ² ·h·°F)	Superior
Windows U-Value (Btu/ft ² ·h·°F)	Fair
Walls + Windows U-Value (Btu/ft ² ·h·°F)	Fair
Window Solar Heat Gain Coefficient	Fair

*System evaluation is not based on a verified TSPR

SITE ENERGY USE INTENSITY BY END USE



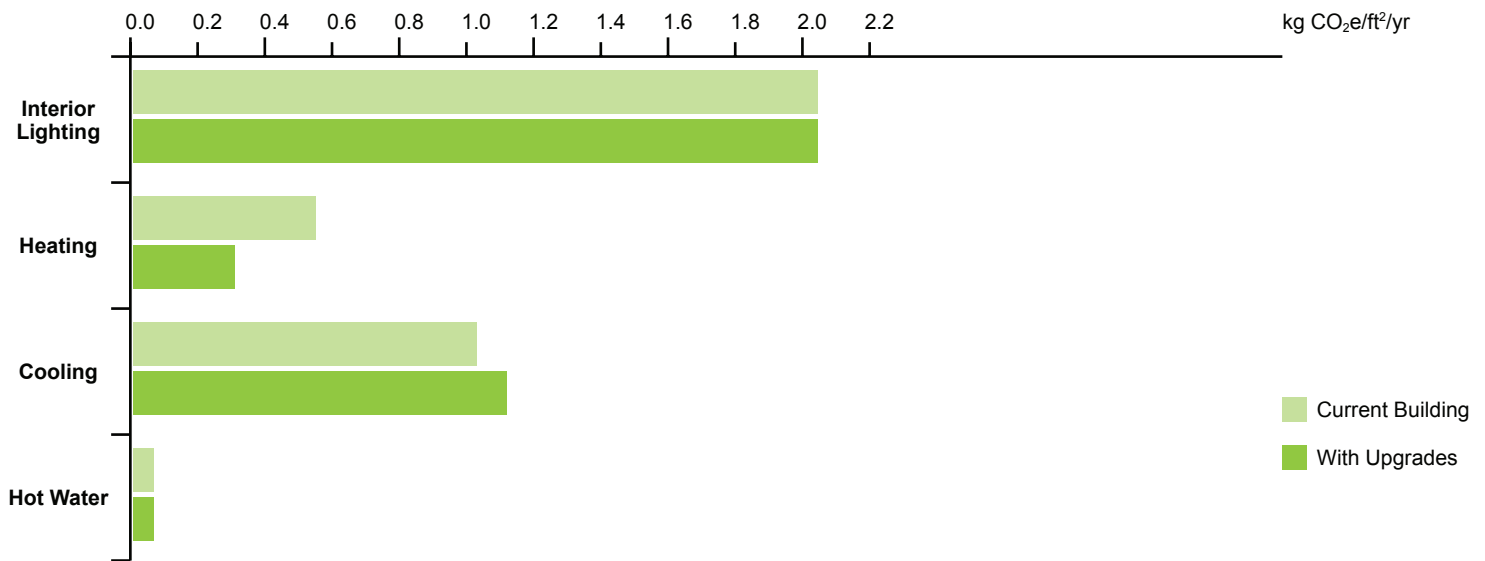
⁵ Ranking Range:

Fair: Building Envelope or Building Systems are less efficient than a typical building built to the AHSRAE 90.1-2004 energy code.
Superior: Building Envelope is more efficient than a typical building built to the AHSRAE 90.1-2013 energy code. Building Systems exceed the highest efficiency levels with market viable technologies.
Good: Building Envelope or Building Systems are between Fair and Superior.
N/A: The building does not have a heating or a cooling system, or the loads are too low for the system to be effectively ranked.

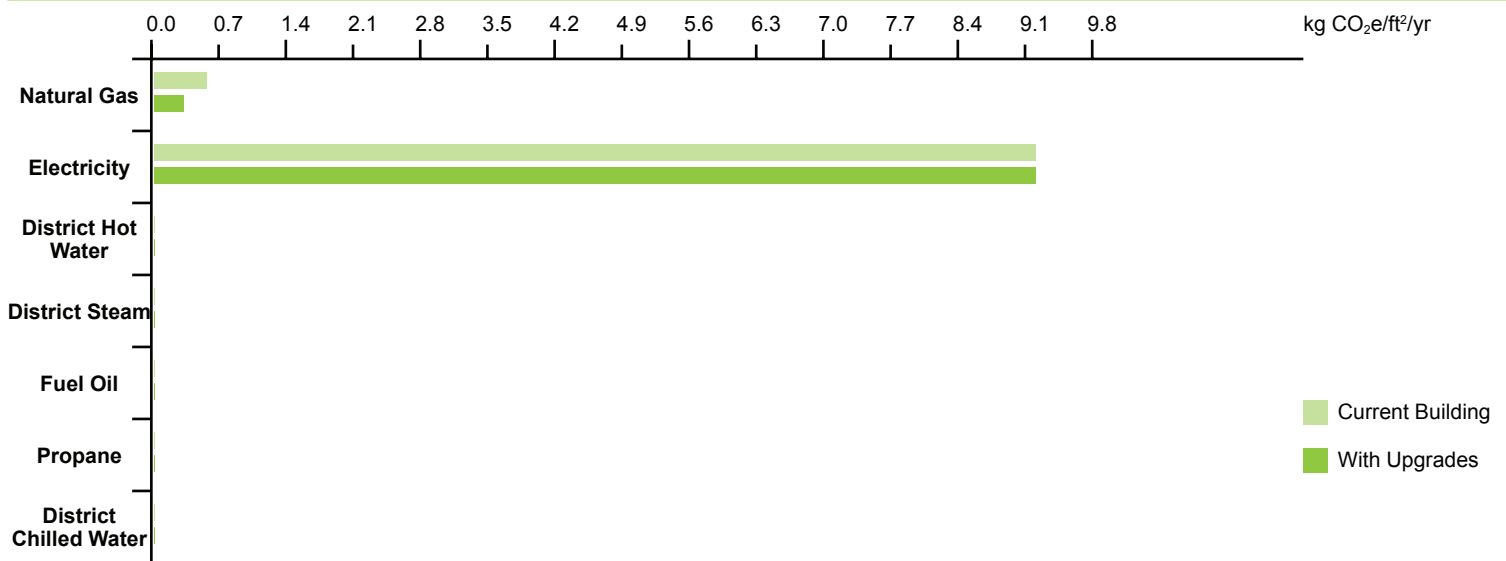
Building Name: **Baraboo - CSMPL**

Gross Floor Area: **31,050 ft²**

CARBON EMISSIONS BY END USE⁶



CARBON EMISSIONS BY FUEL TYPE⁶



⁶ Carbon dioxide equivalent (CO₂e) greenhouse gas annual emission rates are calculated by multiplying the annual energy use rates for each end use and fuel type by emission factors that are specific to each fuel type and then by dividing by the total floor area for the affected blocks. The emission factors for electricity are provided by U.S. EPA Power Profiler v9.1 and are specific to the eGRID subregions that are assigned to the ZIP code for the building. The emissions factors for electricity do not include gross grid loss (line loss).

Building Name: **Baraboo - CSMPL**

Gross Floor Area: **31,050 ft²**

BUILDING CHARACTERISTICS SUMMARY

Plants

HW Plant Loop 1

Plant Loop Type	Heating Loop
Boiler Pump Control	Constant Primary: Variable Secondary
Primary Pump Power	7.457 W/gpm
Secondary Pump Power	27.96 W/gpm
Equipment Type	Boiler
Fuel Type	Natural Gas
Draft Type	Mechanical
Year of Manufacture	2023
Thermal Efficiency	93.7% Et
Average Output Capacity	1405.0 tons

CW Plant Loop

Plant Loop Type	Cooling Loop
Pump Power	27.968 W/gpm
Equipment Type	Chiller
Chilled Water Reset	
Compressor Type	Scroll/Screw
Condenser Type	Air
Year of Manufacture	2023
Efficiency	3.3 COP
# Pieces of Equipment	1

Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

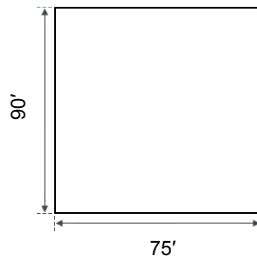
Building Name: **Baraboo - CSMPL**

Gross Floor Area: **31,050 ft²**

Block 1 - Exist CHARACTERISTICS SUMMARY

Geometry

Above Ground: 2 floors
Below Ground: 0 floors
Floor-to-Floor Height: 14.00 ft
Floor-to-Ceiling Height: 12.50 ft
Orientation: 0.0° from North
Use Type: Library



Current Building

Current Building

Window VT	0.8
Window Layout	Discrete
Number of Windows	3
Window Width	4.0 ft
Window Height	8.65999984741211 ft
Exterior Shading Type	No Shading

Surface 2

Wall	Wall 2-Exist
Wall Type	Brick/Stone on steel frame
Intended Occupancy Type	Non-Residential
Window	Window 1
Window Framing Type	Metal w/ Thermal Breaks
Window Glass Type	Double Pane w/ Low-E
Window Gas Fill Type	Default ^{***}
Window U-value	0.34 Btu/°F·ft ² ·h
Window SHGC	0.38
Window VT	0.8
Window Layout	Discrete
Number of Windows	2
Window Width	4.0 ft
Window Height	8.65999984741211 ft
Exterior Shading Type	No Shading

Surface 3

Wall	Wall 2-Exist
Wall Type	Brick/Stone on steel frame
Intended Occupancy Type	Non-Residential
Window	Window 1
Window Framing Type	Metal w/ Thermal Breaks
Window Glass Type	Double Pane w/ Low-E
Window Gas Fill Type	Default ^{***}
Window U-value	0.34 Btu/°F·ft ² ·h
Window SHGC	0.38

Roof

Roof	Roof 1
Roof Type	Built-up w/ metal deck
Roof R-Value	36.0 °F·ft ² ·h/Btu

Skylights

No Skylights

Floor

Floor	Floor 2-Slab on Grade Exist
Floor Type	Slab-on-Grade
Slab Insulation	No Insulation
Floor U-value	Estimated [*]

Walls and Windows

Surface 1

Wall	Wall 2-Exist
Wall Type	Brick/Stone on steel frame
Intended Occupancy Type	Non-Residential
Window	Window 1
Window Framing Type	Metal w/ Thermal Breaks
Window Glass Type	Double Pane w/ Low-E
Window Gas Fill Type	Default ^{***}
Window U-value	0.34 Btu/°F·ft ² ·h
Window SHGC	0.38

Notes:

- ¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
- ² Window includes all vertical fenestration, including curtainwall and storefront.
- ³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

Building Name: **Baraboo - CSMPL**

Gross Floor Area: **31,050 ft²**

	Current Building
Window VT	0.8
Window Layout	Discrete
Number of Windows	2
Window Width	4.0 ft
Window Height	8.65999984741211 ft
Exterior Shading Type	No Shading
Surface 4	
Wall	Wall 2-Exist
Wall Type	Brick/Stone on steel frame
Intended Occupancy Type	Non-Residential
Window	Window 1
Window Framing Type	Metal w/ Thermal Breaks
Window Glass Type	Double Pane w/ Low-E
Window Gas Fill Type	Default ¹
Window U-value	0.34 Btu/°F·ft ² ·h
Window SHGC	0.38
Window VT	0.8
Window Layout	Discrete
Number of Windows	2
Window Width	4.0 ft
Window Height	8.65999984741211 ft
Exterior Shading Type	No Shading

Infiltration

Energy code the building complies with Estimated²

Lighting

Lighting Power Density	1.04 W/ft ²
Fixture	
Fixture	Fixture 1
Lighting Type	LED
Mounting Type	Pendant
Lamp Wattage	40 W/lamp
Lamps per Fixture	2

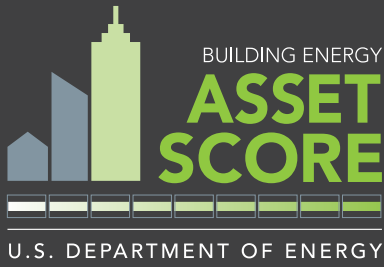
	Current Building
Number of Fixtures	160

Heating/Cooling

Thermal Zone Layout	Perimeter and core
Perimeter Zone Depth	15.0 ft
Primary Heating/Cooling System	
System Type	VAV with HW Reheat
Cooling Equipment	
Cooling Source	Plant
Plant Loop	CW Plant Loop - Cooling Loop - Chiller
Heating Equipment	
Heating Source	Plant
Plant Loop	HW Plant Loop 1 - Heating Loop - Boiler
Distribution	
Distribution Type	Multiple Zone
Terminal	
Terminal Unit	Reheat
Reheat Source	Hot Water Plant
Hot Water Plant Loop	HW Plant Loop 1
Minimum Air Flow Fraction	0.2
Fan Systems	
Total System Fan Power	0.93 W/CFM
Fan Motor Efficiency	95.0%
Economizer	
Demand Control Ventilation	
Fan Control	Variable Air Volume
Supply Air Temperature (SAT) Reset	Warmest Zone
Fan Static Pressure Reset	
Service Water Heating	
Water Heater	
Water Heater	Electricity
Fuel Type	Electricity
Water Heater Efficiency	99.00 Et

Notes:

¹ Total Gross Wall Area³ includes both opaque and glazed wall area.
² Window includes all vertical fenestration, including curtainwall and storefront.
³ Total Gross Roof Area³ includes both opaque and glazed roof area.



Building Assessment Tool Report

Building Asset Information

Building Name: **Baraboo - CSMPL**

Gross Floor Area: **31,050 ft²**

Current Building

Operations

Operation	Using Standard Operations**
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Notes:

- ¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
- ² Window includes all vertical fenestration, including curtainwall and storefront.
- ³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

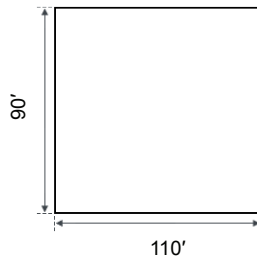
Building Name: **Baraboo - CSMPL**

Gross Floor Area: **31,050 ft²**

Block 2 - New Floor 1 CHARACTERISTICS SUMMARY

Geometry

Above Ground: 1 floor
Below Ground: 0 floors
Floor-to-Floor Height: 16.00 ft
Floor-to-Ceiling Height: 14.50 ft
Orientation: 0.0° from North
Use Type: Library



Current Building

Current Building

Window VT	0.8
Window Layout	Continuous
Window-to-Wall Ratio	0.25
Exterior Shading Type	No Shading

Infiltration

Energy code the building complies with Estimated¹

Lighting

Lighting Power Density	0.53 W/ft ²
Fixture	Fixture 1
Lighting Type	LED
Mounting Type	Pendant
Lamp Wattage	40 W/lamp
Lamps per Fixture	2
Number of Fixtures	60

Roof

Roof	Roof 1
Roof Type	Built-up w/ metal deck
Roof R-Value	36.0 °F·ft ² -h/Btu

Skylights

No Skylights

Floor

Floor	Floor 3-Slab on Grade New
Floor Type	Slab-on-Grade
Slab Insulation	Vertical Insulation
Floor R-value	10.0 °F·ft ² -h/Btu

Walls and Windows

All Surfaces

Wall	Wall 1-New
Wall Type	Brick/Stone on steel frame
Wall U-value	0.036 Btu/°F·ft ² -h
Window	Window 1
Window Framing Type	Metal w/ Thermal Breaks
Window Glass Type	Double Pane w/ Low-E
Window Gas Fill Type	Default ²
Window U-value	0.34 Btu/°F·ft ² -h
Window SHGC	0.38

Heating/Cooling

Thermal Zone Layout	Perimeter and core
Perimeter Zone Depth	15.0 ft
Primary Heating/Cooling System	Air Handler 2
System Type	VAV with HW Reheat
Cooling Equipment	
Cooling Source	Plant
Plant Loop	CW Plant Loop - Cooling Loop - Chiller
Heating Equipment	
Heating Source	Plant
Plant Loop	HW Plant Loop 1 - Heating Loop - Boiler
Distribution	
Distribution Type	Multiple Zone
Terminal	
Terminal Unit	Reheat
Reheat Source	Hot Water Plant

Notes:

¹ Total Gross Wall Area³ includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ Total Gross Roof Area³ includes both opaque and glazed roof area.

Building Name: **Baraboo - CSMPL**

Gross Floor Area: **31,050 ft²**

Current Building

Hot Water Plant Loop HW Plant Loop 1
 Minimum Air Flow Fraction 0.2

Fan Systems

Total System Fan Power 1.02 W/CFM
 Fan Motor Efficiency 93.0%
 Economizer
 Demand Control Ventilation
 Fan Control Variable Air Volume
 Supply Air Temperature (SAT) Reset Warmest Zone
 Fan Static Pressure Reset

Service Water Heating

Water Heater Natural Gas
 Fuel Type Natural Gas
 Water Heater Efficiency 97.00 Et

Operations

Operation Using Standard Operations**

Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
² Window includes all vertical fenestration, including curtainwall and storefront.
³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

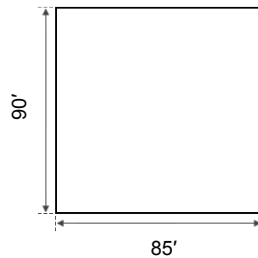
Building Name: **Baraboo - CSMP**

Gross Floor Area: **31,050 ft²**

Block 3 - Second Floor CHARACTERISTICS SUMMARY

Geometry

Above Ground: 1 floor
Below Ground: 0 floors
Floor-to-Floor Height: 12.00 ft
Floor-to-Ceiling Height: 10.50 ft
Orientation: 0.0° from North
Use Type: Library



Current Building

Current Building

Window Layout	Continuous
Window-to-Wall Ratio	0.25
Exterior Shading Type	No Shading
Daylight Controls	

Infiltration

Energy code the building complies with Estimated*

Lighting

Lighting Power Density	0.92 W/ft ²
Fixture	Fixture 1
Lighting Type	LED
Mounting Type	Pendant
Lamp Wattage	40 W/lamp
Lamps per Fixture	2
Number of Fixtures	80

Roof

Roof	Roof 1
Roof Type	Built-up w/ metal deck
Roof R-Value	36.0 °F·ft ² -h/Btu

Skylights

No Skylights

Floor

Floor	Floor 1
Floor Type	Concrete
Intended Occupancy Type	Non-Residential

Heating/Cooling

Thermal Zone Layout	Single zone
Primary Heating/Cooling System	Air Handler 3
System Type	VAV with HW Reheat
Cooling Equipment	
Cooling Source	Plant
Plant Loop	CW Plant Loop - Cooling Loop - Chiller
Heating Equipment	
Heating Source	Plant
Plant Loop	HW Plant Loop 1 - Heating Loop - Boiler
Distribution	
Distribution Type	Single Zone
Fan Systems	
Total System Fan Power	0.87 W/CFM
Fan Motor Efficiency	95.0%
Economizer	

Walls and Windows

All Surfaces

Wall	Wall 1-New
Wall Type	Brick/Stone on steel frame
Wall U-value	0.036 Btu/°F·ft ² -h
Window	Window 1
Window Framing Type	Metal w/ Thermal Breaks
Window Glass Type	Double Pane w/ Low-E
Window Gas Fill Type	Default***
Window U-value	0.34 Btu/°F·ft ² -h
Window SHGC	0.38
Window VT	0.8

Notes:

- * Total Gross Wall Area¹ includes both opaque and glazed wall area.
- ** Window includes all vertical fenestration, including curtainwall and storefront.
- ** Total Gross Roof Area³ includes both opaque and glazed roof area.

Building Name: **Baraboo - CSMPL**

Gross Floor Area: **31,050 ft²**

Current Building

Fan Control Constant Volume

Service Water Heating

Water Heater Natural Gas

Fuel Type Natural Gas

Water Heater Efficiency 97.00 Et

Operations

Operation Using Standard Operations²

Notes:

- ¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
- ² Window includes all vertical fenestration, including curtainwall and storefront.
- ³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

Building Name: **Baraboo - CSMPL**

Gross Floor Area: **31,050 ft²**

BUILDING ENVELOPE INFORMATION

Total Gross Above Grade Wall Area ¹	16960.0 ft ²
Total Window Area ²	2533.0 ft ²
Building Window to Wall Ratio	15%
Total Below Grade Wall Area	0.0 ft ²
Total Gross Roof Area ³	16650.0 ft ²
Total Skylight Area	0.0 ft ²
Total Conditioned Floor Area	Not Available
Total Footprint Area	Not Available

Areas by Orientation

NORTH

Gross Wall Area 4880.0 ft²

Window Area 764.2 ft²

SOUTH

Gross Wall Area 4880.0 ft²

Window Area 764.2 ft²

EAST

Gross Wall Area 3600.0 ft²

Window Area 664.6 ft²

WEST

Gross Wall Area 3600.0 ft²

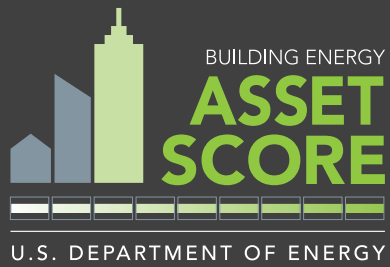
Window Area 339.1 ft²

Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ Total Gross Roof Area¹ includes both opaque and glazed roof area.



