EDGERTON

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Edgerton Municipal Energy Plan

November 7, 2023

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EXECUTIVE SUMMARY

The City of Edgerton first committed to reducing its carbon footprint in 2009 with a resolution to reduce carbon emissions 25 percent by 2025. Since that date, the City has implemented several initiatives to reduce its carbon impact – including a 17-kW solar array, geothermal in its new City Hall, energy efficient equipment in the Wastewater Treatment plant, and policies to incentivize energy efficiency in affordable housing and EV charging in multifamily new construction.

In early 2022, Edgerton identified the need for a municipal energy plan to prioritize next steps and position the community to access and use future implementation funding, meaningfully. To this end, Edgerton developed a coalition with nearby communities, Evansville and Milton, and was awarded a planning grant from the State Office of Energy Innovation (OEI) at the Public Service Commission.

Over the past year, the three communities worked with Slipstream, to develop a municipal energy plan that identified near-term cost-effective energy saving opportunities. The planning process included:

- Collection of energy use and cost data from buildings and fleet
- Compilation of energy data to develop energy and emissions baselines
- Energy assessments at two buildings
- Analysis of energy data to identify opportunities for renewable energy, fleet conversions, and buildings
- Identification of communitywide policies to promote renewable energy, electric vehicles, and sustainable building design

The team started by developing an energy profile to identify savings opportunities and serve as a baseline to use when tracking future progress. Table 2 illustrates the breakdown of costs and carbon dioxide (CO_2) across fleet, buildings, and operations. The carbon baseline is roughly 1,169 metric tons of CO_2 and energy cost baseline is roughly $238,780.

Table 1. Annual emissions and costs by source (2021 data)

Source	CO_2 Emissions (metric tons)	Percent of Total CO_2 Emissions	Cost
Edgerton City Hall	19	2%	$2,915
Edgerton Dept of Public Works	63	5%	$10,960
Edgerton Municipal Pool	68	6%	$10,405
Edgerton Police Station	35	3%	$5,515
Edgerton Public Library	154	13%	$24,910
Edgerton Water Building	32	3%	$5,620
Fleet	176	15%	$60,495
Parks	30	3%	$5,715
Streetlights	17	1%	$3,170
Pumps/Lifts/Wells	167	14%	$31,705
WWTP	408	35%	$77,370
Total	**1,169**	**-**	**$238,780**

Figure 1 provides the overview of the recommendations by category. The recommendations serve as initial items for consideration to save energy and reduce municipal CO_2 emissions. Funding is available through local utility

rebates, federal funding, and state funding to implement these recommendations. Funding options for the recommendations are detailed in the full report.

Figure 1. City of Edgerton Recommended Energy Actions

Building and Facility Energy Efficiency

Benchmark building energy use data.

Implement recommended measures at walkthrough buildings to reach 30% cost savings in each building.

Adopt standard operating procedures across buildings.

Institute standard purchasing policies for building equipment.

Conduct an evaluation of pumps, lifts, and wastewater treatment plant to identify energy savings.

Municipal Solar

Install 115-180 kW of solar at city facilities offsetting10 to 15% of electricity use.

Consider battery installations for resiliency.

Collaborate with utility to offset 50% of municipal electricity with renewable energy.

Municipal Vehicles

Pilot three to four electric vehicles.

Use the estimated total cost of vehicle ownership to guide vehicle purchasing.

Strategically replace non-road equipment with electric alternatives.

Policy

Engage in ongoing collaboration with Rock County communities and Edgerton residents.

Provide educational materials for residents.

Support community adoption of renewable energy.

Adopt municipal new construction guidelines.

Determine how the city can support public EV charging.

We recommend the City prioritize the following investments:

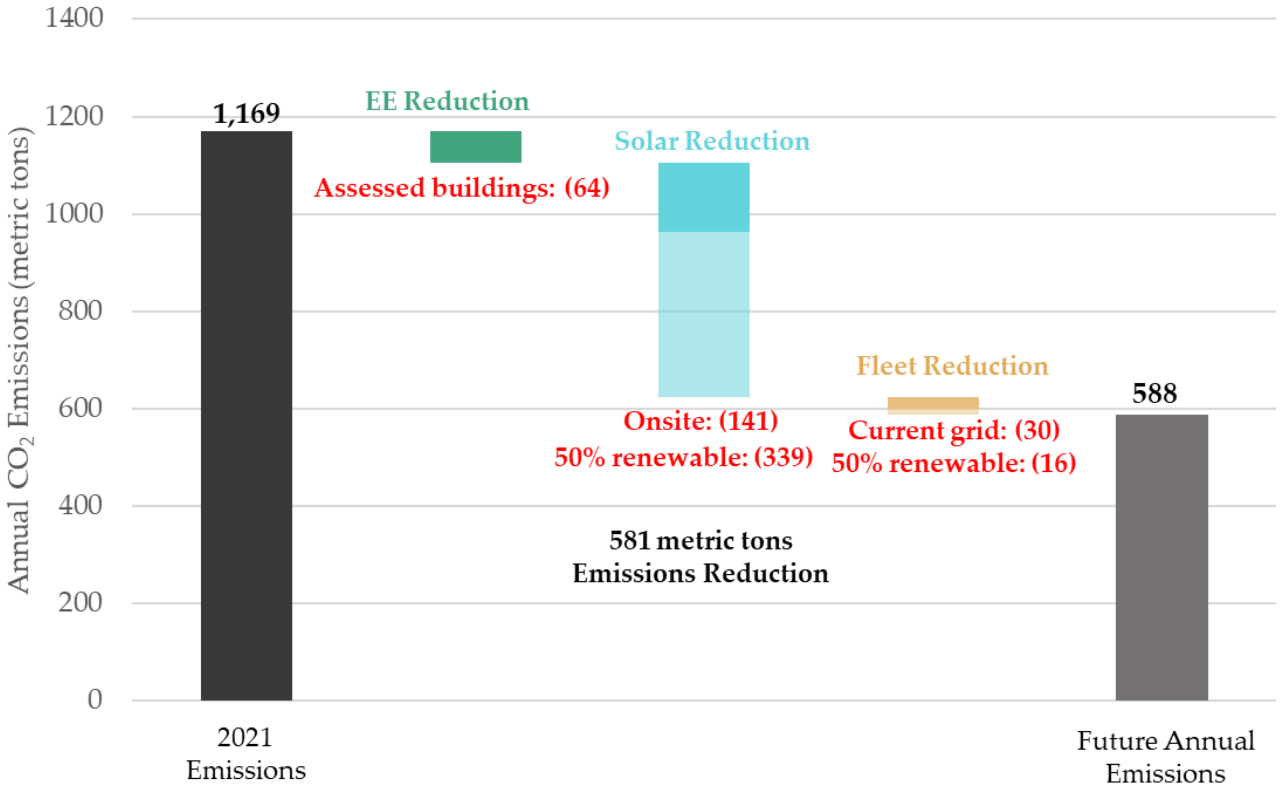
- Install priority measures for audited buildings in the next two to three years.
- Conduct an energy evaluation of wells, lift stations, pumps, and the wastewater treatment plant.
- Install solar at two City facilities in the next two years.
- Work with utility to identify off-site opportunities for solar energy to reach 50% renewable electricity.
- Pilot electric vehicles for three to four light duty vehicles in the next two years.
- Provide educational materials for residents and consider how the city can help encourage other reductions across the city.

Figure 2 illustrates the estimated CO_2 reduction from implementing the recommended measures from this plan. The measures modeled quantitatively include implementing energy efficiency at assessed buildings, installing onsite renewable energy, working with the utility to reach 50% renewable electricity after onsite renewable energy, and transitioning eligible vehicles to EVs.

These recommendations lead to a 50% reduction in CO_2 emissions. Energy efficiency is estimated to achieve 64 metric tons of savings. Onsite solar installations is estimated to achieve 141 metric tons of savings. With 50%

renewable electricity on the grid, we can expect an additional 339 metric tons of savings. Fleet transitions to EVs can result in 30 metric tons of savings under the current grid, and with 50% renewable electricity on the grid, an additional 13 metric tons of savings is possible.

Figure 2. Estimated CO_2 reduction from recommended actions



The estimated emissions reduction should be considered conservative because not all aspects of recommendations were quantitatively modeled. Further CO_2 emissions reductions are possible through additional actions, highlighted below:

- **Implementation of WWTP and pump efficiency measures.** We did not model these savings but suggest ways to address the energy use and associated CO_2 emissions from these systems. Currently the WWTP and water distribution pumps, lifts and wells account for 575 metric tons of emissions, so upgrades have the potential to lead to significant savings.
- **Full electrification of buildings and vehicles.** As the electric grid becomes renewable, electrification of building equipment and vehicles is vital to reach carbon neutrality. Prioritization of electrification items will lead to additional emissions savings over time.
- **Continued transition to renewable electricity.** As illustrated above, a transition to renewable electricity generates significant CO_2 emissions savings and these savings will increase as the City electrifies equipment and systems. Collaboration with the utility and advocacy at the state-level to continue to drive this transition is important to reach carbon neutrality.

GLOSSARY OF TERMS

Battery energy storage system (BESS): Equipment that is able to store energy and then release it when needed for use. Often lithium-ion batteries.

Direct pay: A provision in the Inflation Reduction Act that makes non-taxable entities eligible for tax credits for clean energy items (including renewable energy and alternative vehicles).

Energy walkthrough: Assesses how a building currently uses energy and identifies opportunities to reduce the building's energy consumption.

Electric vehicle (EV): vehicles; cars, trucks, and buses powered by a battery and electricity.

Energy use intensity (EUI): Total energy use of a building divided by the total square feet of the building. Normalizes energy use across buildings of different sizes.

Focus on Energy: Wisconsin's statewide program to increase energy efficiency and renewable energy use among residents, businesses, and local governments.

Heat pump: Single heat pump replaces both furnace and an air conditioner; fueled only by electricity and very efficient.

Internal combustion engine (ICE): Conventional gasoline or diesel vehicles.

Inflation Reduction Act (IRA): Federal law passed in 2022 that directs significant funding to clean energy and climate solutions. A portion of funding is directed at local governments through rebates or grant programs.

Microgrid: A group of interconnected loads and energy resources that can connect and disconnect from the grid. Can operate as part of larger group or on its own.

Net metering: Billing mechanism that credits solar energy owners for electricity added to grid.

Non-taxable entity: An entity that is not required to pay income taxes. Includes nonprofits, local and state governments.

PV: Photovoltaic solar energy; converts energy from the sun to electricity.

Renewable energy: Energy that is generated from a naturally replenishing resource that does not release carbon, such as solar energy, wind energy, or geothermal.