Building Assessment Tool Report

Software Provenance

Building Name: **Baraboo - CSMPL**

Gross Floor Area: **31,050 ft²**

SOFTWARE PROVENANCE

Asset Score/Audit Template
Open Studio
Energy-Plus

Asset Score Open Studio Web Service
Open Studio Simulation

Version: 2025.0.0.746 Build: master_746

3.7.0;
23.2;

Asset Score Open Studio Web Service, Version 3.0.9197.20730, Friday, March 7, 2025 11:31:00 AM
Release_7.1.24_20250428.0

BUILDING INFORMATION

Baraboo - Donahue Terrace
227 1st Ave
Baraboo, WI 53913

Building Type: **Mixed Use**
Gross Floor Area: **60,000 ft²**
Climate Zone: **6A**
Year Built: **1978**

Score Date: **06/05/2025**
Building ID #: **32253**
Climate Description: **Cold - Humid**
Software Release: **2025.0.0.746**

Estimated Annual Site Energy Use Intensity and Greenhouse Gas Intensity

	Site EUI (kBtu/ft ² /yr)	GHGI (kg CO ₂ e/ft ² /yr)
Current	83	16.45
Upgraded	62	12.82

Estimated annual site energy savings: 25.30%

Energy Use Intensity by Fuel Type

Current Building: Site Energy Use (kBtu/ft²/yr)



Upgraded Building: Site Energy Use (kBtu/ft²/yr)



Fuel Type Site EUI (kBtu/ft²) [Current, Upgraded]

- Natural Gas [20.0, 16.6]
- Electricity [63.2, 45.8]
- District Hot Water [0.0, 0.0]
- District Steam [0.0, 0.0]
- Fuel Oil [0.0, 0.0]
- Propane [0.0, 0.0]
- District Chilled Water [0.0, 0.0]

Building Use Types

Multi-family (4 floors or greater): **50,050 ft²**
Lodging: **10,010 ft²**

This report includes a Score for the entire building as well as individual Scores for each of the separate use types.

The **Building Energy Asset Score** is a national rating system developed by the U.S. Department of Energy. The **Score** reflects the energy efficiency of a building based on the building's structure, heating, cooling, ventilation, and hot water systems. The building's **Structure and Systems** are individually evaluated and ranked. The **Upgrade Opportunities** page provides recommendations for how to improve the building's energy efficiency, increase the building's Asset Score, and save money.

³ The energy savings range reflects the expected incremental savings for the overall building associated with the specific efficiency upgrade opportunity assuming all other recommended upgrades have already been implemented. This assumption is made to avoid double counting of savings. The ranges reflect site energy savings and are based on standard operating assumptions, unless actual operating conditions are provided by the user.

⁴ The costs are based on Advanced Energy Retrofit Guide and RS Means. The costs are replacement costs, not incremental costs. The costs do not include local incentives. Costs are shown as a range (\$ = low cost, \$\$ = medium cost, \$\$\$ = high cost).

[†] User-selected energy efficiency measure

Building Name: **Baraboo - Donahue Terrace**

Gross Floor Area: **60,060 ft²**

Selected Upgrade Opportunities	Energy Savings ³	Cost ⁴
--------------------------------	-----------------------------	-------------------

Building Envelope

- | | | |
|---|-----|-------------|
| • Add Floor Insulation for Block in blocks Block 1, Block 2, and Block 3 for Floor 2. [†] - Learn More | Low | \$\$ |
| • Add Wall Insulation for Block in blocks Block 1, Block 2, and Block 3 for Wall 1. [†] - Learn More | Low | \$\$-\$\$\$ |

Lighting Systems

- | | | |
|---|--------|----|
| • Upgrade to LED Fixtures for Lighting Fixture in blocks Block 1 and Block 3 for Fixture 2. [†] - Learn More | Medium | \$ |
| • Upgrade to LED Fixtures for Lighting Fixture in blocks Block 1, Block 2, and Block 3 for Fixture 1. [†] - Learn More | Medium | \$ |

HVAC Systems and Controls

- | | | |
|---|--------|-------------|
| • Replace Existing Packaged Terminal AC with High-performance Packaged Terminal AC in block Block 2 for Zone Equipment 1. [†] - Learn More | Medium | \$\$-\$\$\$ |
|---|--------|-------------|

Service Hot Water Systems

- | | | |
|--|-----|------|
| • Upgrade to Condensing Storage Hot Water Heater in blocks Block 3 and Block 1 for Water Heater 1. [†] - Learn More | Low | \$\$ |
|--|-----|------|

³ The energy savings range reflects the expected incremental savings for the overall building associated with the specific efficiency upgrade opportunity assuming all other recommended upgrades have already been implemented. This assumption is made to avoid double counting of savings. The ranges reflect site energy savings and are based on standard operating assumptions, unless actual operating conditions are provided by the user.

⁴ The costs are based on Advanced Energy Retrofit Guide and RS Means. The costs are replacement costs, not incremental costs. The costs do not include local incentives. Costs are shown as a range (\$ = low cost, \$\$ = medium cost, \$\$\$ = high cost).

[†] User-selected energy efficiency measure

Building Name: **Baraboo - Donahue Terrace**

Gross Floor Area: **60,060 ft²**

Health and Safety Impact of Upgrade Opportunities

Building Envelope

Health and Safety Impact

- Add Floor Insulation for Block in blocks Block 1, Block 2, and Block 3 for Floor 2.[†] Better insulation may improve thermal comfort. However, adding insulation can disturb existing building materials that may contain asbestos. Consult an accredited asbestos professional to determine if this is a concern.
- Add Wall Insulation for Block in blocks Block 1, Block 2, and Block 3 for Wall 1.[†] Better insulation may improve thermal comfort. But note that adding insulation can disturb existing building materials that may contain asbestos. Consult an accredited asbestos professional to determine if this is a concern.

Lighting Systems

- Upgrade to LED Fixtures for Lighting Fixture in blocks Block 1 and Block 3 for Fixture 2.[†] Indoor lighting retrofit has the potential to improve lighting quality and occupant satisfaction. Retrofits that also allow occupants to have more lighting control can provide greater flexibility to adapt and respond to changing needs.
- Upgrade to LED Fixtures for Lighting Fixture in blocks Block 1, Block 2, and Block 3 for Fixture 1.[†] Indoor lighting retrofit has the potential to improve lighting quality and occupant satisfaction. Retrofits that also allow occupants to have more lighting control can provide greater flexibility to adapt and respond to changing needs.

HVAC Systems and Controls

- Replace Existing Packaged Terminal AC with High-performance Packaged Terminal AC in block Block 2 for Zone Equipment 1.[†] Many existing HVAC systems are not providing proper ventilation, filtration, heating, cooling, dehumidification, and are inefficient. HVAC replacement can improve thermal comfort and potentially reduce background noise by selecting equipment that meets the sound specification and with proper installation. In addition, dedicated outdoor air ventilation systems can improve indoor air quality by meeting the minimum outside air ventilation rates and better control of indoor humidity.

Service Hot Water Systems

Building Name: **Baraboo - Donahue Terrace**

Gross Floor Area: **60,060 ft²**

Health and Safety Impact of Upgrade Opportunities

- Upgrade to Condensing Storage Hot Water Heater in blocks Block 3 and Block 1 for Water Heater 1.[†] High-performance condensing hot water systems are designed to operate more efficiently, producing hot water while emitting fewer pollutants, such as nitrogen oxides. This reduction in harmful emissions can contribute to healthier indoor air quality.

Building Name: **Baraboo - Donahue Terrace**

Gross Floor Area: **60,060 ft²**

ABOUT THE BUILDING SYSTEMS

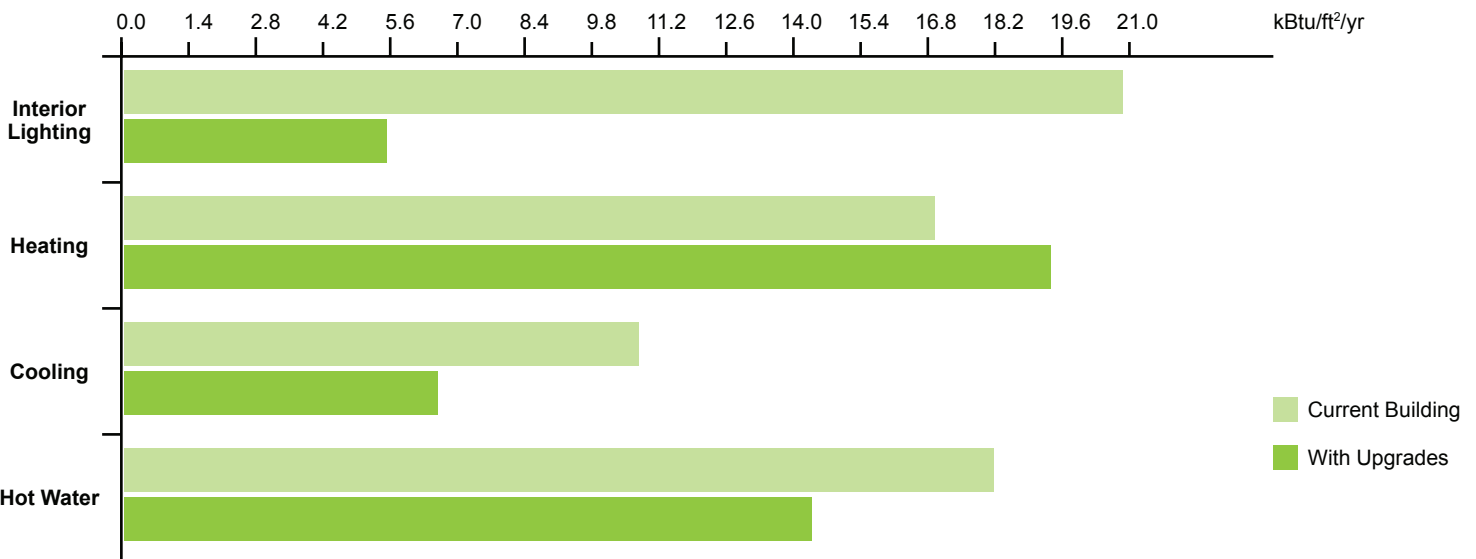
	Ranking ⁵
Interior Lighting	Fair
Whole Building HVAC System TSPR	Fair
Zone Equipment 1	Good

ABOUT THE BUILDING ENVELOPE

	Ranking ⁵
Roof U-Value, Non-Attic (Btu/ft ² ·h·°F)	Good
Walls U-Value, Framed (Btu/ft ² ·h·°F)	Good
Windows U-Value (Btu/ft ² ·h·°F)	Fair
Walls + Windows U-Value (Btu/ft ² ·h·°F)	Fair
Window Solar Heat Gain Coefficient	Fair

*System evaluation is not based on a verified TSPR

SITE ENERGY USE INTENSITY BY END USE



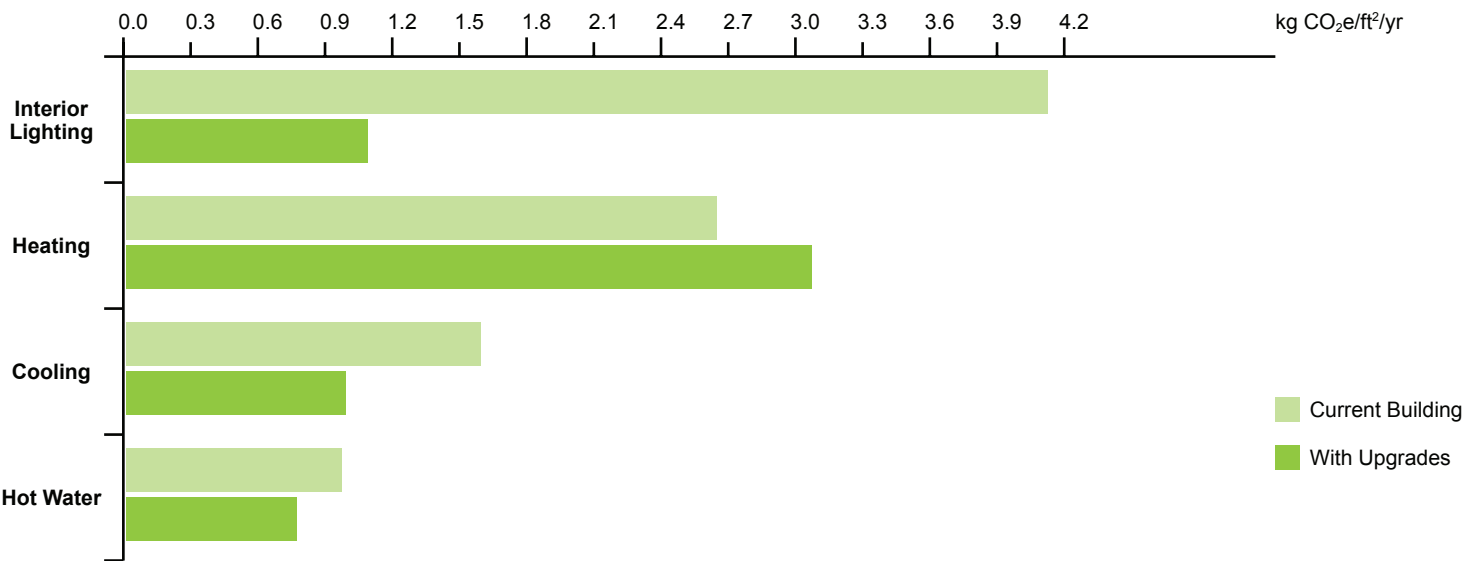
⁵ Ranking Range:

Fair: Building Envelope or Building Systems are less efficient than a typical building built to the AHSRAE 90.1-2004 energy code.
Superior: Building Envelope is more efficient than a typical building built to the AHSRAE 90.1-2013 energy code. Building Systems exceed the highest efficiency levels with market viable technologies.
Good: Building Envelope or Building Systems are between Fair and Superior.
NA: The building does not have a heating or a cooling system, or the loads are too low for the system to be effectively ranked.

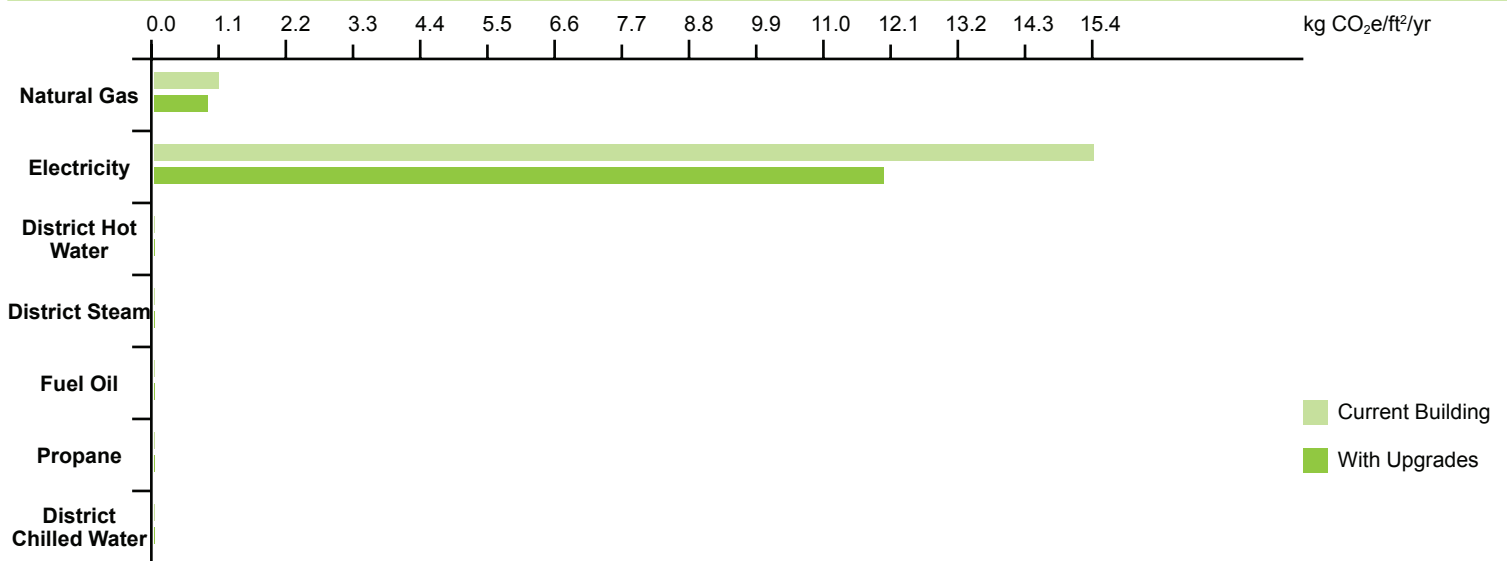
Building Name: **Baraboo - Donahue Terrace**

Gross Floor Area: **60,060 ft²**

CARBON EMISSIONS BY END USE⁶



CARBON EMISSIONS BY FUEL TYPE⁶



⁶ Carbon dioxide equivalent (CO₂e) greenhouse gas annual emission rates are calculated by multiplying the annual energy use rates for each end use and fuel type by emission factors that are specific to each fuel type and then by dividing by the total floor area for the affected blocks. The emission factors for electricity are provided by U.S. EPA Power Profiler v9.1 and are specific to the eGRID subregions that are assigned to the ZIP code for the building. The emissions factors for electricity do not include gross grid loss (line loss).

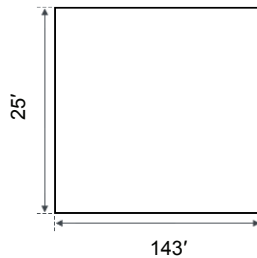
Building Name: **Baraboo - Donahue Terrace**

Gross Floor Area: **60,060 ft²**

Block 1 CHARACTERISTICS SUMMARY

Geometry

Above Ground: 7 floors
 Below Ground: 0 floors
 Floor-to-Floor Height: 9.50 ft
 Floor-to-Ceiling Height: 8.00 ft
 Orientation: 0.0° from North
 Use Type: Multi-family (4 floors or greater)



Current Building

Roof

Roof: Roof 1
 Roof Type: Built-up w/ concrete deck
 Roof Insulation Thickness: 5.5 in

Skylights

No Skylights

Floor

Floor: Floor 2
 Floor Type: Concrete
 Intended Occupancy Type: Residential

Walls and Windows

Surface 1

Wall: Wall 1
 Wall Type: Brick/Stone on masonry
 Wall U-value: 0.74 Btu/°F·ft²·h
 Window: Window 1
 Window Framing Type: Metal w/ Thermal Breaks
 Window Glass Type: Double Pane w/ Low-E
 Window Gas Fill Type: Air
 Intended Occupancy Type: Residential

Window SHGC: Estimated*
 Window VT: Estimated*
 Window Layout: Discrete
 Number of Windows: 4
 Window Width: 4.5 ft
 Window Height: 4.5 ft
 Exterior Shading Type: No Shading

Surface 2

Wall: Wall 1
 Wall Type: Brick/Stone on masonry
 Wall U-value: 0.74 Btu/°F·ft²·h
 Window: Window 1
 Window Framing Type: Metal w/ Thermal Breaks
 Window Glass Type: Double Pane w/ Low-E
 Window Gas Fill Type: Air
 Intended Occupancy Type: Residential
 Window SHGC: Estimated*
 Window VT: Estimated*
 Window Layout: Discrete
 Number of Windows: 48
 Window Width: 4.5 ft
 Window Height: 4.5 ft
 Exterior Shading Type: No Shading

Surface 3

Wall: Wall 1
 Wall Type: Brick/Stone on masonry
 Wall U-value: 0.74 Btu/°F·ft²·h
 Window: Window 1
 Window Framing Type: Metal w/ Thermal Breaks
 Window Glass Type: Double Pane w/ Low-E
 Window Gas Fill Type: Air
 Intended Occupancy Type: Residential

Current Building

Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
² Window includes all vertical fenestration, including curtainwall and storefront.
³ Total Gross Roof Area³ includes both opaque and glazed roof area.

Building Name: **Baraboo - Donahue Terrace**

Gross Floor Area: **60,060 ft²**

	Current Building
Window SHGC	Estimated ¹
Window VT	Estimated ¹
Window Layout	Discrete
Number of Windows	5
Window Width	4.5 ft
Window Height	4.5 ft
Exterior Shading Type	No Shading

Surface 4

Fully Interior Wall

Infiltration

Energy code the building complies with	Estimated ¹
--	------------------------

Lighting

Lighting Power Density	2.34 W/ft ²
------------------------	------------------------

Fixture	Fixture 1
Lighting Type	Fluorescent T8
Mounting Type	Surface
Lamp Wattage	32 W/lamp
Lamps per Fixture	2
Percent Served	60.0%

Fixture	Fixture 2
Lighting Type	Incandescent/Halogen
Mounting Type	Pendant
Lamp Wattage	50 W/lamp
Lamps per Fixture	1
Percent Served	40.0%
Occupancy Controls	

Heating/Cooling

Thermal Zone Layout	Single zone
Primary Heating/Cooling System	Zone Equipment 1
System Type	Window AC

Cooling Equipment

Cooling Source	Terminal DX
Efficiency	Estimated ¹

Heating Equipment

Heating Source	No Heating
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Fan Systems

Total System Fan Power	Default ^{***}
------------------------	------------------------

Secondary Heating/Cooling System

System Type	Zone Equipment 1
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Cooling Equipment

Cooling Source	No Cooling
----------------	------------

Heating Equipment

Heating Source	Convective Baseboard: Electric
----------------	--------------------------------

Fuel Type	Electricity
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Thermal Efficiency	Estimated ¹
--------------------	------------------------

Secondary Heating Fraction	0.2
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Service Water Heating

Water Heater	Natural Gas
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Fuel Type	Natural Gas
-----------	-------------

Water Heater Efficiency	80.00 Et
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Operations

Operation	Operation 1
------------------	-------------

Miscellaneous Electric Load	0.6 W/ft ²
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Miscellaneous Gas Load	Standard ^{**}
------------------------	------------------------

Total Occupants	70 total occupants
-----------------	--------------------

Setpoint Heating	70 °F
------------------	-------

Setpoint Cooling	74 °F
------------------	-------

Number of Units per Block:	30
----------------------------	----

Average Bedrooms per Unit:	1.0
----------------------------	-----

Clothes Dryer Type:	Conventional Vented Dryer
---------------------	---------------------------

Heating Stove Type:	Electric Resistance Burner
---------------------	----------------------------

Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

Building Name: **Baraboo - Donahue Terrace**

Gross Floor Area: **60,060 ft²**

Current Building

Saturdays	12:00am - 12:00am
Sundays	12:00am - 12:00am
Elevator	Elevator 1
Elevator Type	Hydraulic
Number of Elevators	2
Year of Manufacture	2022

Notes:

- ¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
- ² Window includes all vertical fenestration, including curtainwall and storefront.
- ³ Total Gross Roof Area³ includes both opaque and glazed roof area.

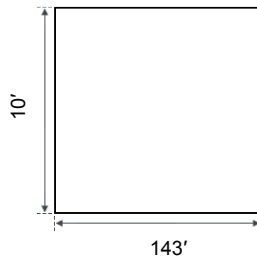
Building Name: **Baraboo - Donahue Terrace**

Gross Floor Area: **60,060 ft²**

Block 2 CHARACTERISTICS SUMMARY

Geometry

Above Ground: 7 floors
Below Ground: 0 floors
Floor-to-Floor Height: 9.50 ft
Floor-to-Ceiling Height: 8.00 ft
Orientation: 0.0° from North
Use Type: Lodging



Current Building

Roof

Roof	Roof 1
Roof Type	Built-up w/ concrete deck
Roof Insulation Thickness	5.5 in

Skylights

No Skylights

Floor

Floor	Floor 2
Floor Type	Concrete
Intended Occupancy Type	Residential

Walls and Windows

All Surfaces

Wall	Wall 1
Wall Type	Brick/Stone on masonry
Wall U-value	0.74 Btu/°F·ft ² ·h

No Windows

Infiltration

Energy code the building complies with	Estimated ¹
--	------------------------

Lighting

Lighting Power Density	0.86 W/ft ²
------------------------	------------------------

Current Building

Fixture	Fixture 1
Lighting Type	Fluorescent T8
Mounting Type	Surface
Lamp Wattage	32 W/lamp
Lamps per Fixture	2
Percent Served	100.0%

Heating/Cooling

Thermal Zone Layout	Single zone
Primary Heating/Cooling System	Zone Equipment 1
System Type	Pkgd Terminal AC
Cooling Equipment	
Cooling Source	Terminal DX
Efficiency	Estimated ¹
Heating Equipment	
Heating Source	Single Zone Central Furnace
Fuel Type	Natural Gas
Thermal Efficiency	Estimated ¹

Fan Systems

Total System Fan Power	Default ²
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Service Water Heating

No Water Heater

Operations

Operation	Using Standard Operations ²
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Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
² Window includes all vertical fenestration, including curtainwall and storefront.
³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

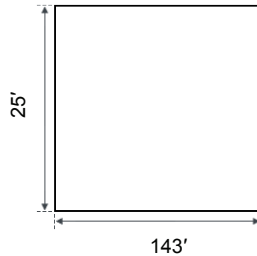
Building Name: **Baraboo - Donahue Terrace**

Gross Floor Area: **60,060 ft²**

Block 3 CHARACTERISTICS SUMMARY

Geometry

Above Ground: 7 floors
 Below Ground: 0 floors
 Floor-to-Floor Height: 9.50 ft
 Floor-to-Ceiling Height: 8.00 ft
 Orientation: 0.0° from North
 Use Type: Multi-family (4 floors or greater)



Current Building

Current Building

Window SHGC: Estimated*
 Window VT: Estimated*
 Window Layout: Discrete
 Number of Windows: 6
 Window Width: 4.5 ft
 Window Height: 4.5 ft
 Exterior Shading Type: No Shading

Surface 2

Fully Interior Wall

Surface 3

Wall: Wall 1
 Wall Type: Brick/Stone on masonry
 Wall U-value: 0.74 Btu/°F·ft²·h
 Window: Window 1
 Window Framing Type: Metal w/ Thermal Breaks
 Window Glass Type: Double Pane w/ Low-E
 Window Gas Fill Type: Air
 Intended Occupancy Type: Residential
 Window SHGC: Estimated*
 Window VT: Estimated*
 Window Layout: Discrete
 Number of Windows: 6
 Window Width: 4.5 ft
 Window Height: 4.5 ft
 Exterior Shading Type: No Shading

Surface 4

Wall: Wall 1
 Wall Type: Brick/Stone on masonry
 Wall U-value: 0.74 Btu/°F·ft²·h
 Window: Window 1
 Window Framing Type: Metal w/ Thermal Breaks

Roof

Roof: Roof 1
 Roof Type: Built-up w/ concrete deck
 Roof Insulation Thickness: 5.5 in

Skylights

No Skylights

Floor

Floor: Floor 2
 Floor Type: Concrete
 Intended Occupancy Type: Residential

Walls and Windows

Surface 1

Wall: Wall 1
 Wall Type: Brick/Stone on masonry
 Wall U-value: 0.74 Btu/°F·ft²·h
 Window: Window 1
 Window Framing Type: Metal w/ Thermal Breaks
 Window Glass Type: Double Pane w/ Low-E
 Window Gas Fill Type: Air
 Intended Occupancy Type: Residential

Notes:

- ¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
- ² Window includes all vertical fenestration, including curtainwall and storefront.
- ³ Total Gross Roof Area³ includes both opaque and glazed roof area.

Building Name: **Baraboo - Donahue Terrace**

Gross Floor Area: **60,060 ft²**

	Current Building
Window Glass Type	Double Pane w/ Low-E
Window Gas Fill Type	Air
Intended Occupancy Type	Residential
Window SHGC	Estimated ¹
Window VT	Estimated ¹
Window Layout	Discrete
Number of Windows	62
Window Width	4.5 ft
Window Height	4.5 ft
Exterior Shading Type	No Shading

Infiltration

Energy code the building complies with	Estimated ¹
--	------------------------

Lighting

Lighting Power Density	2.34 W/ft ²
------------------------	------------------------

Fixture	Fixture 1
Lighting Type	Fluorescent T8
Mounting Type	Surface
Lamp Wattage	32 W/lamp
Lamps per Fixture	2
Percent Served	60.0%
Fixture	Fixture 2
Lighting Type	Incandescent/Halogen
Mounting Type	Pendant
Lamp Wattage	50 W/lamp
Lamps per Fixture	1
Percent Served	40.0%

Heating/Cooling

Thermal Zone Layout	Single zone
Primary Heating/Cooling System	Zone Equipment 1
System Type	Window AC

Cooling Equipment

Cooling Source	Terminal DX
Efficiency	Estimated ¹

Heating Equipment

Heating Source	No Heating
----------------	------------

Fan Systems

Total System Fan Power	Default ^{***}
------------------------	------------------------

Secondary Heating/Cooling System

System Type	Baseboard
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Cooling Equipment

Cooling Source	No Cooling
----------------	------------

Heating Equipment

Heating Source	Convective Baseboard: Electric
Fuel Type	Electricity
Thermal Efficiency	Estimated ¹
Secondary Heating Fraction	0.2

Service Water Heating

Water Heater	Natural Gas
Fuel Type	Natural Gas
Water Heater Efficiency	80.00 Et

Operations

Operation	Operation 1
Miscellaneous Electric Load	0.6 W/ft ²
Miscellaneous Gas Load	Standard ^{**}
Total Occupants	70 total occupants
Setpoint Heating	70 °F
Setpoint Cooling	74 °F
Number of Units per Block:	30
Average Bedrooms per Unit:	1.0
Clothes Dryer Type:	Conventional Vented Dryer
Heating Stove Type:	Electric Resistance Burner

Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

Building Name: **Baraboo - Donahue Terrace**

Gross Floor Area: **60,060 ft²**

Current Building

Saturdays	12:00am - 12:00am
Sundays	12:00am - 12:00am
Elevator	Elevator 1
Elevator Type	Hydraulic
Number of Elevators	2
Year of Manufacture	2022

Notes:

- ¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
- ² Window includes all vertical fenestration, including curtainwall and storefront.
- ³ Total Gross Roof Area³ includes both opaque and glazed roof area.

Building Name: **Baraboo - Donahue Terrace**

Gross Floor Area: **60,060 ft²**

BUILDING ENVELOPE INFORMATION

Total Gross Above Grade Wall Area ¹	26999.0 ft ²
Total Window Area ²	2410.0 ft ²
Building Window to Wall Ratio	9%
Total Below Grade Wall Area	0.0 ft ²
Total Gross Roof Area ³	8580.0 ft ²
Total Skylight Area	0.0 ft ²
Total Conditioned Floor Area	Not Available
Total Footprint Area	Not Available

Areas by Orientation

NORTH

Gross Wall Area 9509.0 ft²

Window Area 850.1 ft²

SOUTH

Gross Wall Area 9509.0 ft²

Window Area 1133.5 ft²

EAST

Gross Wall Area 3990.0 ft²

Window Area 222.6 ft²

WEST

Gross Wall Area 3990.0 ft²

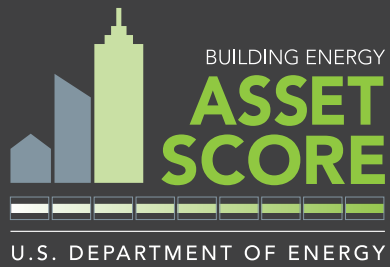
Window Area 202.7 ft²

Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ Total Gross Roof Area¹ includes both opaque and glazed roof area.



Building Assessment Tool Report

Software Provenance

Building Name: **Baraboo - Donahue Terrace**

Gross Floor Area: **60,060 ft²**

SOFTWARE PROVENANCE

Asset Score/Audit Template	Version: 2025.0.0.746 Build: master_746
Open Studio	3.7.0;
Energy-Plus	23.2;
Asset Score Open Studio Web Service	Asset Score Open Studio Web Service, Version 3.0.9197.20730, Friday, March 7, 2025 11:31:00 AM
Open Studio Simulation	Release_7.1.24_20250428.0

BUILDING INFORMATION

Baraboo - Hockey Pavillion

1100 Walnut St
Baraboo, WI 53913

Building Type:

Warehouse non-refrigerated

Gross Floor Area:
Climate Zone:
Year Built:

32,266 ft²
6A
1993

Score Date:

06/05/2025

Building ID #:
Climate Description:
Software Release:

32865
Cold - Humid
2025.0.0.746

Estimated Annual Site Energy Use Intensity and Greenhouse Gas Intensity

	Site EUI (kBtu/ft ² /yr)	GHGI (kg CO ₂ e/ft ² /yr)
Current	76	9.96
Upgraded	73	9.54

Estimated annual site energy savings: 3.95%

Energy Use Intensity by Fuel Type

Current Building: Site Energy Use (kBtu/ft²/yr)



Upgraded Building: Site Energy Use (kBtu/ft²/yr)



Standard Occupancy and Operating Conditions

Number of Assumed Occupants	0
Hours of Operation	0.0 hrs/wk
Cooling Set Point	80° F
Heating Set Point	60° F
Misc. Energy Loads	0.66 W/ft ²

The **Building Energy Asset Score** is a national rating system developed by the U.S. Department of Energy. The **Score** reflects the energy efficiency of a building based on the building's structure, heating, cooling, ventilation, and hot water systems. The building's **Structure and Systems** are individually evaluated and ranked. The **Upgrade Opportunities** page provides recommendations for how to improve the building's energy efficiency, increase the building's Asset Score, and save money.

³ The energy savings range reflects the expected incremental savings for the overall building associated with the specific efficiency upgrade opportunity assuming all other recommended upgrades have already been implemented. This assumption is made to avoid double counting of savings. The ranges reflect site energy savings and are based on standard operating assumptions, unless actual operating conditions are provided by the user.

⁴ The costs are based on Advanced Energy Retrofit Guide and RS Means. The costs are replacement costs, not incremental costs. The costs do not include local incentives. Costs are shown as a range (\$ = low cost, \$\$ = medium cost, \$\$\$ = high cost).

[†] User-selected energy efficiency measure

Building Name: **Baraboo - Hockey Pavillion**

Gross Floor Area: **31,500 ft²**

Selected Upgrade Opportunities

Energy Savings ³

Cost⁴

Building Envelope

No opportunities identified.

Lighting Systems

No opportunities identified.

HVAC Systems and Controls

- Replace Existing Chiller with High-performance Chiller in block Block 1 for IceLoop.[†] - [Learn More](#)

Medium

\$\$\$

Service Hot Water Systems

No opportunities identified.

³ The energy savings range reflects the expected incremental savings for the overall building associated with the specific efficiency upgrade opportunity assuming all other recommended upgrades have already been implemented. This assumption is made to avoid double counting of savings. The ranges reflect site energy savings and are based on standard operating assumptions, unless actual operating conditions are provided by the user.

⁴ The costs are based on Advanced Energy Retrofit Guide and RS Means. The costs are replacement costs, not incremental costs. The costs do not include local incentives. Costs are shown as a range (\$ = low cost, \$\$ = medium cost, \$\$\$ = high cost).

[†] User-selected energy efficiency measure

Building Name: **Baraboo - Hockey Pavillion**

Gross Floor Area: **31,500 ft²**

Health and Safety Impact of Upgrade Opportunities

Building Envelope

Health and Safety Impact

No opportunities identified.

Lighting Systems

No opportunities identified.

HVAC Systems and Controls

- Replace Existing Chiller with High-performance Chiller in block Block 1 for IceLoop.†

Many existing HVAC systems are not providing proper ventilation, filtration, heating, cooling, dehumidification, and are inefficient. HVAC replacement can improve thermal comfort and potentially reduce background noise by selecting equipment that meets the sound specification and with proper installation. In addition, dedicated outdoor air ventilation systems can improve indoor air quality by meeting the minimum outside air ventilation rates and better control of indoor humidity.

Service Hot Water Systems

No opportunities identified.

Building Name: **Baraboo - Hockey Pavillion**

Gross Floor Area: **31,500 ft²**

ABOUT THE BUILDING SYSTEMS

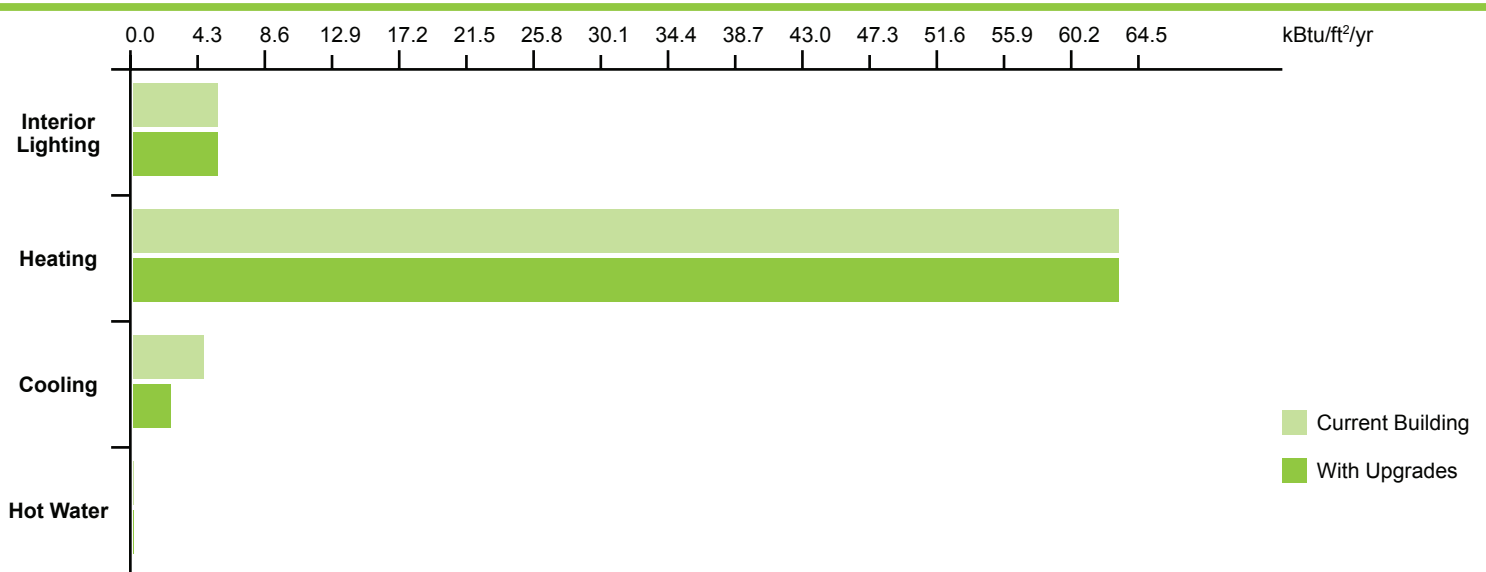
	Ranking ⁵
Interior Lighting	Superior
Whole Building HVAC System TSPR	Superior
Air Handler 1	N/A

ABOUT THE BUILDING ENVELOPE

	Ranking ⁵
Roof U-Value, Non-Attic (Btu/ft ² ·h·°F)	Good
Walls U-Value, Framed (Btu/ft ² ·h·°F)	Fair
Windows U-Value (Btu/ft ² ·h·°F)	N/A
Walls + Windows U-Value (Btu/ft ² ·h·°F)	N/A
Window Solar Heat Gain Coefficient	N/A

*System evaluation is not based on a verified TSPR

SITE ENERGY USE INTENSITY BY END USE



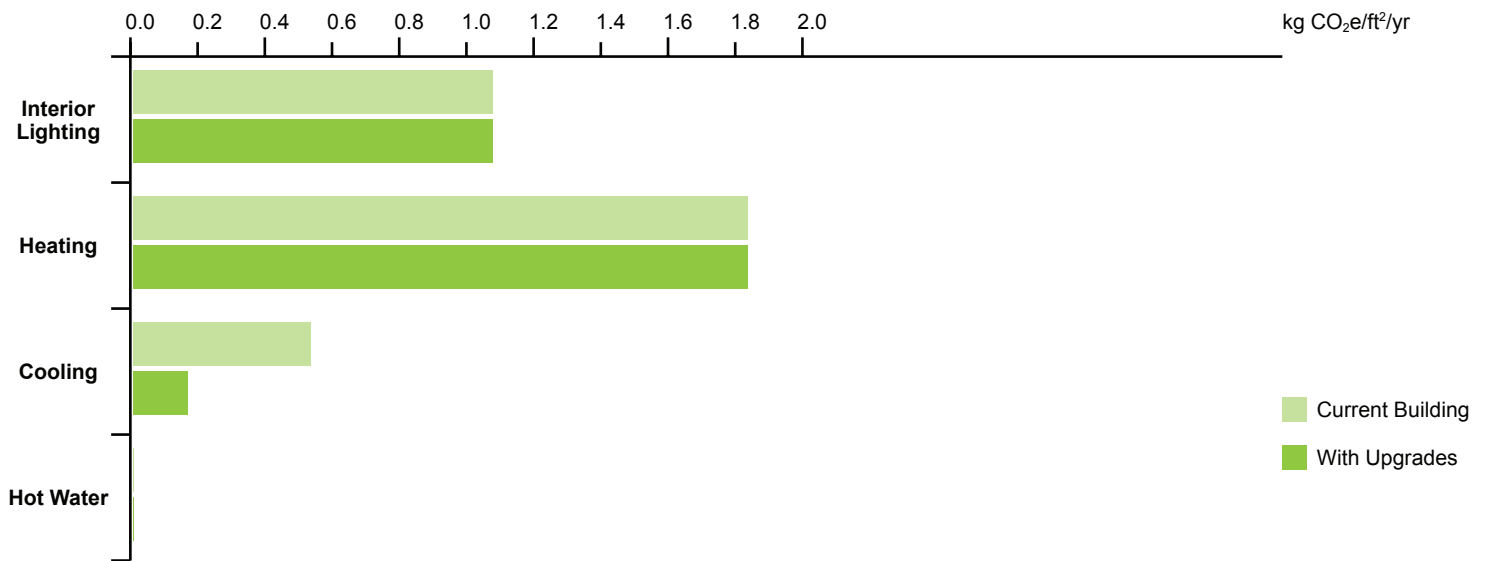
⁵ Ranking Range:

Fair: Building Envelope or Building Systems are less efficient than a typical building built to the AHSRAE 90.1-2004 energy code.
Superior: Building Envelope is more efficient than a typical building built to the AHSRAE 90.1-2013 energy code. Building Systems exceed the highest efficiency levels with market viable technologies.
Good: Building Envelope or Building Systems are between Fair and Superior.
N/A: The building does not have a heating or a cooling system, or the loads are too low for the system to be effectively ranked.