Tax increment financing (TIF): Captures the increase in property taxes, resulting from new development, and diverts that revenue to subsidize that development.

Total cost of ownership (TCO): Total cost of owning equipment, including upfront cost, any energy or maintenance costs, and resale forecast.

Weather-normalized site EUI: The energy use a building would have consumed during 30-year average weather conditions. It can be helpful to use this weather normalized value to understand changes in energy when accounting for changes in weather. Energy use is divided by square feet.

Wisconsin Local Government Climate Coalition (WLGCC): Coalition of local governments in Wisconsin committed to accelerating local climate change solutions.

INTRODUCTION

The City of Edgerton first committed to reducing its carbon footprint in 2009 with a resolution to reduce carbon emissions 25 percent by 2025. Since that date, the City has implemented several initiatives to reduce its carbon impact – including a 17-kW solar array, geothermal in its new City Hall, energy efficient equipment in the Wastewater Treatment plant, and policies to incentivize energy efficiency in affordable housing and EV charging in multifamily new construction.

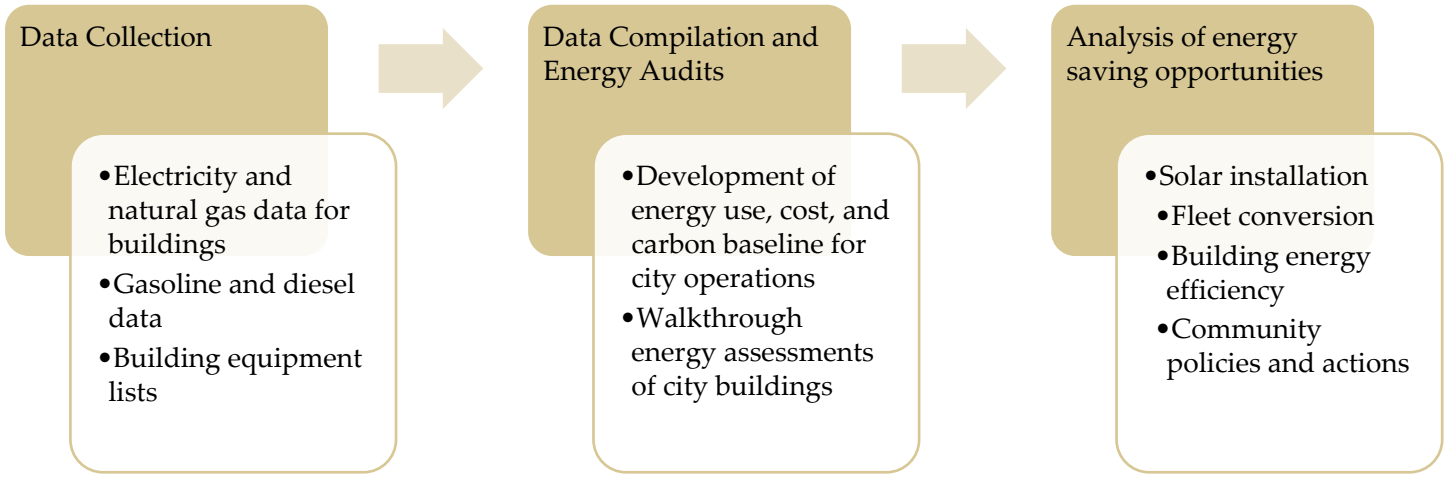
In early 2022, Edgerton identified the need for a municipal energy plan to prioritize next steps and position the community to access and use future implementation funding, meaningfully. To this end, Edgerton developed a coalition with nearby communities, Evansville and Milton, to pursue a planning grant from the State Office of Energy Innovation (OEI) at the Public Service Commission. The grant set out to develop an energy plan for each community while leveraging the alliance to create a broader understanding of what actions are possible for communities of a similar size. The team was awarded the grant from OEI in summer 2022.

Over the past year, the three communities worked with Slipstream to compile current energy, building, and fleet data. Slipstream, a nonprofit, served as the technical advisor to the City and analyzed the data to identify near-term opportunities for upgrades. The process included collection and compilation of energy data to develop an energy baseline, energy walkthroughs at two city facilities, and analysis of energy data to identify cost-savings opportunities for renewable energy, fleet conversions, and building energy efficiency. Slipstream also identified associated policies to support community reductions and institutionalize municipal progress.

During this process, the City of Edgerton continued to illustrate its commitment to carbon reductions. The City passed a new resolution to join the Wisconsin Local Government Climate Coalition, a coalition of local governments across the state, and commit to its goals to support carbon reductions across the state.

This document details the near-term roadmap for municipal operations. The plan begins with a summary of the baseline energy profile for City of Edgerton buildings, operations, and fleet. We then provide recommendations for building and equipment efficiency upgrades, solar installations on city facilities, fleet upgrades to electric vehicles, and community policies.

Figure 3. Overview of planning process



BASELINE DATA

Edgerton has five municipal buildings, a community pool, 24 vehicles and numerous other pieces of equipment in its city fleet; and operates a wastewater treatment plant, wells/pumps/lifts, numerous parks, and streetlights. The City currently has one 17-kW solar installation on its City Hall and a few hybrid vehicles. The energy use across municipal operations amounts to 1,169 metric tons of carbon dioxide (CO_2) and costs the City roughly $238,780 a year. Table 2 illustrates the breakdown of costs and CO_2 across categories.