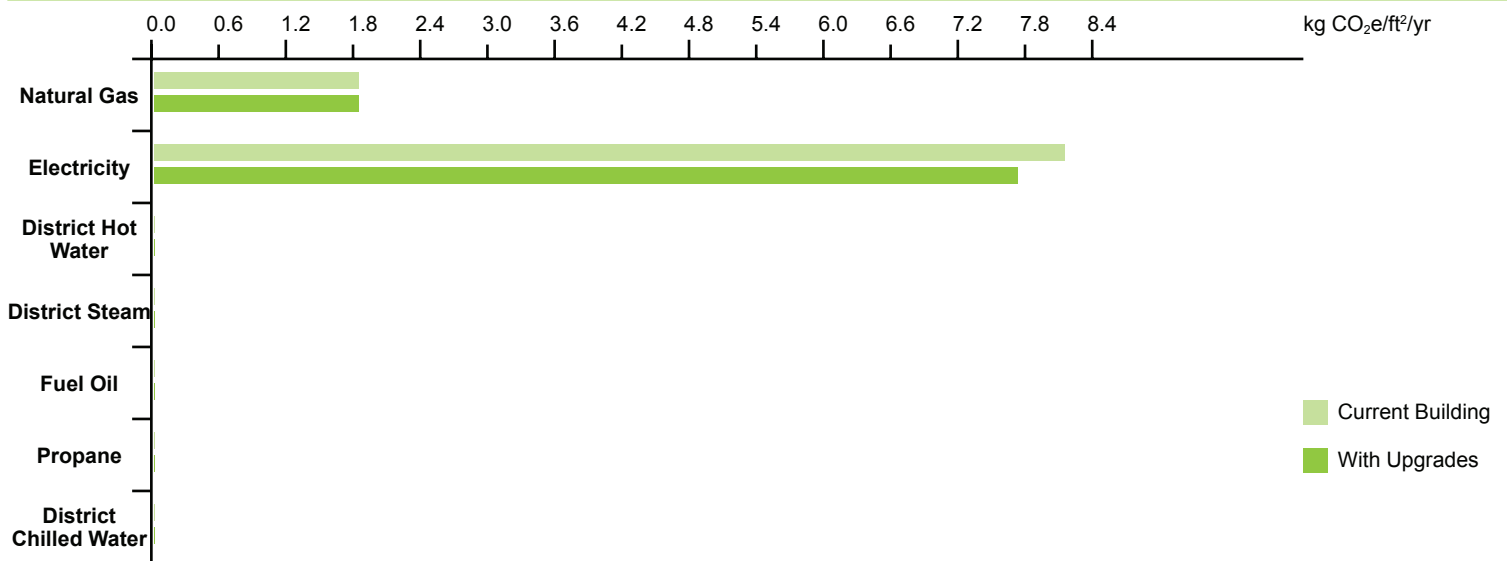
Building Name: **Baraboo - Hockey Pavillion**

Gross Floor Area: **31,500 ft²**

CARBON EMISSIONS BY END USE⁶



CARBON EMISSIONS BY FUEL TYPE⁶



⁶ Carbon dioxide equivalent (CO₂e) greenhouse gas annual emission rates are calculated by multiplying the annual energy use rates for each end use and fuel type by emission factors that are specific to each fuel type and then by dividing by the total floor area for the affected blocks. The emission factors for electricity are provided by U.S. EPA Power Profiler v9.1 and are specific to the eGRID subregions that are assigned to the ZIP code for the building. The emissions factors for electricity do not include gross grid loss (line loss).

Building Name: **Baraboo - Hockey Pavillion**

Gross Floor Area: **31,500 ft²**

BUILDING CHARACTERISTICS SUMMARY

Plants

CondenserLoop

Plant Loop Type	Condenser Loop
Condenser Pump Control	Constant Speed
Equipment Type	Cooling Tower
Cooling Tower Fan Control	Single Speed

IceLoop

Plant Loop Type	Cooling Loop
Equipment Type	Chiller
Compressor Type	Centrifugal
Condenser Type	Water
Condenser Loop	CondenserLoop
Year of Manufacture	1983
Efficiency	2.0 COP

Notes:

¹ 'Total Gross Wall Area' includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ 'Total Gross Roof Area' includes both opaque and glazed roof area.

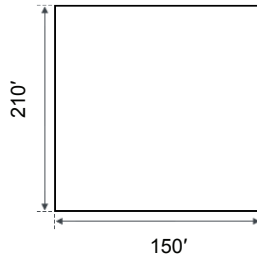
Building Name: **Baraboo - Hockey Pavillion**

Gross Floor Area: **31,500 ft²**

Block 1 CHARACTERISTICS SUMMARY

Geometry

Above Ground: 1 floor
 Below Ground: 0 floors
 Floor-to-Floor Height: 20.00 ft
 Floor-to-Ceiling: 18.50 ft
 Height:
 Orientation: 0.0° from North
 Use Type: Warehouse non-refrigerated



Current Building

Roof

Roof	Roof 1
Roof Type	Metal surfacing
Roof Insulation Thickness	6.0 in

Skylights

No Skylights

Floor

Floor	Floor 1
Floor Type	Slab-on-Grade
Floor U-value	Estimated*

Walls and Windows

All Surfaces

Wall	Wall 1
Wall Type	Metal panel/Curtain Wall
Wall U-value	1.0 Btu/°F·ft ² ·h

No Windows

Infiltration

Energy code the building complies with	Estimated*
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Lighting

Current Building

Lighting Power Density	0.56 W/ft ²
Fixture	Fixture 1
Lighting Type	LED
Mounting Type	Pendant
Lamp Wattage	40 W/lamp
Lamps per Fixture	8
Number of Fixtures	50

Heating/Cooling

Thermal Zone Layout	Single zone
Primary Heating/Cooling System	Air Handler 1
Cooling Equipment	
Cooling Source	Plant
Plant Loop	IceLoop - Cooling Loop - Chiller
Heating Equipment	
Heating Source	Central Furnace
Fuel Type	Natural Gas
# Pieces of Equipment	1
Thermal Efficiency	80.00%
Distribution	
Distribution Type	Single Zone
Fan Systems	
Fan Control	Constant Volume

Service Water Heating

Water Heater	Natural Gas
Fuel Type	Natural Gas
Water Heater Efficiency	80.00 Et

Operations

Operation	Using Standard Operations**
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Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
² Window includes all vertical fenestration, including curtainwall and storefront.
³ Total Gross Roof Area³ includes both opaque and glazed roof area.

Building Name: **Baraboo - Hockey Pavillion**

Gross Floor Area: **31,500 ft²**

BUILDING ENVELOPE INFORMATION

Total Gross Above Grade Wall Area ¹	14400.0 ft ²
Total Window Area ²	0.0 ft ²
Building Window to Wall Ratio	0%
Total Below Grade Wall Area	0.0 ft ²
Total Gross Roof Area ³	31500.0 ft ²
Total Skylight Area	0.0 ft ²
Total Conditioned Floor Area	Not Available
Total Footprint Area	Not Available

Areas by Orientation

NORTH

Gross Wall Area 3000.0 ft²

Window Area 0.0 ft²

SOUTH

Gross Wall Area 3000.0 ft²

Window Area 0.0 ft²

EAST

Gross Wall Area 4200.0 ft²

Window Area 0.0 ft²

WEST

Gross Wall Area 4200.0 ft²

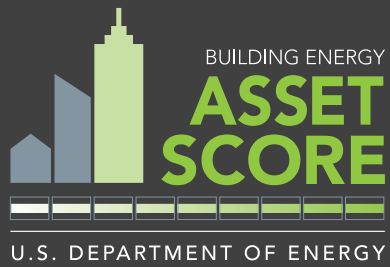
Window Area 0.0 ft²

Notes:

¹ 'Total Gross Wall Area' includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ 'Total Gross Roof Area' includes both opaque and glazed roof area.



Building Assessment Tool Report

Software Provenance

Building Name: **Baraboo - Hockey Pavillion**

Gross Floor Area: **31,500 ft²**

SOFTWARE PROVENANCE

Asset Score/Audit Template	Version: 2025.0.0.746 Build: master_746
Open Studio	3.7.0;
Energy-Plus	23.2;
Asset Score Open Studio Web Service	Asset Score Open Studio Web Service, Version 3.0.9197.20730, Friday, March 7, 2025 11:31:00 AM
Open Studio Simulation	Release_7.1.24_20250428.0

BUILDING INFORMATION

Baraboo - Municipal Building
101 South Blvd
Baraboo, WI 53719

Building Type: **Mixed Use**
Gross Floor Area: **48,600 ft²**
Climate Zone: **6A**
Year Built: **2018**

Score Date: **06/05/2025**
Building ID #: **32515**
Climate Description: **Cold - Humid**
Software Release: **2025.0.0.746**

Estimated Annual Site Energy Use Intensity and Greenhouse Gas Intensity

	Site EUI (kBtu/ft ² /yr)	GHGI (kg CO ₂ e/ft ² /yr)
Current	47	7.61
Upgraded	40	7.15

Estimated annual site energy savings: 14.89%

Energy Use Intensity by Fuel Type

Current Building: Site Energy Use (kBtu/ft²/yr)



Upgraded Building: Site Energy Use (kBtu/ft²/yr)



Fuel Type Site EUI (kBtu/ft²) [Current, Upgraded]

Natural Gas	[11.9, 5.3]
Electricity	[35.3, 34.7]
District Hot Water	[0.0, 0.0]
District Steam	[0.0, 0.0]
Fuel Oil	[0.0, 0.0]
Propane	[0.0, 0.0]
District Chilled Water	[0.0, 0.0]

Building Use Types

City Hall:	22,542 ft²
Police Station:	16,912 ft²
Parking Garage (Heated Only):	9,136 ft²

This report includes a Score for the entire building as well as individual Scores for each of the separate use types.

The **Building Energy Asset Score** is a national rating system developed by the U.S. Department of Energy. The **Score** reflects the energy efficiency of a building based on the building's structure, heating, cooling, ventilation, and hot water systems. The building's **Structure and Systems** are individually evaluated and ranked. The **Upgrade Opportunities** page provides recommendations for how to improve the building's energy efficiency, increase the building's Asset Score, and save money.

³ The energy savings range reflects the expected incremental savings for the overall building associated with the specific efficiency upgrade opportunity assuming all other recommended upgrades have already been implemented. This assumption is made to avoid double counting of savings. The ranges reflect site energy savings and are based on standard operating assumptions, unless actual operating conditions are provided by the user.

⁴ The costs are based on Advanced Energy Retrofit Guide and RS Means. The costs are replacement costs, not incremental costs. The costs do not include local incentives. Costs are shown as a range (\$ = low cost, \$\$ = medium cost, \$\$\$ = high cost).

[†] User-selected energy efficiency measure

Building Name: **Baraboo - Municipal Building**

Gross Floor Area: **48,590 ft²**

Selected Upgrade Opportunities	Energy Savings ³	Cost ⁴
Building Envelope		
<ul style="list-style-type: none"> Seal Building Envelope to Reduce Air Infiltration[†] - Learn More 	Low	\$\$
Lighting Systems		
<i>No opportunities identified.</i>		
HVAC Systems and Controls		
<ul style="list-style-type: none"> Add Demand Controlled Ventilation (DCV) Sensors to Air Loop in block Block 1-Police for RTU-1.[†] - Learn More Implement Fan Static Pressure Reset for Air Loop in block Block 1-Police for RTU-1.[†] - Learn More Implement Supply Air Temperature Reset on Air Loop in block Block 1-Police for RTU-1.[†] - Learn More Add Air-Side Economizer to Air Loop in block Block 2-Vehicle Storage for Air Handler -Vehicle Storage.[†] - Learn More 	Medium	\$\$-\$\$\$
Service Hot Water Systems		
<i>No opportunities identified.</i>		

³ The energy savings range reflects the expected incremental savings for the overall building associated with the specific efficiency upgrade opportunity assuming all other recommended upgrades have already been implemented. This assumption is made to avoid double counting of savings. The ranges reflect site energy savings and are based on standard operating assumptions, unless actual operating conditions are provided by the user.

⁴ The costs are based on Advanced Energy Retrofit Guide and RS Means. The costs are replacement costs, not incremental costs. The costs do not include local incentives. Costs are shown as a range (\$ = low cost, \$\$ = medium cost, \$\$\$ = high cost).

[†] User-selected energy efficiency measure

Building Name: **Baraboo - Municipal Building**

Gross Floor Area: **48,590 ft²**

Health and Safety Impact of Upgrade Opportunities

Building Envelope

Health and Safety Impact

- Seal Building Envelope to Reduce Air Infiltration[†]

Air sealing can improve thermal comfort by reducing cold drafts, and reduce occupant exposure to outdoor air pollutants, such as vehicle exhaust. It may also help with moisture and pest control by eliminating entry points. But with less outside air being provided by air infiltration, it is important to make sure that the building has sufficient ventilation after air sealing, such as by HVAC commissioning, otherwise indoor air quality may deteriorate.

Lighting Systems

No opportunities identified.

HVAC Systems and Controls

- Add Demand Controlled Ventilation (DCV) Sensors to Air Loop in block Block 1-Police for RTU-1.[†]

For DCV with zone level CO₂ sensors, the control system can reduce the risk of having insufficient outside air ventilation when the space is occupied. Adequate ventilation is important for occupant health, work performance and learning. Adequate ventilation is also important for reducing building-related symptoms and mitigating infectious disease airborne transmission risks. For proper functioning of DCV, it is important that CO₂ sensors are calibrated regularly.

- Implement Fan Static Pressure Reset for Air Loop in block Block 1-Police for RTU-1.[†]

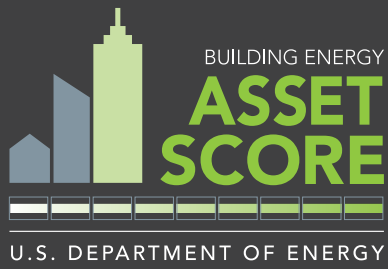
Adjustment of HVAC system control can affect thermal comfort. Monitor indoor temperature, relative humidity, and supply air flow, or conduct occupancy survey, to check for potential impact.

- Implement Supply Air Temperature Reset on Air Loop in block Block 1-Police for RTU-1.[†]

Adjustment of HVAC system control can affect thermal comfort. Monitor indoor temperature, relative humidity, and supply air flow, or conduct occupancy survey, to check for potential impact.

- Add Air-Side Economizer to Air Loop in block Block 2-Vehicle Storage for Air Handler -Vehicle Storage.[†]

Adding an economizer will increase outside air and can improve indoor air quality. In offices and schools, studies found that more outside air can reduce building-related symptoms and improves work performance and learning. Increasing ventilation can also mean more outdoor air pollutants may be brought indoors, such as vehicle exhausts if the outside air intake is near an area with significant traffic. It is therefore even more important to use high efficiency air filters, such as MERV 13 or better, to removal particulate matter (PM).



Building Assessment Tool Report

Health and Safety Impact

Building Name: **Baraboo - Municipal Building**

Gross Floor Area: **48,590 ft²**

Health and Safety Impact of Upgrade Opportunities

Service Hot Water Systems

No opportunities identified.

Building Name: **Baraboo - Municipal Building**

Gross Floor Area: **48,590 ft²**

ABOUT THE BUILDING SYSTEMS

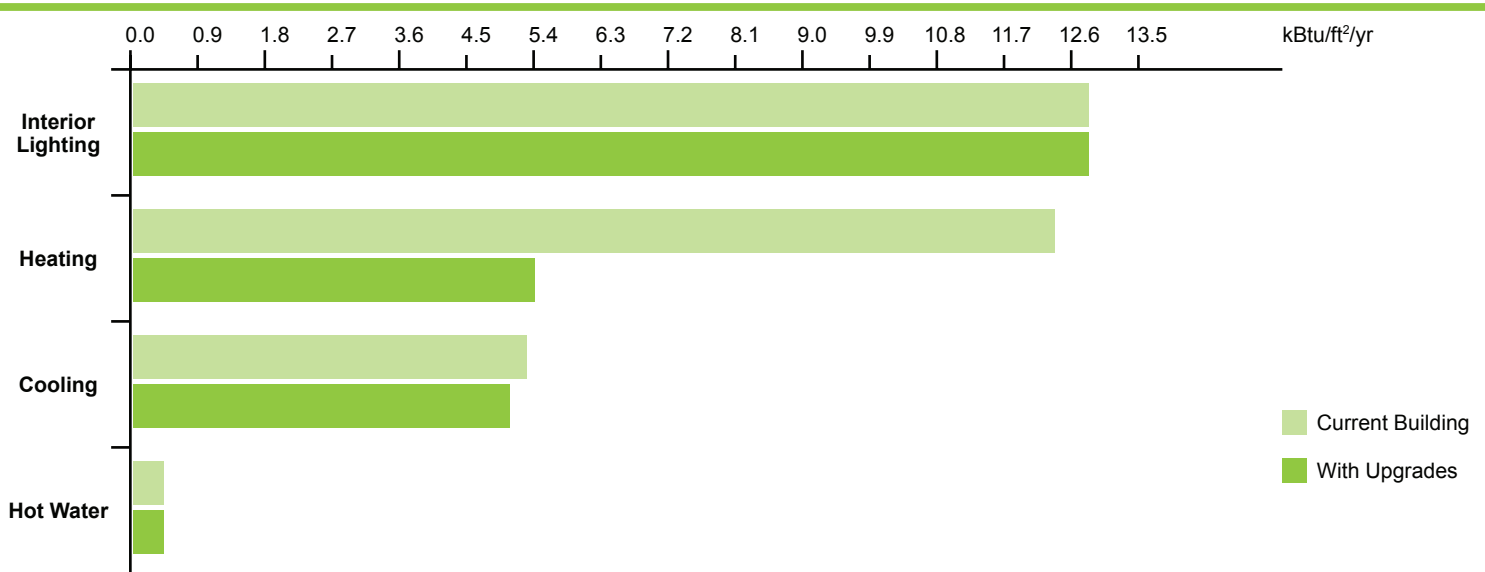
	Ranking ⁵
Interior Lighting	Good
Whole Building HVAC System TSPR	Superior
RTU-1	N/A
Air Handler -Vehicle Storage	N/A
AH-1	N/A

ABOUT THE BUILDING ENVELOPE

	Ranking ⁵
Roof U-Value, Non-Attic (Btu/ft ² ·h·°F)	Good
Walls U-Value, Framed (Btu/ft ² ·h·°F)	Good
Windows U-Value (Btu/ft ² ·h·°F)	Fair
Walls + Windows U-Value (Btu/ft ² ·h·°F)	Fair
Window Solar Heat Gain Coefficient	Fair

*System evaluation is not based on a verified TSPR

SITE ENERGY USE INTENSITY BY END USE



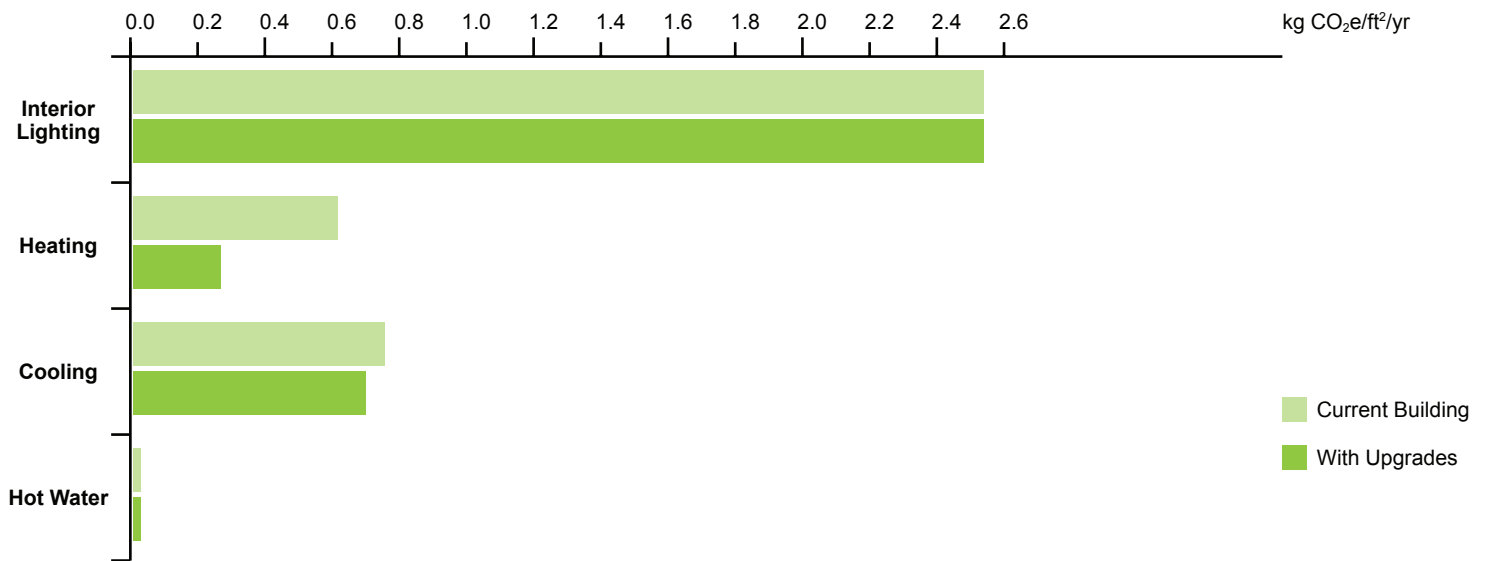
⁵ Ranking Range:

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Superior: Building Envelope is more efficient than a typical building built to the AHSRAE 90.1-2013 energy code. Building Systems exceed the highest efficiency levels with market viable technologies.
Good: Building Envelope or Building Systems are between Fair and Superior.
N/A: The building does not have a heating or a cooling system, or the loads are too low for the system to be effectively ranked.

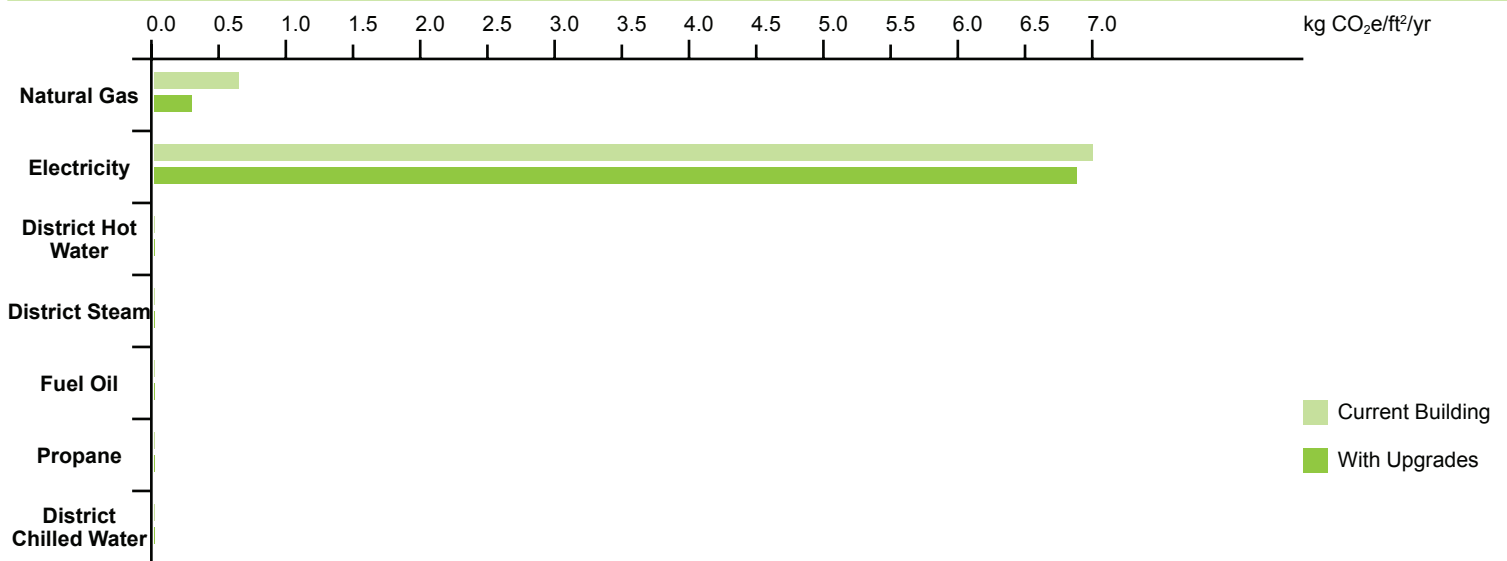
Building Name: **Baraboo - Municipal Building**

Gross Floor Area: **48,590 ft²**

CARBON EMISSIONS BY END USE⁶



CARBON EMISSIONS BY FUEL TYPE⁶



⁶ Carbon dioxide equivalent (CO₂e) greenhouse gas annual emission rates are calculated by multiplying the annual energy use rates for each end use and fuel type by emission factors that are specific to each fuel type and then by dividing by the total floor area for the affected blocks. The emission factors for electricity are provided by U.S. EPA Power Profiler v9.1 and are specific to the eGRID subregions that are assigned to the ZIP code for the building. The emissions factors for electricity do not include gross grid loss (line loss).

Building Name: **Baraboo - Municipal Building**

Gross Floor Area: **48,590 ft²**

BUILDING CHARACTERISTICS SUMMARY

Plants

Plant Loop 1-HW

Plant Loop Type	Heating Loop
Boiler Pump Control	Constant Primary: Variable Secondary
Primary Pump Power	6.2 W/gpm
Secondary Pump Power	31.0 W/gpm
Equipment Type	Boiler
Fuel Type	Natural Gas
Draft Type	Mechanical
Year of Manufacture	2018
Thermal Efficiency	96.0% Et
Average Output Capacity	1200.0 tons

Plant Loop 2-CHW

Plant Loop Type	Cooling Loop
Pump Power	17.2 W/gpm
Equipment Type	Chiller
Compressor Type	Scroll/Screw
Condenser Type	Air
Year of Manufacture	2017
Efficiency	4.6 COP
Average Output Capacity	70.0 tons

Notes:

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² Window includes all vertical fenestration, including curtainwall and storefront.

³ 'Total Gross Roof Area' includes both opaque and glazed roof area.

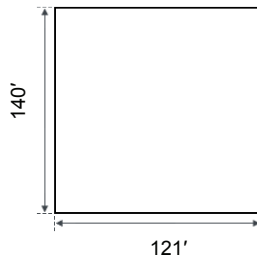
Building Name: **Baraboo - Municipal Building**

Gross Floor Area: **48,590 ft²**

Block 1-Police CHARACTERISTICS SUMMARY

Geometry

Above Ground: 1 floor
Below Ground: 0 floors
Floor-to-Floor Height: 14.00 ft
Floor-to-Ceiling Height: 12.50 ft
Orientation: 0.0° from North
Use Type: Police Station



Current Building

Current Building

Lighting Power Density	0.78 W/ft ²
Fixture	Fixture 1
Lighting Type	LED
Mounting Type	Pendant
Lamp Wattage	40 W/lamp
Lamps per Fixture	2
Number of Fixtures	150
Occupancy Controls	

Roof

Roof	Roof 1-Flat Concrete
Roof Type	Built-up w/ concrete deck
Roof R-Value	45.0 °F·ft ² -h/Btu

Skylights

No Skylights

Floor

Floor	Floor 1
Floor Type	Slab-on-Grade
Slab Insulation	Vertical Insulation
Floor R-value	10.0 °F·ft ² -h/Btu

Walls and Windows

All Surfaces

Wall	Wall 1-Face Brick
Wall Type	Brick/Stone on steel frame
Wall U-value	0.064 Btu/°F·ft ² -h

No Windows

Infiltration

Energy code the building complies with	Estimated ³
--	------------------------

Lighting

Heating/Cooling

Thermal Zone Layout	Perimeter and core
Perimeter Zone Depth	15.0 ft
Primary Heating/Cooling System	RTU-1
System Type	Pkgd VAV with HW Reheat

Cooling Equipment

Cooling Source	Central DX
Year of Manufacture	2017
# Pieces of Equipment	1
Efficiency	4.23 COP
Capacity	30.00 tons

Heating Equipment

Heating Source	Central Furnace
Fuel Type	Natural Gas
Year of Manufacture	2017
# Pieces of Equipment	1
Thermal Efficiency	80.00%
Capacity	320.00 kBtu/hr

Distribution

Distribution Type	Multiple Zone
-------------------	---------------

Terminal

Terminal Unit	Reheat
Reheat Source	Hot Water Plant

Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
² Window includes all vertical fenestration, including curtainwall and storefront.
³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

Building Name: **Baraboo - Municipal Building**

Gross Floor Area: **48,590 ft²**

Current Building

Hot Water Plant Loop Plant Loop 1-HW
 Minimum Air Flow Fraction 0.3

Fan Systems

Total System Fan Power 0.627 W/CFM
 Economizer
 Fan Control Variable Air Volume
 Supply Air Temperature (SAT) Reset None

Service Water Heating

Water Heater Natural Gas
 Fuel Type Natural Gas
 Water Heater Efficiency 95.00 Et
 Low Flow Faucets

Operations

Operation Using Standard Operations™

Notes:
¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
² Window includes all vertical fenestration, including curtainwall and storefront.
³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

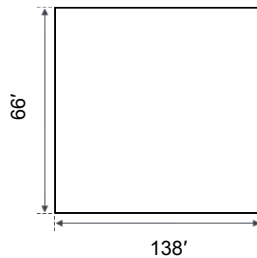
Building Name: **Baraboo - Municipal Building**

Gross Floor Area: **48,590 ft²**

Block 2-Vehicle Storage CHARACTERISTICS SUMMARY

Geometry

Above Ground: 1 floor
 Below Ground: 0 floors
 Floor-to-Floor Height: 18.00 ft
 Floor-to-Ceiling Height: 16.50 ft
 Height:
 Orientation: 0.0° from North
 Use Type: Parking Garage (Heated Only)



Current Building

Current Building

Roof

Roof	Roof 2-Flat Steel
Roof Type	Built-up w/ metal deck
Roof R-Value	40.0 °F-ft ² -h/Btu

Skylights

No Skylights

Floor

Floor	Floor 1
Floor Type	Slab-on-Grade
Slab Insulation	Vertical Insulation
Floor R-value	10.0 °F-ft ² -h/Btu

Walls and Windows

All Surfaces

Wall	Wall 2-Precast
Wall Type	Brick/Stone on masonry
Wall U-value	0.059 Btu/°F-ft ² -h

No Windows

Infiltration

Energy code the building complies with Estimated¹

Lighting

Lighting Power Density	1.04 W/ft ²
Fixture	Fixture 1
Lighting Type	LED
Mounting Type	Pendant
Lamp Wattage	40 W/lamp
Lamps per Fixture	2
Number of Fixtures	108

Heating/Cooling

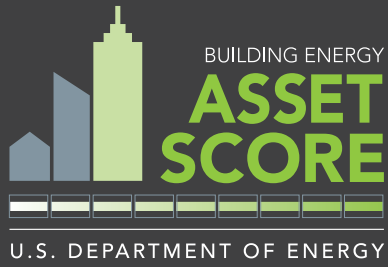
Thermal Zone Layout	Single zone
CO Sensors	
Primary Heating/Cooling System	Air Handler -Vehicle Storage
System Type	Warm Air Furnace
Cooling Equipment	
Cooling Source	No Cooling
Heating Equipment	
Heating Source	Central Furnace
Fuel Type	Natural Gas
Year of Manufacture	2017
# Pieces of Equipment	1
Thermal Efficiency	80.00%
Capacity	625.00 kBtu/hr
Distribution	
Distribution Type	Single Zone
Fan Systems	
Total System Fan Power	2.14 W/CFM
Fan Control	Variable Air Volume

Service Water Heating

No Water Heater

Notes:

- ¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
- ² Window includes all vertical fenestration, including curtainwall and storefront.
- ³ Total Gross Roof Area³ includes both opaque and glazed roof area.



Building Assessment Tool Report

Building Asset Information

Building Name: **Baraboo - Municipal Building**

Gross Floor Area: **48,590 ft²**

Current Building

Operations

Operation	Using Standard Operations**
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Notes:

- ¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
- ² Window includes all vertical fenestration, including curtainwall and storefront.
- ³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

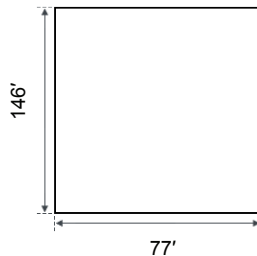
Building Name: **Baraboo - Municipal Building**

Gross Floor Area: **48,590 ft²**

Block 3-City Hall CHARACTERISTICS SUMMARY

Geometry

Above Ground: 2 floors
Below Ground: 0 floors
Floor-to-Floor Height: 14.00 ft
Floor-to-Ceiling Height: 12.50 ft
Orientation: 0.0° from North
Use Type: City Hall



Current Building

Roof

Roof	Roof 3-Pitched
Roof Type	Metal surfacing
Roof R-Value	20.0 °F·ft ² ·h/Btu

Skylights

No Skylights

Floor

Floor	Floor 1
Floor Type	Slab-on-Grade
Slab Insulation	Vertical Insulation
Floor R-value	10.0 °F·ft ² ·h/Btu

Walls and Windows

All Surfaces

Wall	Wall 1-Face Brick
Wall Type	Brick/Stone on steel frame
Wall U-value	0.064 Btu/°F·ft ² ·h
Window	Window 1
Window Framing Type	Metal w/ Thermal Breaks
Window Glass Type	Double Pane w/ Low-E
Window Gas Fill Type	Default ¹
Window U-value	0.29 Btu/°F·ft ² ·h
Window SHGC	0.38

Current Building

Window VT	Estimated ¹
Window Layout	Continuous
Window-to-Wall Ratio	0.2
Exterior Shading Type	External Overhangs

Infiltration

Energy code the building complies with Estimated¹

Lighting

Lighting Power Density	0.78 W/ft ²
Fixture	Fixture 1
Lighting Type	LED
Mounting Type	Pendant
Lamp Wattage	40 W/lamp
Lamps per Fixture	2
Number of Fixtures	200
Occupancy Controls	

Heating/Cooling

Thermal Zone Layout	Perimeter and core
Perimeter Zone Depth	15.0 ft
Primary Heating/Cooling System	AH-1
System Type	VAV with HW Reheat
Cooling Equipment	
Cooling Source	Plant
Plant Loop	Plant Loop 2-CHW - Cooling Loop - Chiller
Heating Equipment	
Heating Source	Plant
Plant Loop	Plant Loop 1-HW - Heating Loop - Boiler
Distribution	
Distribution Type	Multiple Zone
Terminal	
Terminal Unit	Reheat

Notes:

- ¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.
- ² Window includes all vertical fenestration, including curtainwall and storefront.
- ³ Total Gross Roof Area¹ includes both opaque and glazed roof area.

Building Name: **Baraboo - Municipal Building**

Gross Floor Area: **48,590 ft²**

Current Building

Reheat Source Hot Water Plant
Hot Water Plant Loop Plant Loop 1-HW
Minimum Air Flow Fraction 0.3

Fan Systems

Total System Fan Power 0.89 W/CFM
Economizer
Demand Control Ventilation
Fan Control Variable Air Volume
Supply Air Temperature (SAT) Reset None
Fan Static Pressure Reset

Service Water Heating

Water Heater Natural Gas
Fuel Type Natural Gas
Water Heater Efficiency 95.00 Et
Low Flow Faucets

Operations

Operation Using Standard Operations**

Notes:

¹ Total Gross Wall Area¹ includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ Total Gross Roof Area³ includes both opaque and glazed roof area.

Building Name: **Baraboo - Municipal Building**

Gross Floor Area: **48,590 ft²**

BUILDING ENVELOPE INFORMATION

Total Gross Above Grade Wall Area ¹	21376.0 ft ²
Total Window Area ²	2108.0 ft ²
Building Window to Wall Ratio	10%
Total Below Grade Wall Area	0.0 ft ²
Total Gross Roof Area ³	37319.0 ft ²
Total Skylight Area	0.0 ft ²
Total Conditioned Floor Area	Not Available
Total Footprint Area	Not Available

Areas by Orientation

NORTH

Gross Wall Area 6335.0 ft²

Window Area 432.0 ft²

SOUTH

Gross Wall Area 6335.0 ft²

Window Area 432.0 ft²

EAST

Gross Wall Area 4353.0 ft²

Window Area 425.7 ft²

WEST

Gross Wall Area 4353.0 ft²

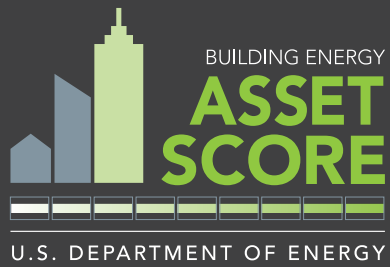
Window Area 817.5 ft²

Notes:

¹ 'Total Gross Wall Area' includes both opaque and glazed wall area.

² Window includes all vertical fenestration, including curtainwall and storefront.

³ 'Total Gross Roof Area' includes both opaque and glazed roof area.



Building Assessment Tool Report

Software Provenance

Building Name: **Baraboo - Municipal Building**

Gross Floor Area: **48,590 ft²**

SOFTWARE PROVENANCE

Asset Score/Audit Template	Version: 2025.0.0.746 Build: master_746
Open Studio	3.7.0;
Energy-Plus	23.2;
Asset Score Open Studio Web Service	Asset Score Open Studio Web Service, Version 3.0.9197.20730, Friday, March 7, 2025 11:31:00 AM
Open Studio Simulation	Release_7.1.24_20250428.0

Appendix C
LED Evaluation Civic Center

May 7, 2025
File No. 25224271.00

MEMORANDUM

TO: John Young
FROM: Tony Kriel
SUBJECT: Post-Installation Energy Savings Evaluation – Baraboo Civic Center LED Lighting

As part of the City of Baraboo's Energy Efficiency Revolving Fund, a LED lighting upgrade project was completed at the City of Baraboo's Civic Center in the summer of 2023. The project involved the replacement of the existing interior lighting, mostly T8 fluorescent, with LED fixtures. Several installation bids were received with a range of estimated electricity costs savings from \$1,484 to \$9,000 per year.