Table 2. Annual emissions and costs by source (2021 data)

Source	CO_2 Emissions (metric tons)	Percent of Total CO_2 Emissions	Cost
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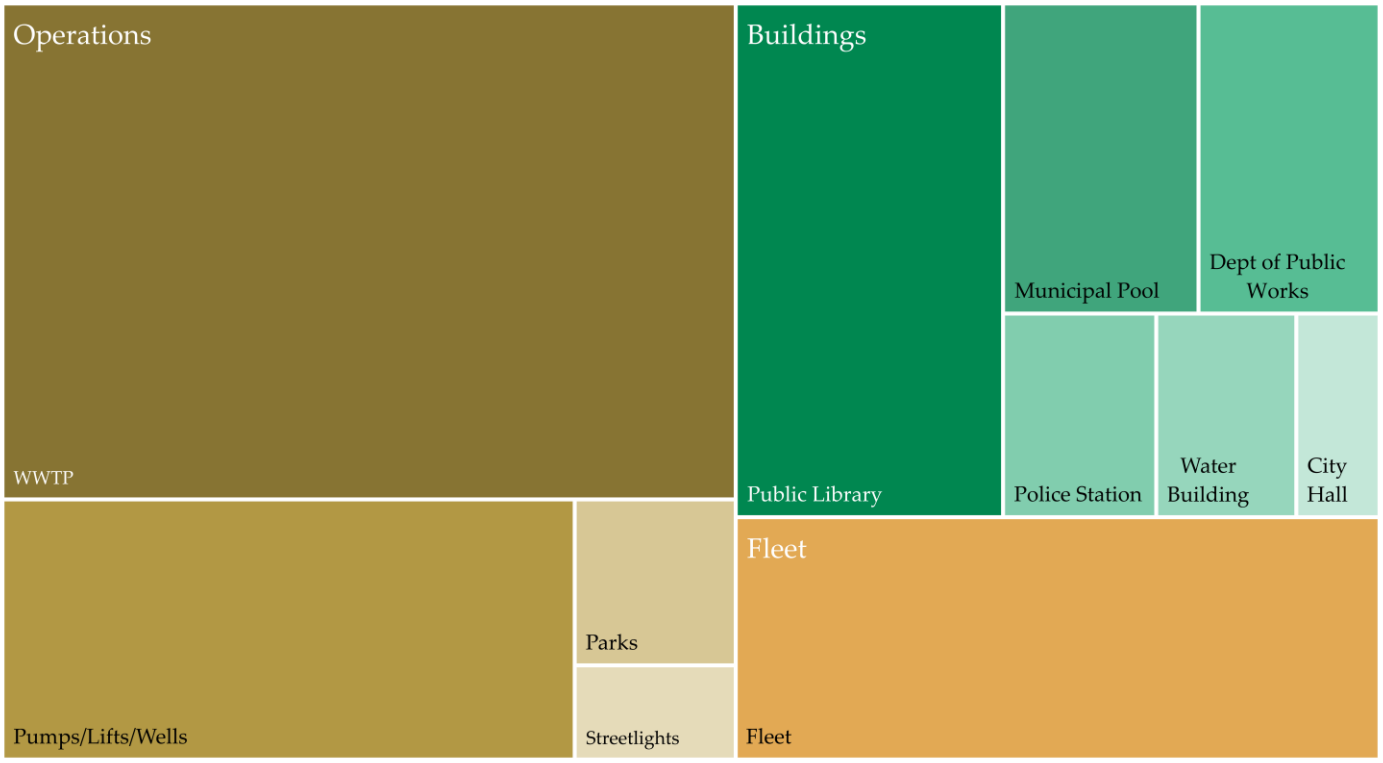
Figure 4 illustrates the relative CO_2 impact across the three main categories of energy use (operations in brown, buildings in green, and fleet in orange). The WWTP has the largest overall impact followed by fleet, pumps/lift/wells, and the public library.

Figure 4. Annual CO_2 impacts of City buildings fleet and operations



RECOMMENDATION OVERVIEW

The project team identified specific building upgrades, solar installations, and low-carbon fleet alternatives for the City as well as recommendations for policies that institutionalize progress and encourage community-wide emissions reductions. The team recommends that the City of Edgerton continue to collaborate with Milton and Evansville and develop a community sustainability council to formalize and institutionalize the City's commitment.

The recommendations are split into four primary categories – energy efficiency upgrades, solar upgrades, municipal vehicle transitions, and policy recommendations. The first three categories are focused only on municipal operations while the policy recommendations cover how to encourage emissions reductions by Edgerton's residents and businesses.

Figure 5 provides the overview of all the recommendations by category. The following sections of the report go into more detail for each of these recommendations. Funding opportunities for these recommendations are also presented in detail at the end of the report.

Figure 5. City of Edgerton recommended energy actions

Building and Facility Energy Efficiency

Benchmark building energy use data.

Implement recommended measures at walkthrough buildings to reach 30% cost savings in each building.

Adopt standard operating procedures across buildings.

Institute standard purchasing policies for building equipment.

Conduct an evaluation of pumps, lifts, and wastewater treatment plant to identify energy savings.

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Engage in ongoing collaboration with Rock County communities and Edgerton residents.

Provide educational materials for residents.

Support community adoption of renewable energy.

Adopt municipal new construction guidelines.

Determine how the city can support public EV charging.