The City of Baraboo requested projected electricity cost savings estimates from Alliant Energy (Alliant) and Focus on Energy to check if the estimated savings were credible. There appeared to be a general consensus suggesting an annual electricity savings of \$5,000 for the Baraboo Civic Center. However, the basis for this consensus remains unclear, with some communications suggesting that this projected savings might still be overly optimistic.

The purpose of this memo is to provide post-installation energy savings evaluation to help clarify how the pre-installation estimated electricity savings for the LED retrofit were too optimistic. We offer an approach to settle the electricity cost savings resulting from the retrofit project which sets the value of the electricity savings achieved to an agreed-upon amount. Using this approach, we calculated a cost savings of \$1,733.78 for the first post-Installation year.

FINDINGS

Following the installation and operational use of the new lighting system, a review of actual electricity consumption data revealed that the energy savings were substantially lower than originally estimated. While some electricity reduction was observed, it did not align with the predicted outcomes communicated during the planning phase.

Key observations include:

- 1. Overestimated Project Energy Savings:** The baseline energy usage for the existing T8 lighting system was likely not accurately quantified prior to project implementation. Assumptions were likely made based on generalized consumption data and/or occupancy schedules rather than measured and documented site-specific data. We did not obtain the contractors' bids but believe that the estimated energy costs savings were overly optimistic. Considering that the other



estimated electricity cost savings by other contractors and utility representatives were typically 3x to 4x times less than the selected bid.

2. **Blended Energy Rates:** Energy costs are typically calculated by applying the same rate schedule in computing both the pre-installation and post-installation energy consumption. The Civic Center operates under a time-of-use (TOU) rate structure (WGS3) from Alliant that had some significant relative price changes between 2021 and 2024 for their regular rate and high-rate periods. It is presumed that a blended electricity rate value was used for pre-installation estimates in lieu of TOU rates.
3. **Uncertainty of Operating Conditions:** Some LED fixtures were installed in areas with limited operating hours, reducing the potential for savings. Observations of current operating conditions included occupants turning the lights off at the local wall switches upon leaving the space. The initial estimated energy savings likely did not adequately account for variance in fixture runtime across different tenant spaces and building zones.
4. **Lack of Formal M&V Plan:** A comprehensive Measurement & Verification (M&V) strategy to validate energy savings was not provided and is assumed to not exist. As a result, there is insufficient pre-installation and post-installation data to distinguish the actual impact of the retrofit from other variables affecting building energy use. These other variables can include: seasonal variation (i.e. hotter summer or colder winter), changes in occupancy patterns, or interactive effects (e.g. reducing lighting may lower mechanical cooling requirements but may increase heating requirements).

FUTURE PROJECT RECOMMENDATIONS

To assist with more accurate energy savings forecasting and validation in future projects, the following actions are recommended:

1. **Establish a Reliable Baseline:** Conduct pre-installation measurements of energy consumption in representative areas of the facility to develop a robust baseline.
2. **Segment Savings Estimates:** Customize projections based on actual operating hours, occupancy patterns, and fixture types in different facility zones.
3. **Use Rate Schedule:** Apply the same rate schedule in computing both the pre-installation and post-installation energy consumption to better account for rate changes in lieu of a blended rate.
4. **Implement a Formal M&V Plan:** Adopt IPMVP (International Performance Measurement and Verification Protocol) or a similar methodology to capture pre- and post-installation data.
5. **Post-Installation Audit:** Conduct a follow-up energy audit to recalibrate savings expectations and document lessons learned.

POST-INSTALLATION EVALUATION

Measurement and verification (M&V) is critical to accurately assess energy savings from an energy conservation measure (ECM). Because energy savings reflect the absence of energy use or demand, determining accurate calculations requires an understanding of the baseline energy use as well as the pertinent factors that influence energy demand across the project scope.

The general electricity savings equation is:

$$\text{Electricity Savings} = \text{Baseline Electricity} - \text{Post-Installation Electricity} \pm \text{Adjustments}$$

Under a well-structured M&V process, the conditions before and after ECM implementation are well understood and documented to provide more reliable comparisons that incorporate factors with significant influence on energy consumption.

One significant complication is transitioning energy savings into cost savings. If cost savings are being calculated directly from energy unit savings, then utilization of proper rates for the given utility time-of-use time period should be used and evaluated.

Project Description

The project at the Civic Center involved the replacement of mostly existing T8 fluorescent lighting fixtures with energy-efficient LED fixtures throughout the facility. The retrofit aimed to reduce electrical consumption and maintenance costs while maintaining or improving lighting levels.

The total quantity of bulbs to be replaced was approximately 775 bulbs. The specific fixture types/counts were not available for review. Installation occurred in the 2nd half of 2023 and is believed to be completed at the end of October 2023.

Methodology

Monthly electricity data seemed to be used for supplementary analysis, context, and validation, but this requires careful interpretation due to other possible adjustments like weather, other non-lighting loads, and escalating rates.

- The International Performance Measurement and Verification Protocol (IPMVP) Option A seems to be represented due to the project's limited scope (lighting only) and the ability to isolate its effects.
- Key parameters that should be documented include fixture wattage, operating hours, and actual utility data pre-installation and post-installation.
- Monthly electricity and gas data can be gathered and analyzed against weather to normalize for HVAC energy influence.

Lighting Fixture Schedule Evaluation

A lighting fixture schedule is a detailed table or list used in electrical engineering construction documents. Its primary purpose is to provide a comprehensive inventory for every type of lighting fixture or bulb/luminaire used on a project.

SCS reviewed the lighting fixture schedule from the 2011/2012 Civic Center HVAC Replacement Project. Per a review of the lighting fixture schedule most of the luminaires were to be 2-lamp, 4-foot F32T8. The ballast were scheduled to have a ballast factor of 0.87.

We also reviewed the request for proposal (RFP) that the City of Baraboo had sent out for contractor quotes. Within that document it was noted that most of the lamps were “primarily 2-lamp F25T8”.

It is possible that this could have been a typo in the RFP. It is also possible that City staff replaced F32T8 lamps with F25T8 lamps when F32T8 lamps failed.

Nonetheless, F25T8 bulbs will use approximately 20% less electricity per bulb than F32T8 bulbs, all else being equal. This could have led to less anticipated electricity savings. Additionally, if burnt out bulbs were not replaced when they failed, this too could have led to less anticipated electricity savings in the post-installation scenario.

Electricity Evaluation

We reviewed the utility data for the 12 months prior to the LED installation (i.e. Pre-Installation or Baseline) and compared that to the 12 months after the LED installation (i.e. Post-Installation). Per a review of the utility data, electricity consumption decreased by 12,640 kWh (7.7%) and electricity cost decreased by \$552.37 (2.6%) for the Post-Installation period.

Table 1. Electricity Savings

	Pre-Installation 11/22-10/23	Post-Installation 11/23-10/24	Savings
Electricity (kWh)	164,400 kWh	151,760 kWh	12,640 kWh (7.7%) ↓
Electricity Cost (\$)	\$21,234	\$20,681	\$552.37 (2.6%) ↓

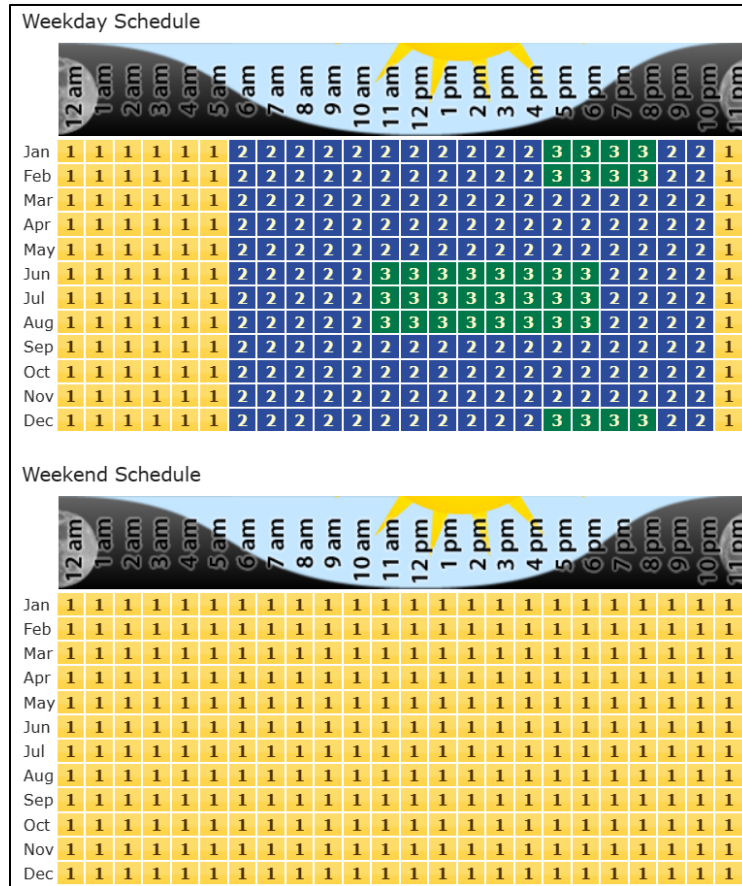
Time-of-Use (TOU) Evaluation

The Civic Center is billed under Alliant Energy's General Service Time-of-Use (TOU) rate schedule (WGS-3). The WGS-3 rate schedule has the following defined TOU rate periods:

1. Low Rate Hours: 11pm - 6am weeknights; all hours on weekends and holidays
2. Regular Rate Hours: All other hours other than Low
3. High Rate Hours: Summer = Jun./Jul./Aug. 11am - 7pm; Winter = Dec./Jan./Feb. 5pm - 9pm

The following figure illustrates the periods: Low Rate = 1/yellow, Regular Rate = 2/blue, High Rate = 3/green.

Figure 1. Alliant Energy WGS-3 Rate Schedule



[Source: <https://apps.openei.org/>]

We reviewed the electricity consumption across the utility-defined TOU periods: low, regular, and high periods. Electricity savings were seen across all periods.

Table 2. TOU Evaluation

	Period	Pre-Installation 11/22-10/23	Post-Installation 11/23-10/24	Savings
1	Low	56,320 kWh	52,800 kWh	3,520 kWh (6.3%) ↓
2	Regular	81,280 kWh	74,480 kWh	6,800 kWh (8.4%) ↓
3	High	26,800 kWh	24,480 kWh	2,320 kWh (8.7%) ↓
	Total	164,400 kWh	151,760 kWh	12,640 kWh (7.7%) ↓

Blended Rate

Often a blended rate is used to aggregate the fixed and variable electricity charges a utility customer might see on their utility bill. Sometimes this blended rate is called an effective rate, average rate, or a marginal rate. To calculate the blended rate, the total costs are divided by the electricity consumed. The following table represents an increase of the blended rate by 5.5% even though electricity consumption decreased over the given time periods.

Table 3. Blended Rate

	Pre-Installation 11/22–10/23	Post-Installation 11/23–10/24	Savings
Electricity (kWh)	164,400 kWh	151,760 kWh	12,640 kWh (7.7%) ↓
Electricity Cost (\$)	\$21,234	\$20,681	\$552.37 (2.6%) ↓
Blended Rate (\$/kWh)	\$0.1292/kWh	\$0.1363/kWh	\$0.0071/kWh (5.5%) ↑

Time-of-Use (TOU) Rate Evaluation

While electricity consumption decreased in each period, the rates increased substantially, especially for the regular and high periods. Table 4 shows the increase of electricity rates for each period starting in 2021 when the concept of this project likely commenced.

Table 4. TOU Rate Evaluation

	Period	Project Concept 2021	Pre-Installation 11/22–10/23	Post-Installation 11/23–10/24	Difference 2021-2024
1	Low Rate	\$0.0637/kWh	\$0.0688/kWh	\$0.0679/kWh	\$0.0042/kWh (6.7%) ↑
2	Regular Rate	\$0.1225/kWh	\$0.1368/kWh	\$0.1508/kWh	\$0.0283/kWh (23.1%) ↑
3	High Rate	\$0.1630/kWh	\$0.1743/kWh	\$0.2023/kWh	\$0.0393/kWh (24.1%) ↑

Note that increases in other fixed or fuel adjustment charges are not included in the evaluation.

We think the substantial increase in the regular rate and high rate periods could be one factor that could lead to less anticipated electricity cost savings in the post-installation scenario pending when the cost savings were calculated and what rate (i.e. blended rate) was used.

Weather Normalization

To account for variations in HVAC-related energy use that may obscure lighting savings, we normalized the total facility electricity usage using local weather data.

Degree days are essentially a simplified representation of outside air-temperature data. Degree days are widely used in the energy industry for calculations relating to the effect of outside air temperature on building energy consumption because they also account for the severity of the outside air temperature over a given duration.

Heating Degree Days (HDD) are a measure of how much (in degrees), and for how long (in days), outside air temperature was lower than the base temperature (65°F). Likewise Cooling Degree Days (CDD) are a measure of how much (in degrees), and for how long (in days), outside air temperature was higher than a specific base temperature (65°F).

Reviewing HDD and CDD data helps answer the questions: (1) Was the winter this year colder overall than other years? (2) Was the summer this year hotter overall than other years?

The following table shows the 30-year average, Pre-Installation, and Post-Installation degree data for Baraboo. Per the data, the pre-installation winter was colder overall (i.e., more severe) compared to the post-installation winter and close to the 30-year average. The data also shows that the pre-installation summer was warmer overall (i.e., more severe) compared to post-installation summer and the 30-year average.

Table 5. Annual HDD and CDD Data

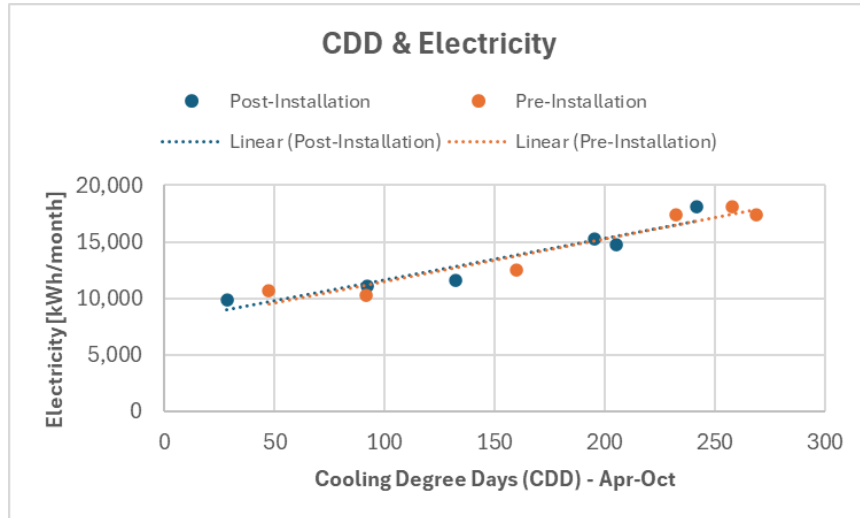
	30-year Average	Pre-Installation 11/22–10/23	Post-Installation 11/23–10/24
HDD	7,187	6,805	5,774
CDD	590	1,064	937
Total	7,777	7,869	6,711

CDD & Electricity Evaluation

The April - October monthly CDD is compared to the summer monthly electricity usage as shown on the following figure for pre-installation and post-installation. Higher CDD months correspond with increased electricity consumption, suggesting a reasonable correlation for air conditioning.

Additionally, linear regression lines for pre-installation and post-installation were fit to the respective data set and have nearly identical slopes. This indicates similar facility operations from pre-installation and post-installation scenarios.

Figure 2. Monthly CDD & Electricity Consumption

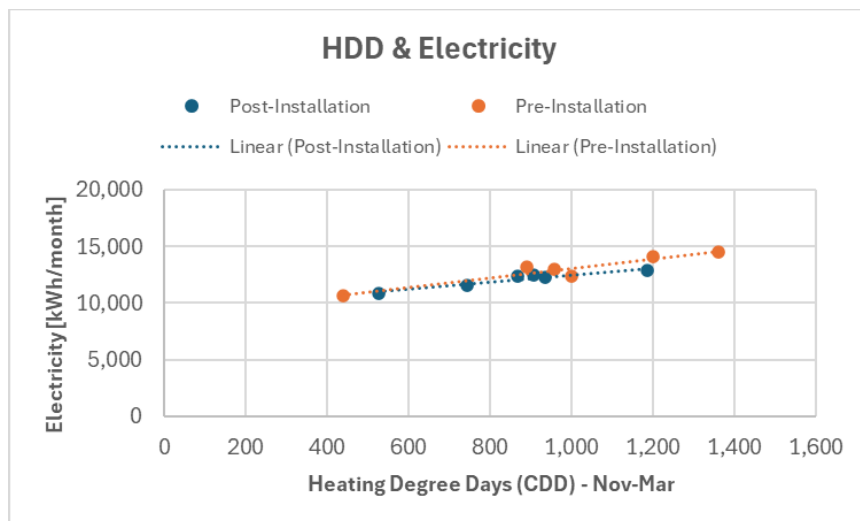


HDD & Electricity Evaluation

The November - October monthly HDD is compared to the winter monthly electricity usage as shown on the following figure for Pre-Installation and Post-Installation. Higher HDD months correspond with increased electricity consumption, suggesting a reasonable correlation for lighting and ventilation.

Linear regression lines for Pre-Installation and Post-Installation were fit to the respective data set and have nearly identical slopes. This indicates similar facility operations from pre-installation and post-installation scenarios.

Figure 3. Monthly HDD & Electricity Consumption



Weather differences between pre-installation and post-installation time periods likely impacted usage, but quantification of savings would require further analysis.

Operating Hours

It is unclear what operational hours were used in energy saving estimates. Typically, the assumptions of light operating hours are listed in a M&V Plan and then confirmed in a post-evaluation effort. Key factors influencing energy use during the reporting period (operating schedules, occupancy levels, any changes from baseline) are noted.

An example of baseline operating hours might look something like the following table.

Table 6. Example Baseline Operating Hours

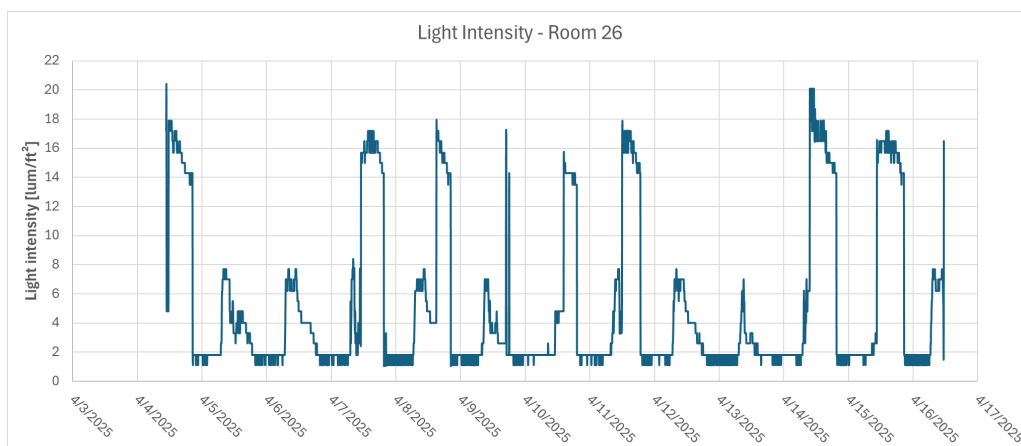
Area	Notes	Estimated Hours/Week
Gymnasium	14 hours/day, 7 days/week	98
Boys & Girls Club	16 hours/day, 5 days/week 5 hours Sat	85
Parks & Rec Dept	14 hours/day, 5 days/week	70
Hallways/Common Areas	16 hours/day, 7 days/week	112

Room 26 Light Evaluation

There might be scenarios where the baseline operating hours are not correct or change. We installed data loggers that could measure the room light levels. The following figure shows the light intensity in the Boys and Girls Club – Room 26 starting on Saturday, April 5 and ending on Friday, April 11.

Some days the lights were on while other days they measured only natural daylight (less than 8 lum/ft²) that diminished as the day progressed. We observed the time when the lights were on within the space varied daily.

Figure 4. Light Intensity – Room 26



A daily summary of when the lights were on is listed in the following table. Beyond the variability of when the lights were on each day, the data shows that the lights were on for 25.85 hours for the given week. This finding is significantly lower than what might have been originally estimated in a contractor's bid or in the previous table (85 hours/week). This site information adds a significant amount of uncertainty to a pre-installation energy savings estimate.

Table 7. Operating Hours Based on Light Intensity – Room 26

Date	Day	Lights On	Lights Off	Time On [Hours]
4/5/2025	Saturday	-	-	0
4/6/2025	Sunday	-	-	0
4/7/2025	Monday	11:05 AM	7:30 PM	8.6
4/8/2025	Tuesday	3:05 PM	8:20 PM	5.3
4/9/2025	Wednesday	4:55 PM 6:05 PM	5:00:00 PM 6:15:00 PM	0.3
4/10/2025	Thursday	2:20 PM	7:10 PM	4.9
4/11/2025	Friday	10:35 AM	8:35 PM	6.8
Weekly Hours				25.85

Light Levels

Light levels were spot-checked with a light meter and provided sufficient lighting levels for the intended use of the space. Without pre-installation light level values to compare to it is unclear if the light levels have improved. However, staff interviews have shared that light levels are significantly better and brighter than before. Staff reported that occupants utilizing the gym are more likely to switch on only half the lights while utilizing the space. This site information also adds an amount of uncertainty to a pre-installation energy savings estimate.

ESTIMATE POST-INSTALLATION SAVINGS

This section offers an approach to settle the electricity cost savings resulting from the retrofit project. The approach accounts for the potential shortcomings in developing the baseline effort including; pre-installation lighting type, TOU evaluation, weather, and operating hours.

This approach sets the value of the electricity savings achieved based on an agreed-upon level of electricity reduction moving forward.

Agreed-Upon Electricity Savings (kWh)

For this cost savings approach, we provide a recommendation where the annual electricity savings attributed to the LED lighting retrofit be set or generally agreed upon. Here we use 12,640 kWh/year moving forward.

Furthermore, based on the analysis of consumption across the utility's TOU rate structure, these savings are distributed across the rate tiers as noted in the following table.

Methodology for Cost Savings Calculation

To isolate the financial impact of the energy efficiency improvement from changes in utility pricing, cost savings could be calculated using the post-installation period's electricity rates. This approach determines the monetary value of the electricity savings. This value represents the direct cost savings generated by the project's efficiency gains.

Table 8. Cost Savings Calculation

	Period	Set Electricity Savings	Rate 11/23-10/24	Cost Savings 11/23-10/24
1	Low	3,520 kWh	\$0.0679/kWh	\$239.01
2	Regular	6,800 kWh	\$0.1508/kWh	\$1,025.44
3	High	2,320 kWh	\$0.2023/kWh	\$469.34
	Total	12,640 kWh	--	\$1,733.78

Future Cost Savings Calculation

We recommend that future cost savings be linked directly to the TOU rates. The table below shows what the cost savings would be using an agreed upon amount (like 12,640 kWh) and the Alliant Energy rates effective 1/1/2025 (including fuel adjustments if appropriate):


Table 9. Future Cost Savings Calculation

	Period	Set Electricity Savings	Rate 2025	Cost Savings 2025
1	Low	3,520 kWh	\$0.0808/kWh	\$284.31
2	Regular	6,800 kWh	\$0.1608/kWh	\$1,093.23
3	High	2,320 kWh	\$0.2438/kWh	\$565.54
	Total	12,640 kWh	--	\$1,943.08

CONCLUSIONS

While the lighting retrofit has still contributed to electricity savings, this experience underscores the importance of possibly more rigorous baseline development and M&V planning to support data-driven decision making. We hope this analysis will help refine future energy projects and improve outcome accuracy.

TRK/xxx/CJJ



Appendix D
Renewable Energy Assessment

September 25, 2025
File No. 25224271.00

MEMORANDUM

TO: John Young
FROM: Tony Kriel
SUBJECT: Renewable Energy Opportunities – City of Baraboo

This memorandum outlines renewable energy generation opportunities available to the City of Baraboo through Alliant Energy’s renewable energy programs. It evaluates the feasibility of solar photovoltaic (PV) installations on City-owned buildings, shelters, and vacant land; and provides a comparative analysis of three key renewable energy pathways:

1. Customer-Owned Solar Installations
2. Customer-Hosted Renewables
3. Renewable Energy Partner Program

The memo also includes rough order of magnitude cost estimates, benefits, and implementation considerations. It is structured to serve as the foundation for guiding the City of Baraboo in making informed decisions about renewable energy investments.

BACKGROUND

The City of Baraboo has expressed a commitment to sustainability and energy efficiency. Many municipal buildings feature flat roofs with southern exposure, making those buildings candidates for solar PV systems. Two new fire stations are scheduled for construction and have been designed as “solar-ready.” Additionally, the City owns numerous pavilions, shelters, and parcels of vacant land that could support canopy or ground-mounted solar arrays.

Disclaimer: Prior to implementing any renewable energy installations or program participation, it is essential that comprehensive engineering evaluations be conducted. These evaluations should assess site-specific structural, electrical, and safety requirements to confirm the proposed systems are both feasible and compliant with all relevant site conditions, codes, and standards.

OPTIONS FROM ALLIANT ENERGY

Here is an overview of Alliant Energy’s renewable energy programs and how the City might utilize the programs to achieve the City’s renewable energy goals. **Table 1** summarizes each renewable energy program option.



Table 1. Alliant Energy Renewable Energy Program Options

Model	Capital Cost	Revenue/Savings	Ownership	Maintenance	Candidate Sites
Customer-Owned	High	High (energy savings)	City	City	Donahue Terrace, Library
Customer-Hosted	None	Moderate (lease payments)	Alliant	Alliant	City Services Center, WRRF, Hockey Pavilion
Renewable Energy Partner	None	Moderate (energy credits)	Alliant	Alliant	Closed Baraboo Landfill

Additional details for each are described in the following sections.

Customer-Owned Solar Installations

Sample Description: The City is responsible for solar installation and maintenance costs. Energy generated in this scenario is utilized on site and excess generation is credited through net metering.

City Benefits:

- Full control over system design, operation, and ownership.
- Long-term energy savings and reduced utility bills.
- Eligible for federal tax incentives via direct pay.
- Net metering credits generates revenue.

Cost Structure:

- **Arrangement:** Net metering credits.
- **Credit Rate:** Excess generation is credited at the retail rate up to the monthly usage. Surplus beyond that is credited at the avoided cost rate, which is significantly lower.
- **Eligibility:** Systems up to 20 kW are eligible for net metering. Larger systems may operate under a different parallel generation rate structure.

Candidate Sites:

- Sufficient clear area, generally small-medium flat roofs (e.g., Library, Fire Station).
- Sufficient structural capacity.
- Sufficient electrical load or demand to fully utilize on-site generation.

Considerations:

- Requires City to provide upfront capital or financing.
- Operations and Maintenance are the City's responsibility.
- Best suited for buildings with consistent daytime energy use.

Customer-Hosted Renewables

Sample Description: Alliant Energy installs, owns, and maintains a solar array on City property. The City receives lease payments for hosting the system.

City Benefits:

- No capital investment required.
- Generates lease revenue from underutilized land or rooftops.
- Supports renewable energy goals without operational burden.
- Alliant handles permitting, construction, operations and maintenance.

Cost Structure

- **Arrangement:** Leased Payment to City.
- **Typical Rate:** \$46/kW annually.
- **Term:** Typically 20 years with options for extension.

Candidate Sites:

- Sufficient clear area, generally larger flat roofs (e.g., City Services Center).
- Sufficient structural capacity.
- Local Examples: Iowa County's Law Enforcement Center (300-kW), City of Sheboygan (1 MW, 5 acres).

Considerations:

- Lease terms vary based on site conditions and system size.
- The City does not receive direct energy savings but contributes to grid decarbonization.
- May require zoning or land use adjustments.

Renewable Energy Partner Program

Sample Description: Alliant Energy builds and operates a dedicated renewable energy project (e.g., solar farm) on behalf of the City. The City enters a long-term agreement to purchase the renewable energy credits (RECs).

City Benefits:

- No upfront capital required.
- Receives 100% of RECs.
- Predictable long-term energy pricing.
- Alliant handles permitting, construction, and maintenance.

Cost Structure:

- Arrangement: Custom Rate.
- Energy Purchase Rate: Custom-calculated to cover project costs; designed to be cost-neutral.
- Term: Typically 20 years with options for extension.
- **Example:** A 1 MW project might cost \$1.5M–\$2M to build. The City would pay a fixed rate (e.g., \$0.06–\$0.08/kWh) over the contract term, generally below future utility rates.

Ideal Sites:

- Large vacant land with minimal shading.
- Local Examples: Dane County - Yahara Solar (17 MW, 90 acre).

Considerations:



- Requires a long-term commitment.
- Best suited for large energy users.
- Best suited for large areas (e.g. > 5 acres).
- May require land dedication or site development.

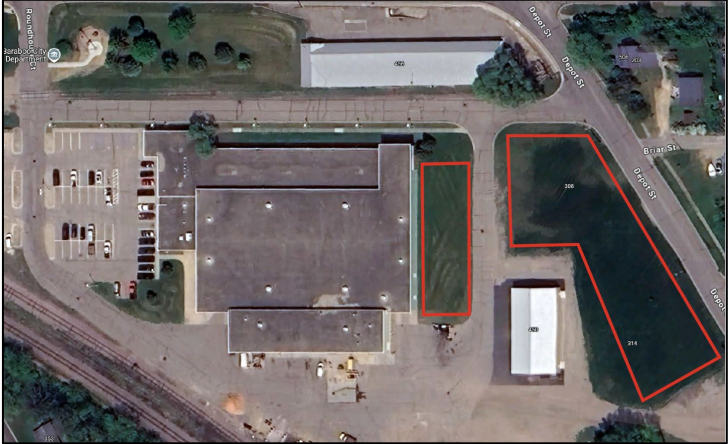
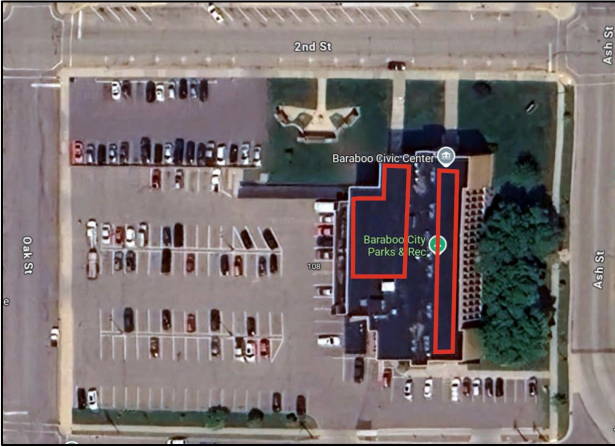

PRELIMINARY SITE EVALUATIONS

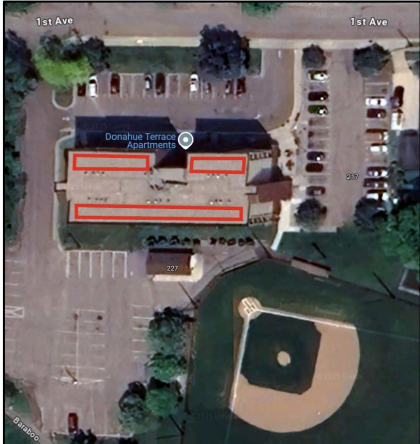
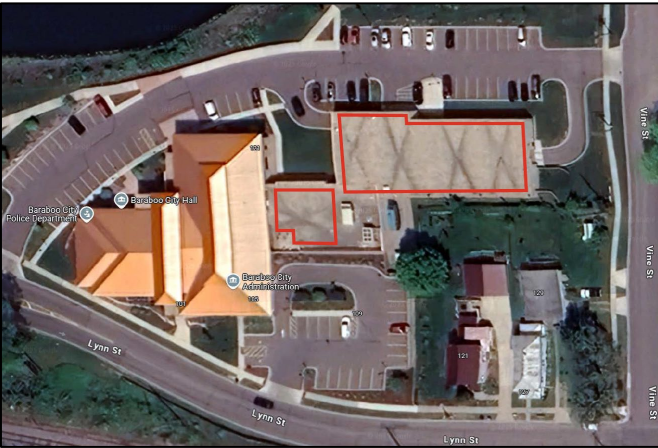
The solar generation potential across various City of Baraboo properties is provided in **Table 2** and the following sections. The data includes both rooftop and ground-mounted systems, estimated system capacities, energy production, emissions reductions, and financial metrics.



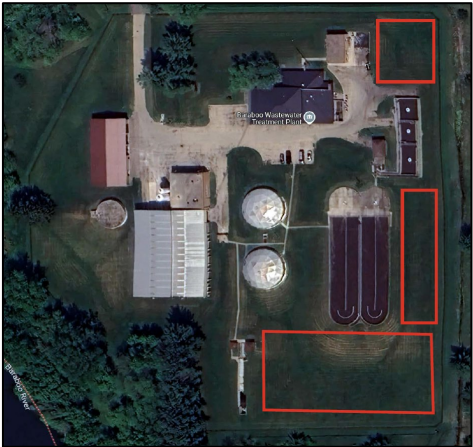
Table 2 provides a summary description of the array at each site as well as an aerial view of the arrays. The red outlines represent where the arrays would be located.

Table 2. Solar Site Evaluations - Aerial Views

Property Name	Location	Aerial View
Carnegie-Schadde Memorial Library	Roof	<p style="text-align: center;">Installation Complete</p> 
City Services Center	Roof	

Property Name	Location	Aerial View
City Services Center	Ground	
Civic Center	Roof	
Closed Baraboo Landfill	Ground	

Property Name	Location	Aerial View
Corson Square Apartments	Roof	Yet to be constructed
Donahue Terrace	Roof	 <p>An aerial photograph of the Donahue Terrace Apartments complex. The main building is a large, rectangular structure with a flat roof, outlined in red. There are several smaller buildings and a parking lot nearby. A baseball field is visible in the lower right corner. The surrounding area includes streets labeled '1st Ave' and '21st'.</p>
Fire Station #1 (New)	Roof	Yet to be constructed
Municipal Building	Roof	 <p>An aerial photograph of the Municipal Building complex. The main building is a large, rectangular structure with a flat roof, outlined in red. There are several smaller buildings and a parking lot nearby. The surrounding area includes streets labeled 'Lynn St' and 'Vine St'. Other landmarks include 'Baraboo City Police Department' and 'Baraboo City Hall'.</p>

Property Name	Location	Aerial View
Pierce Park Hockey Pavillion	Roof	 An aerial photograph of Pierce Park. A large, rectangular, light-colored building with a flat roof is the central focus. Two vertical sections of this roof are outlined in red. To the right of the building is a parking lot with several cars. In the background, there is a large, circular, light-colored area, possibly a pond or a field, and some trees. A small red location pin is visible in the bottom left corner of the image.
Water Resource Recovery Facility	Roof	 An aerial photograph of a water resource recovery facility. The facility includes several large, circular tanks, rectangular basins, and various buildings. Two rectangular roof sections are highlighted in red: one is a long, narrow rectangle on the left side, and the other is a larger rectangle in the center. The surrounding area is green with trees and grass.
Water Resource Recovery Facility	Ground	 An aerial photograph of the same water resource recovery facility as in the previous row. This view highlights three ground areas with red rectangles: a small square in the top right, a long narrow rectangle on the right side, and a large rectangular area at the bottom. The facility's structures, including tanks and basins, are visible in the center.

Solar Potential

Table 3 lists the preliminary site evaluations for the various facilities included in the assessment and a few other City-owned properties for ground mount applications.

Table 3. Solar Site Evaluations - Solar Potential

Property Name	Location	Solar Roof Area (sf)	Solar Ground Area (ac)	Capacity (kW_dc)	Solar Panels (Qty.)	Electricity Production (kWh/year)
Carnegie-Schadde Memorial Library	Roof	1,900		30	70	39,000
City Services Center	Roof	40,000		570	1,270	741,000
City Services Center	Ground		1.0	200	440	260,000
Civic Center	Roof	5,000		70	160	91,000
Closed Baraboo Landfill	Ground		12.0	2,400	5,330	3,120,000
Corson Square Apartments	Roof	10,000		140	310	182,000
Donahue Terrace	Roof	4,000		60	130	78,000
Fire Station #1 (New)	Roof	9,500		140	310	182,000
Municipal Building	Roof	9,000		130	290	169,000
Pierce Park Hockey Pavillion	Roof	26,000		370	820	481,000
Water Resource Recovery Facility	Roof	16,000		230	510	299,000
Water Resource Recovery Facility	Ground		1.5	300	670	390,000
	Total	121,400	14.5	4,640	10,310	6,032,000

For reference, of the facilities we were tasked to analyze, annual electricity consumption for a 2-year period (December 2022 - November 2024) was 2,773,200 kWh and 2,817,440 kWh per year, respectively.

Emission Reductions

The energy-related Greenhouse Gas (GHG) Emissions are the carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) gases released into the atmosphere as a result of energy consumption at the property. GHG emissions are expressed in carbon dioxide equivalent (CO₂e), a universal unit of measure that combines the quantity and global warming potential of each greenhouse gas. Emissions are totaled with units of metric tons (Metric Tons CO₂e or MTCO₂e).

Emissions offsets from electricity are categorized as Scope 2 emissions and were calculated using a location-based method that reflects the average emissions intensity of grids on which energy consumption occurs. Table 4 shows the Scope 2 - Electricity emission offsets on an annual basis. Also shown is the equivalent number of homes/year the solar system would offset if installed.

Table 4. Solar Site Evaluations – Emission Reductions

Property Name	Location	Electricity Production (kWh/year)	Scope 2 Emission Offset (MTCO _{2e})	Electricity Offset (Homes/year)
Carnegie-Schadde Memorial Library	Roof	39,000	25	6
City Services Center	Roof	741,000	474	108
City Services Center	Ground	260,000	166	38
Civic Center	Roof	91,000	58	13
Closed Baraboo Landfill	Ground	3,120,000	1,995	456
Corson Square Apartments	Roof	182,000	116	27
Donahue Terrace	Roof	78,000	50	11
Fire Station #1 (New)	Roof	182,000	116	27
Municipal Building	Roof	169,000	108	25
Pierce Park Hockey Pavillion	Roof	481,000	308	70
Water Resource Recovery Facility	Roof	299,000	191	44
Water Resource Recovery Facility	Ground	390,000	249	57
	Total	6,032,000	3,857	882

For reference, of the facilities we were tasked to analyze, the annual Scope 2 electricity emissions are approximately 1,955 MTCO_{2e} per year. Installing solar on all potential facilities could offset all City Scope 1 and Scope 2 operational emissions.

Financial Analysis

The City has prospective solar project site locations, ranging from small rooftop systems to large-scale ground-mounted arrays. Each project type aligns with different financial models, which influence upfront costs, long-term savings, annual revenue, and 20-year revenue potential.

When considering these projects, it is important to recognize that actual costs and savings can vary significantly depending on site-specific factors such as installation complexity. Therefore, while the following table provides valuable guidance, we strongly recommend seeking quotes from solar developers or Alliant to obtain the most accurate and tailored estimates.

The following table outlines likely financial pathways available from Alliant Energy.

Table 5. Solar Site Evaluations – Financial Analysis

Property Name	Location	Projected Installation Cost	Alliant Program	Upfront Cost to City	Revenue to City (\$/year)	20-year Revenue Total	Simple Payback (years)
Carnegie-Schadde Memorial Library	Roof	\$60,000	Customer-Owned	Donations On-going	\$0		N/A
City Services Center	Roof	\$1,140,000	Customer-Hosted	\$0	\$26,220	\$524,400	N/A
City Services Center	Ground	\$400,000	Customer-Hosted	\$0	\$9,200	\$184,000	N/A
Civic Center	Roof	\$140,000	Customer-Hosted	\$0	\$3,220	\$64,400	N/A
Closed Baraboo Landfill	Ground	\$4,800,000	Renewable Energy Partner	\$0	\$62,400	\$1,248,000	N/A
Corson Square Apartments	Roof	\$280,000	Customer-Hosted	\$0	\$6,440	\$128,800	N/A
Donahue Terrace	Roof	\$120,000	Customer-Owned	\$84,000	\$9,360	\$187,200	9.0
Fire Station #1 (New)	Roof	\$280,000	Customer-Hosted	\$0	\$6,440	\$128,800	N/A
Municipal Building	Roof	\$260,000	Customer-Hosted	\$0	\$5,980	\$119,600	N/A
Pierce Park Hockey Pavillion	Roof	\$740,000	Customer-Hosted	\$0	\$17,020	\$340,400	N/A
Water Resource Recovery Facility	Roof	\$460,000	Customer-Hosted	\$0	\$10,580	\$211,600	N/A
Water Resource Recovery Facility	Ground	\$600,000	Customer-Hosted	\$0	\$13,800	\$276,000	N/A
	Total	\$9,280,000		\$84,000	\$170,660	\$3,413,200	

ENGAGE ALLIANT ENERGY

The City can take an important step toward adopting renewable energy by initiating direct engagement with Alliant Energy. This collaboration begins with communication regarding the City’s energy goals, available sites, and project priorities. By requesting site-specific proposals, the City works with Alliant Energy’s technical staff, who will work to assess feasibility and tailor recommendations to the City’s assets and objectives.