We recommend the City prioritize a few upgrades each year starting with the following:

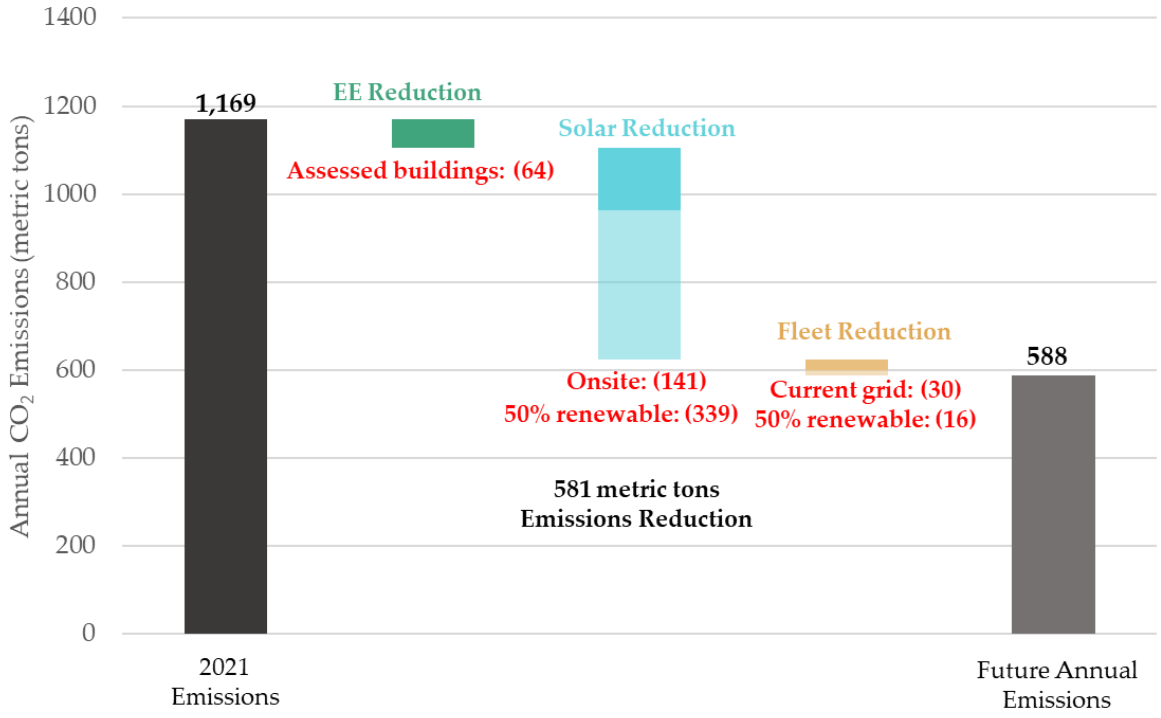
- Install priority measures for audited buildings in the next two to three years.
- Conduct an energy evaluation of wells, lift stations, pumps, and the wastewater treatment plant.
- Install solar at two City facilities in the next two years.

- Work with utility to identify off-site opportunities for solar energy to reach 50% renewable electricity.
- Pilot electric vehicles for three to four light duty vehicles in the next two years.
- Provide educational materials for residents and consider how the city can help encourage other reductions across the city.

Figure 6 illustrates the estimated CO_2 reduction from implementing the recommended measures. The measures modeled quantitatively include implementing energy efficiency at assessed buildings, installing onsite renewable energy, working with the utility to reach 50% renewable electricity after onsite renewable energy, and transitioning eligible vehicles to EVs.

These recommendations lead to a 50% reduction in CO_2 emissions. Energy efficiency is estimated to achieve 64 metric tons of savings. Onsite solar installations are estimated to achieve 141 metric tons of savings. With 50% renewable electricity, we can expect an additional 339 metric tons of savings. Fleet transitions to EVs can result in 30 metric tons of savings under the current grid, and with 50% renewable electricity on the grid, an additional 13 metric tons of savings is possible.

Figure 6. Estimated CO_2 reduction from recommended actions

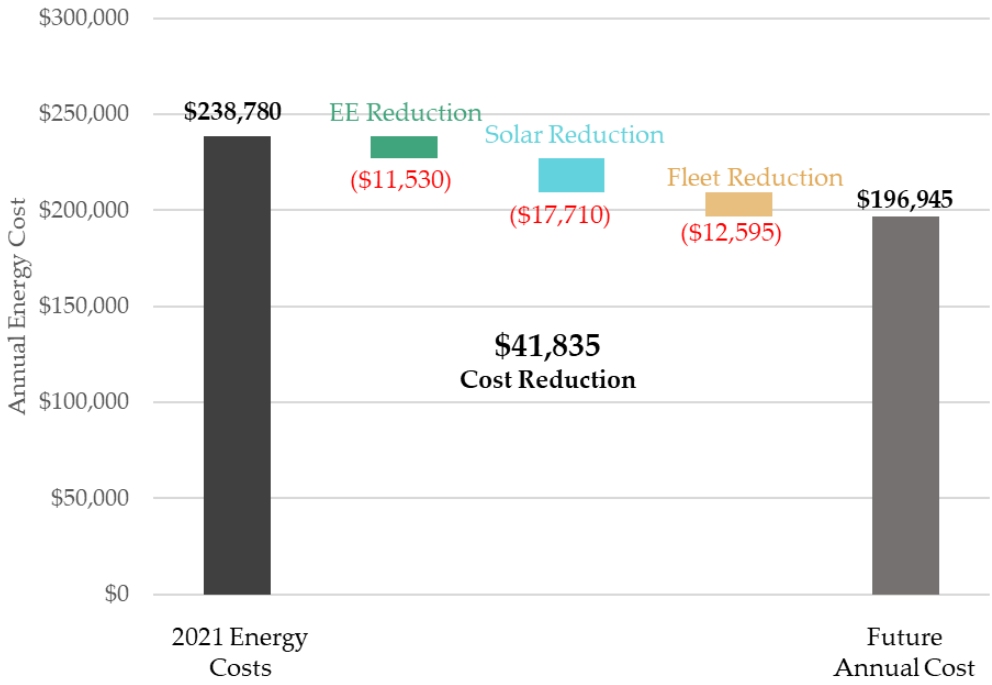


Every recommendation in this plan is not modeled, meaning that the 50% reduction is a conservative estimate of emissions reduction. Further CO_2 emissions reductions are possible through additional actions, highlighted below:

- **Implementation of WWTP and pump efficiency measures.** We did not model savings from these measures as it is outside the scope of the project. Currently the WWTP and water distribution pumps, lifts and wells account for 575 metric tons of emissions, so upgrades have the potential to lead to significant savings.
- **Electrification of buildings and vehicles.** As the electric grid becomes renewable, electrification of building equipment and vehicles is vital to reach carbon neutrality. Prioritization of these items will lead to additional emissions savings.
- **Continued transition to renewable electricity.** As illustrated above, a transition to renewable electricity generates significant CO_2 emissions savings and these savings will increase as equipment electrifies.

Figure 7 illustrates the estimated cost reduction from implementing recommended measures from this plan. The cost savings estimates only include onsite renewables, transitions to EVs, and energy efficiency improvements. These estimates are likely conservative; other recommendations which were not explicitly modeled may also yield cost savings. Energy efficiency investments, solar installations and fleet upgrades are estimated to result in annual savings of $11,530, $17,710, and $12,595, respectively. This amounts to a 18% reduction in cost, or $41,835 annual savings

Figure 7. Estimated cost reduction from recommended actions



BUILDING AND FACILITY RECOMMENDATIONS

RECOMMENDATION 1: CONTINUE ONGOING BENCHMARKING OF BUILDING PERFORMANCE

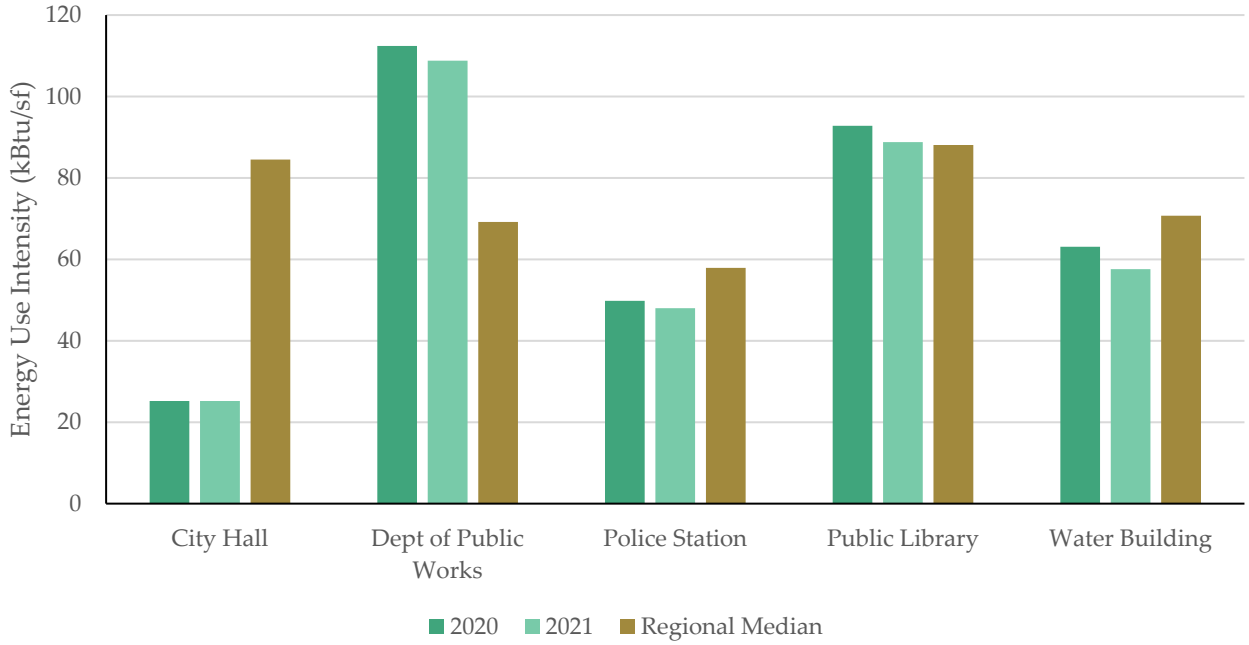
The energy performance of buildings can be tracked by examining energy use intensity over time or in comparison to other buildings through a process called benchmarking. Energy use intensity (EUI) is a metric that shows the building's total energy use divided by square feet of the building and provides a standard approach to examine energy performance of a building.