Preliminary Steps

1. Site Identification: Provide Alliant Energy with a list of municipal properties, specifying roof size, orientation, site access, and any known limitations (like structural or electrical factors).
2. Project Goals: Communicate the City’s renewable energy targets, interest in on-site generation versus participation in partner programs, and preferred ownership or financing structures.

Typical Information Provided by Alliant Energy

Upon receiving a request, Alliant Energy will typically provide a project proposal package containing:

- **Site Assessment Reports:** Analysis of solar potential, estimated annual output, and structural or environmental factors affecting installation.
- **System Designs and Layouts:** Preliminary schematics illustrating array locations, estimated system sizes (kW), and integration options for rooftops or ground mounts.
- **Financial Models:** Detailed breakdowns of upfront costs, available incentives, rate structure, long-term savings, and anticipated payback periods for each program pathway (Customer-Owned, Customer-Hosted, Partner Programs).
- **Implementation Roadmaps:** Step-by-step timelines covering permitting, procurement, construction, and commissioning processes.
- **Environmental Benefits:** Calculated reductions in greenhouse gas emissions, utility bill impacts, and contributions to municipal sustainability goals.
- **Operational Considerations:** Recommendations regarding ongoing maintenance, monitoring, and responsibilities under each ownership model.

Engaging Alliant Energy in this manner helps the City of Baraboo receive tailored, actionable information to support decision-making and maximize the benefits of its renewable energy investments.

OPPORTUNITIES FOR OTHER FUNDING AND INCENTIVES

Municipalities and organizations seeking to invest in renewable energy have access to an array of robust funding sources and incentives that can significantly reduce upfront costs and enhance long-term project value. Among the most impactful opportunities are the Federal Investment Tax Credit (ITC), USDA's Rural Energy for America Program (REAP); and a variety of state, local, and private funding streams.

Federal Investment Tax Credit (ITC)

The ITC remains one of the most valuable incentives for solar and renewable energy projects. This program allows eligible entities to claim a tax credit equal to 30% of qualified expenditures for solar installations. The ITC is available to projects utilizing both direct ownership and certain third-party ownership models. In addition, recent updates have introduced bonus credits for projects that incorporate domestic content, are located in energy communities, or serve low-income areas, further increasing the potential financial benefit.

Brownfield Site Bonus: For projects located on designated brownfield sites, an additional federal incentive may be available in the form of an ITC bonus. This bonus can increase the base ITC by up to 10% points, significantly improving the financial outlook for solar installations on previously contaminated land. By leveraging this brownfield bonus, municipalities can not only advance their

clean energy goals but also revitalize underutilized properties, transforming them into productive community assets.

USDA Rural Energy for America Program (REAP)

The USDA's REAP initiative is designed to assist rural communities and agricultural producers in making energy efficiency improvements or investing in renewable energy systems. Through a competitive application process, REAP offers:

- Grants covering up to 50% of total eligible project costs.
- Loan guarantees for up to 75% of project costs.
- Technical assistance and guidance on project development.

Eligibility is broad for agricultural producers and small rural businesses, making REAP a critical tool for communities aiming to embrace clean energy technologies.

Additional Grants, Loans, and Financing Mechanisms

Beyond federal tax incentives and USDA programs, a spectrum of supplementary funding options exists:

- **State Incentives:** Programs such as Focus on Energy (Focus) provide grants, technical support, and rebates based on system size and customer profile, further lowering the financial barrier to entry.
- **Green Bonds:** Municipalities may issue green bonds to finance large-scale renewable energy infrastructure, benefiting from favorable interest rates and attracting sustainability-focused investors.
- **Private and Philanthropic Grants:** Nonprofit organizations, foundations, and utility programs may offer competitive grant opportunities or match funding for local government initiatives.

By combining these funding mechanisms, municipalities and organizations can significantly reduce the net cost of solar and renewable energy projects, accelerate implementation timelines, and amplify the long-term economic and environmental benefits for their communities. Early engagement with financial advisors and program administrators is highly recommended to navigate eligibility criteria and optimize the funding mix for each unique project.

SITE PRIORITIZATION

To guide implementation, the following criteria should be used to prioritize sites:

- **Energy Offset Potential:** Focus on sites with high annual kWh production and alignment with on-site energy use.
- **Financial Return:** Consider sites with favorable payback periods or strong lease revenue.

- **Visibility and Public Impact:** Prioritize high-visibility sites (e.g., Municipal Building, Library) for educational and community engagement value.
- **Readiness:** Give preference to “solar-ready” buildings (e.g., new fire stations) and sites with minimal permitting or structural integrity concerns.
- **Partnership Suitability:** Match sites to the most appropriate Alliant program based on size, ownership preference, and financial goals.

By strategically leveraging diverse funding sources and thoughtfully prioritizing sites, the City can maximize the impact of their renewable energy investments, fostering resilient, sustainable communities that serve as models for environmental leadership.


RECOMMENDATIONS

To assist with more accurate energy savings forecasting and validation in future projects, the following actions are recommended:

1. **Pursue a Pilot Project:** Consider installing a small solar array on one of the Municipal Buildings to demonstrate feasibility and build internal capacity.
2. **Engage Alliant Energy:** Request site-specific proposals for Customer-Hosted and Renewable Energy Partner programs.
3. **Apply for Incentives:** Coordinate with Focus on Energy and explore federal funding opportunities.

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Appendix E
Energy Design Review – Fire Station

March 7, 2025
File No. 25224271.00

MEMORANDUM

TO: John Young

FROM: Tony Kriel

SUBJECT: Review of Baraboo Fire & EMS Station #1 Design Plans – Energy Efficiency Recommendations

SCS Engineers conducted an energy design review (EDR) of the 11.15.2023 plan set (drawings and specifications) of the Baraboo Fire & EMS Station #1. The intent is to identify opportunities for energy savings before the facility is fully constructed.

An EDR is a structured analysis of the proposed design and comparison to industry best design practices for facility energy savings. We share an attached table of energy recommendations. While we made several recommendations for the City's of Baraboo's consideration, the following recommendations were identified as having the highest qualitative impact for this facility:

- 1.) **Geothermal heat pump** heating/cooling system. (HVAC)
- 2.) **Solar photovoltaic system** on the flat roof and south facing pitched roof areas. (Other)
- 3.) **Insulating door panels** (U-0.10) (R-17.4) for top and bottom overhead door panel sections. (Envelope)
- 4.) **Exhaust rates for the apparatus bays** per the operation of automatic detection devices. (HVAC)
- 5.) **Reconsideration of installing the exterior snow melt system.** (Other)

The following main systems were reviewed as part of this EDR:

1. Building Envelope Systems
2. Lighting Systems
3. Plumbing Systems
4. HVAC/Mechanical Systems

Building Envelope Systems

The building envelope plays a crucial role in minimizing energy loss and maintaining indoor comfort. SCS's EDR focused on:

1. **Insulation:** Verify compliance with applicable energy codes (e.g., IECC-2015) with a review of R-values and overall walls, roof, and slab assembly U-Factor.



2. **Windows & Doors:** Assess the assembly U-factor and Solar Heat Gain Coefficient for glazing to optimize thermal performance.
3. **Air Barriers:** Examine air barrier details to reduce infiltration and enhance envelope tightness.

Lighting System

Energy-efficient lighting design reduces electrical energy consumption and enhances occupant comfort. SCS's EDR focused on:

1. **Fixture Selection:** Ensure LED lighting is specified with high efficacy and appropriate color temperature.
2. **Controls & Daylighting:** Review occupancy sensors, daylight harvesting, and dimming capabilities to optimize energy savings.
3. **Exterior Lighting:** Verify fixture efficiency, shielding to maintain safety and minimize light pollution.

Plumbing Systems

Efficient plumbing and domestic hot water systems help reduce energy and water consumption. SCS's EDR focused on:

1. **Water Heater Selection:** Evaluate energy efficiency ratings, fuel type, and insulation levels of storage tanks.
2. **Recirculation Systems:** Assess design for demand-controlled recirculation to minimize standby heat loss.
3. **Low-Flow Fixtures:** Verify specification of low-flow faucets and showerheads to reduce water and heating demand.

HVAC/Mechanical Systems

A high-efficiency mechanical (a.k.a. Heating, Ventilating, and Air-Conditioning (HVAC)) system is essential for reducing energy consumption and maintaining indoor air quality. Key aspects reviewed include:

1. **System Selection:** Evaluate the efficiency ratings of heating and cooling equipment.
2. **Ventilation Strategies:** Assess compliance with code requirements for adequate fresh air intake and energy recovery ventilation implementation.
3. **Zoning & Controls:** Review zoning strategy, thermostats, and integration with a Building Automation System for optimal operation.

ENERGY EFFICIENCY RECOMMENDATIONS

Based on our review, the proposed design for the Baraboo Fire & EMS Station #1 is well-balanced and incorporates many best practices that align with the City's energy efficiency goals. We did identify several recommendations for the City of Baraboo's consideration that are provided in the attached table (**Attachment 1**).

The recommendation table includes a set of common items arranged by building subsystem: envelope, lighting, plumbing, HVAC, and other/miscellaneous.

MEMORANDUM

March 7, 2025

Page 3

The table compares the best practices in energy efficiency component with the proposed design component. If we identified an opportunity for the City of Baraboo's consideration, you'll see that the component is marked with a checkmark in the opportunity column ("Opp"), In addition, the recommendation is provided in the next column.

In the far right column on the attached table, SCS provides a qualitative energy impact declaration which is noted as either Low (< 3%), Medium (< 10%), or High (> 10%), to help focus the City of Baraboo's discussion and with prioritization. These qualitative declarations note the perceived annual energy savings from implementing the recommendation. Unlike quantitative impacts which are calculated or measured, qualitative impacts are often based on subjective opinions, experiences, and perceptions of a building's typical energy consumption.

Installation costs are not provided in this EDR. The City of Baraboo can use these recommendations to further discuss with the design team and/or potential contractor if there are opportunities that can be cost effectively incorporated into the overall design. The design team, potential contractor, or SCS can provide an opinion of added installation cost if the City of Baraboo wants to evaluate certain recommendations. Please note that bundling certain recommendations may reduce the overall facility energy savings.

At this stage, we recommend additional coordination with the design team and/or potential contractors to address any identified gaps and help with alignment to the City of Baraboo's sustainability goals.

Attachment 1 – Energy Design Review Table

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Attachment 1 - Energy Design Review Table

	Item	Component	Best Practice	Proposed Design	Opp	Recommendations/Comments	Qualitative Energy Impact
Envelope	Roofs	Insulation entirely above deck	>R-30 continuous insulation	R-30 continuous insulation	<input type="checkbox"/>	--	--
		Attic and other	>R-49	R-50	<input type="checkbox"/>	--	--
		Solar Reflectance Index	White = 100 Black = 0	Copper Penny = 35 Black Membrane = 0	<input checked="" type="checkbox"/>	White membrane and bifacial panels for solar integration. See solar recommendation.	Low (< 3%)
	Walls	Above-grade walls (Mass)	>R-19 continuous insulation	R-15.6 continuous insulation	<input checked="" type="checkbox"/>	Consider increasing to R-19 continuous insulation (2.5" to 3")	Low (< 3%)
		Below-grade walls	>R-10 continuous insulation	R-10 continuous insulation	<input type="checkbox"/>	--	--
	Floors/Slabs	Unheated	>R-20 for 24 in.	N/A	<input type="checkbox"/>	--	--
		Heated	>R-20 for 48 in.	R-10 for 24 in.	<input checked="" type="checkbox"/>	Increase to R-20 for 48 in. horizontally/ vertically.	Low (< 3%)
	Doors	Swinging	<U-0.50	U-0.50	<input type="checkbox"/>	--	--
		Nonswinging (overhead)	<U-0.21	U-0.30 (R-value 2.87)	<input checked="" type="checkbox"/>	Evaluate an insulating door panel system U-0.10 (R-value 17.4) for top and bottom overhead door panel sections.	Medium (< 10%)
	Vestibules	At building entrances	Yes	Yes	<input type="checkbox"/>	--	--
Air Barrier	Continuous air barrier	Entire building envelope	Entire building envelope	<input type="checkbox"/>	--	--	
Windows	Window to Wall Ratio	20% to 40%	High for apparatus bays	<input checked="" type="checkbox"/>	See insulating door panel system recommendation.	Medium (< 10%)	
	Thermal transmittance	<U-0.39	U-0.34	<input type="checkbox"/>	--	--	
	Solar Heat Gain Coefficient	SHGC-0.38	SHGC-0.38	<input type="checkbox"/>	--	--	
Lighting	Interior	Lighting Power Density	<0.75 W/sf	0.5 W/sf	<input type="checkbox"/>	--	--
		24-hour lighting power density	<10% of total LPD	<10% of total LPD	<input type="checkbox"/>	--	--
		Light Source Efficacy	>50 Lum/W	150 Lum/W	<input type="checkbox"/>	--	--
		Occupancy Sensor Controls (auto on, auto off)	Incorporate in design	Corridors utilize occupancy sensors (adjustable 1 to 15 min.)	<input checked="" type="checkbox"/>	Program for 10 minutes. Install grouped occupancy sensors in EMS Apparatus Bay, Fire Apparatus Bay, and Support Garage.	Low (< 3%)
		Vacancy Sensor Controls (manual on, auto off)	Incorporate in design	More than 80% of spaces utilize vacancy sensors (adjustable 1 to 15 min.)	<input checked="" type="checkbox"/>	Program for 15 minutes.	Low (< 3%)
	Daylight Controls (auto)	Dim/switch lights within daylight zones	No photocells	<input type="checkbox"/>	--	--	
	Exterior	Façade and landscape lighting	<0.010 W/sf	0.13 W/sf	<input checked="" type="checkbox"/>	Reduce the façade lighting.	Low (< 3%)
		Parking lots and drives	<0.04 W/ sf	0.01 W/sf	<input type="checkbox"/>	--	--
		Controls	Photocell or astronomical time switch	Photocells	<input checked="" type="checkbox"/>	Add controls for exterior façade lighting to reduce power by 75% from 12 am - 6am.	Low (< 3%)
	Plumbing	Water Heater	Type	Varies	Nat Gas Storage	<input checked="" type="checkbox"/>	Install solar thermal system to offset system losses.
Efficiency			>90%	>90%	<input type="checkbox"/>	--	--
Pipe Insulation			1" for d < 1.25", 1.5" for d >1.25"	1" for d < 1.25", 1.5" for d >1.25"	<input type="checkbox"/>	--	--
Controls			Incorporate in design	Temperature (tank, circulating pump)	<input type="checkbox"/>	--	--
Fixtures			Low-flow	Low-flow	<input type="checkbox"/>	--	--

	Item	Component	Best Practice	Proposed Design	Opp	Recommendations/Comments	Qualitative Energy Impact
HVAC	Ventilation System 1	Zone Strategy	Single Zone (Heating only)	Single Zone (Heating only)	<input type="checkbox"/>	--	--
		Type	Energy Recovery Ventilator with Radiant Floor Heating	Energy Recovery Ventilator with Radiant Floor Heating	<input type="checkbox"/>	--	--
		Energy Recovery	Air-to-Air Heat Exchanger	Air-to-Air Heat Exchanger	<input type="checkbox"/>	--	--
		Heating Source	Hot Water System	Hot Water System	<input type="checkbox"/>	--	--
		Fan Controls	Variable	Constant	<input checked="" type="checkbox"/>	Reduce exhaust rates per the operation of automatic detection devices.	Medium (< 10%)
	Ventilation System 2	Zone Strategy	Mixed Support Spaces	Mixed Support Spaces	<input type="checkbox"/>	--	--
		System Type	RTUs w/ VAV	RTUs w/ VAV	<input type="checkbox"/>	--	--
		Heating Source	Varies	Heat Pump with Nat Gas backup	<input type="checkbox"/>	--	--
		Heating Efficiency	> 3.2 COP	Range 2.5 COP - 3.4 COP	<input checked="" type="checkbox"/>	Increase minimum efficiencies to at least 3.2 COP.	Low (< 3%)
		Cooling Source	RTU w/ DX and zone IACU	RTU w/ DX and zone IACU	<input type="checkbox"/>	--	--
		Fan Controls	Variable	Variable	<input type="checkbox"/>	--	--
		Economizer	Differential Dry-Bulb	Differential Enthalpy w/ Temp High Limit	<input type="checkbox"/>	--	--
	Heating System(s)	Type	Varies	Condensing Boiler	<input checked="" type="checkbox"/>	Evaluate a geothermal heat pump heating/cooling system.	High (> 10%)
		Heating Efficiency	>90%	>90%	<input checked="" type="checkbox"/>	Operate boiler with low return water temperature setpoint to increase boiler efficiency.	Low (< 3%)
		Pumping Arrangement	Varies	Primary-Secondary-Tertiary	<input type="checkbox"/>	--	--
		Flow Arrangement	Variable Flow	Primary = Constant Secondary=Variable Tertiary=Constant	<input type="checkbox"/>	--	--
		Pump Controls	Variable	Variable with reset	<input type="checkbox"/>	--	--
		Piping Arrangement	Reverse Return	Direct Return	<input checked="" type="checkbox"/>	Add pump and pipe glycol heat exchanger from and into the HWR line to improve condensing efficiency.	Low (< 3%)
	Cooling System(s)	Type	Varies	Direct Expansion	<input checked="" type="checkbox"/>	--	--
		Cooling Efficiency	> 10.7 EER	Range 10.0 EER - 13.8 EER	<input checked="" type="checkbox"/>	Increase minimum efficiencies to at least 10.7 EER.	Low (< 3%)
Type		Varies	Split System (IACU)	<input type="checkbox"/>	--	--	
Cooling Efficiency		> 10.7 EER	Not defined	<input checked="" type="checkbox"/>	Install units with minimum efficiencies of at least 10.7 EER and consider refrigerant heat recovery application.	Low (< 3%)	
Other	Optimize Operations	Snow Melt System	Consider alternatives	4 Zones	<input checked="" type="checkbox"/>	Evaluate need for installation of exterior snow melt system.	Medium (< 10%)
		Snow Melt Control	Melt Mode Only	Idle Mode, Melt Mode	<input checked="" type="checkbox"/>	Evaluate idle mode control setpoints.	Low (< 3%)
		Radiant Floor Control	Cycle	On	<input checked="" type="checkbox"/>	Review radiant floor pump operation to allow unit to cycle.	Low (< 3%)
		Radiant Floor Control	Room Temp Setpoint	Slab Temp Setpoint	<input checked="" type="checkbox"/>	Review radiant floor slab temp setpoint to prevent simultaneous heating/cooling situations.	Low (< 3%)
		Cabinet Unit Heater Controls	Cycle	On	<input checked="" type="checkbox"/>	Review fan operation to allow unit to cycle	Low (< 3%)
		Apparatus Bay Control	Room Temp Setpoint = 55°F	Room Temp Setpoint = 65°F	<input checked="" type="checkbox"/>	Reduce the room temperature setpoint to prevent excessive heating consumption.	Low (< 3%)
		Overhead Bay Doors Control	Timer-to-close	Manual	<input checked="" type="checkbox"/>	Evaluate a timer-to-close setting for doors that are left open upon calls.	Low (< 3%)
		Vacancy Sensor Controls	Integrate with HVAC controls.	Not integrated.	<input checked="" type="checkbox"/>	Integrating vacancy sensors into building automation system to trigger HVAC setbacks.	Low (< 3%)
		Compressed Air System	Timer on/off	Not Included	<input checked="" type="checkbox"/>	Install a timer to schedule the unit off during non-usage periods.	Medium (< 10%)
		Elevator Type	Electric Traction	Electric Traction	<input checked="" type="checkbox"/>	Review if regenerative technology is specified.	Low (< 3%)
Solar	Include	Not Included	<input checked="" type="checkbox"/>	Install solar photovoltaic system on flat roof and south facing pitched roof areas.	High (> 10%)		