Figure 8 illustrates the EUI of all Edgerton city buildings over time and compared to the median EUI of similar buildings (age, building type, and characteristics) in the climate zone. City Hall is a well-performing building, reflecting the geothermal heating system and energy efficient equipment installed. The Department of Public Works and Public Library both show higher EUIs compared to the median. This suggests that those are buildings to prioritize with initial upgrades. Recommendations in this section highlight specific items to consider for each building. The Police Station and Water Building are both slightly lower than the median; however, this does not mean that there is not an opportunity to further reduce energy use and the city should still strive to reduce overall EUI year over year.

Recommendations

1. Benchmark building energy use data.
2. Implement recommended measures for audited buildings to reach 30% cost savings in each building.
3. Adopt standard operating procedures across buildings.
4. Institute standard purchasing policies for building equipment.
5. Conduct an evaluation of pumps, lifts, and wastewater treatment plant to identify energy savings.

Figure 8. Energy use intensity of city facilities compared to median energy use intensity of similar buildings in same climate zone (2021 data)



Continuing this tracking over time is a key mechanism to address unexpected changes in energy use, identify maintenance needs, and measure progress toward energy saving goals. EnergyStar Portfolio Manager is a free tool that provides a centralized location for data collection and the ability to benchmark against a sample of similar buildings in the same use type, building age, and climate zone. The City of Edgerton started adding data to the website in 2022 and the project team recommends that the City continue adding data at least annually to the tool.

RECOMMENDATION 2: IMPLEMENT RECOMMENDED MEASURES FOR AUDITED BUILDINGS

The project team performed energy assessment walkthroughs at two buildings, the Public Library and Department of Public Works. These two buildings were selected due to their EUIs being higher than comparable buildings.

The walkthroughs included reviewing current heating and cooling systems, lighting equipment, and appliances and discussing comfort and operations with building staff. The team then developed energy models to estimate savings opportunities. The models were informed by equipment and condition of facilities, building energy code requirements at time of construction, and weather data.

Measure costs were based on secondary research, industry reference materials, and past project experience. These estimates intend to inform prioritizing improvement measures. Actual energy savings from the recommended improvements will be highly dependent on weather and actual building operation. Further engineering and final pricing of all recommended measures will be required prior to implementation.

Edgerton has already implemented LEDs in select buildings and works to keep temperature settings at reasonable settings. Table 3 illustrates the recommended measures for assessed buildings. The measures are organized by high priority, end-of-life, and medium priority. The high priority measures are items with short payback periods, significant savings, or important comfort upgrades. Medium priority are upgrades with higher payback periods or lower savings, and end-of-life (EOL) are recommendations for when equipment reaches its replacement age.

Table 3. Overview of recommended measures

	LIBRARY	PUBLIC WORKS
HIGH PRIORITY	Maintenance refresh Retrocommissioning	Garage door weather sealing Install LED bulbs with lighting controls
MEDIUM PRIORITY	Variable speed HVAC fans	Air sealing Infrared Heaters
END OF LIFE	Roof insulation HVAC upgrades ENERGYSTAR appliances.	Roof insulation Packaged terminal heat pump for office ENERGYSTAR fridges

Table 4 details the upfront cost, annual cost savings, payback period, and annual CO_2 savings. Payback period is calculated as total upfront cost divided by annual cost savings. The upfront cost does not include incentives, and it is recommended that the City discuss with their Focus on Energy Representative what incentives are available. EOL measures' payback is not included as it depends on incremental cost compared to the other replacement option. The library's high priority measures have a higher payback as retrocommissioning is included to improve comfort, which has a longer payback period. Appendix 1: Building Descriptions has a full description of each building.

Table 4. Cost and CO_2 savings from recommended measures

	Upfront Cost ($)	Annual Energy Cost Savings ($)	Percent Cost Savings	Annual CO_2 Savings (MT)	Percent CO_2 Savings	Average Payback
Library	**$226,000**	**$8,030**	**36%**	**45.2**	**35%**	**-**
High Priority	$9,000	$1,400	6%	7.6	6%	6.4
Medium Priority	$16,600	$2,000	8%	8.8	7%	8.3
EOL	$200,400	$4,630	20%	28.8	22%	-
Public Works	**$33,700**	**$3,500**	**32%**	**19.2**	**29%**	**-**
High Priority	$7,000	$1,100	9%	5.8	9%	6.4
Medium Priority	$9,000	$1,300	11%	8.4	13%	6.9
EOL	$17,700	$1,100	9%	17.4	14%	-

RECOMMENDATION 3: INSTITUTE A STANDARD OPERATING GUIDELINES AT ALL BUILDINGS

The operation of a building and the behavior of building occupants has a significant impact on building energy use. Operational guidelines can save energy without significant investment and have the potential to positively impact occupant comfort and productivity. We recommend that City of Edgerton develop a policy that defines clear guidelines for the operation of municipal buildings. The guidelines should be written flexibly enough to reflect that each building has unique characteristics and that decisions should balance energy use and comfort. The municipality should also set up the appropriate communications channels so that building occupants can provide ongoing feedback.

Figure 9 provides a full list of items to consider for an operating policy. The operating policy covers ongoing maintenance, HVAC system operation, plug load management, and lighting. The City of Edgerton already implements several of these recommendations, such as putting computers in standby and adjusting thermostat settings. However, it is important to develop a policy to institutionalize current norms and habits.

In the walkthroughs, staff mentioned HVAC and comfort concerns in the library. The development of a standard process for feedback on comfort will be important as the City implements measures to try to address energy use and comfort in the space.

Figure 9. Operating policy examples

Operational Policies	Maintenance	Follow regular maintenance schedule for buildings and equipment.
		Change air filters on regular basis.
		Ensure air-conditioning units maintain refrigerant charge
	Heating, ventilation, and air conditioning (HVAC) systems	Establish temperature setpoints and setbacks for occupied and unoccupied times.
		Keep a list of operating parameters, including the temperature set points and operating schedule, for each piece of equipment. Locate in visible locations to make sure equipment is programmed correctly.
		Post guidance on when operable windows can be opened based on room thermostat setpoints. For example, assuming thermostats are set from 70 degrees to 75 degrees, building occupants should have clear direction that they can opened windows between 68-77 degrees outdoor temperature.
		Create communication channels for building occupants to provide feedback on comfort or operational issues. A regularly administered survey can be useful to gather additional feedback on occupant comfort
	Plug loads	Develop a policy that prohibits or limits the use of individual fridges, space heaters, printers, and other peripheral equipment at workstations. Consider ways to consolidate the number of fridges and printers across the building.
		Implement computer power management on worker's computers using a 30 minute or less delay before putting computers to sleep.
		Implement TV sleep requirements to ensure TVs are not running all day.
	Lighting	Promote or incentivize occupants to turn off switched lights when not in use.

RECOMMENDATION 4: INSTITUTE A STANDARD PURCHASING POLICY FOR FUTURE UPGRADES

There are opportunities to increase building efficiency at every point of purchase with any piece of equipment that uses energy. In limited cases, it may make sense to upgrade equipment early; but the decision at replacement is most important and impacts energy use for decades. We recommend that purchasing guidelines be put in place so all employees have a clear guideline as to what to target in purchases to meet the municipal energy goals.

Figure 10 summarizes the purchasing recommendations across HVAC, appliances, and lighting. Several of these items are implemented already, such as purchasing of LEDs and installing energy efficient equipment. Similar to the operating policy, it's important to develop guidelines so that staff changes do not impact existing practices.

Figure 10. Purchasing policy example items

Purchasing Policies	Heating, ventilation, and air conditioning (HVAC) systems	Consider installation of air source or dual-fuel heat pumps
		Install a minimum of a condensing furnace with efficiency higher than 95%
		Install a minimum of ENERGY STAR certified AC with SEER2 ≥15.2. Refer to CEE Tiers for energy efficient equipment for larger cooling equipment like RTUs.
		Install smart thermostats with occupancy sensors to setback temperatures
		Consider installing or upgrading building automation system when replace equipment.
	Appliances and other equipment	Purchase ENERGY STAR equipment to replace office equipment and water heaters
		New windows should meet or exceed ENERGY STAR requirements. Large commercial windows or store front windows should target U-value of 0.3 and SHGC of 0.25.
		Consider replacing water heaters with hybrid electric water heaters
	Lighting	Consider addition of daylighting and occupancy controls for LED systems
		Continue purchasing of LED bulbs for lighting replacements

Electrification Considerations

Electrification is the process of phasing out equipment that uses fossil fuels (i.e., natural gas, propane, gasoline) with equipment that uses electricity. The main benefit of electrification is a reduction in CO_2 emissions. CO_2 emissions from electric equipment will continue to drop as the electric grid turns to renewable energy while gas equipment will have a constant emissions rate across time.

In many situations, heat pumps are still more expensive than a high-efficiency natural gas system. However, incentives and changing energy costs are causing heat pumps to become more cost competitive. During future HVAC and water heating decisions, staff should compare costs and CO_2 emissions of conventional equipment and heat pumps. Table 5 lists the heat pump options for Edgerton buildings.

Table 5. Heat pump system options for existing systems in Edgerton buildings

Existing System	Heat Pump System	Notes
Furnace and A/C Split System	Dual-Fuel Air-Source Heat Pump	A cost-effective electrification option that still uses gas but electrifies heating at temperatures above 25°F.
	Air-Source Heat Pump	Full electrification option.
Steam Boiler System	Variable Refrigerant Flow (VRF)	Suitable for historic retrofits and buildings with many smaller rooms, such as offices, courthouses, and police/fire stations.
	Geothermal heat pump system	Requires land for geothermal borefield. Inflation Reduction Act offsets 30% of cost.
Single Zone RTU	Heat-Pump RTU	Emerging technology.

RECOMMENDATON 5: CONDUCT AN EVALUATION OF PUMPS, LIFTS, AND WASTEWATER TREATMENT PLANT TO IDENTIFY SAVINGS

Wells, pumps, and lifts for water distribution and the wastewater treatment plant at Edgerton accounts for nearly 50% of total CO_2 emissions annually. To significantly reduce energy cost and CO_2 emissions, it's vital to address these facilities. It was outside the scope of this project to fully estimate potential energy savings or fully review existing processes at these facilities. However, we offer several recommended actions to analyze and reduce energy use at these sites. The recommendations are below:

- **Use benchmarking to understand energy use.** ENERGY STAR Portfolio Manager has an option for benchmarking wastewater and water utilities. It requires multiple parameters to receive an accurate score and compare to other WWTPs across the nation. The energy use for the WWTP has been added to ENERGY STAR but the additional parameters have not. This can provide a comparison to other similar facilities.

- **Install equipment for granular monitoring of equipment.** WWTP is a large complex with multiple important water treatment processes than run all-year. To fully understand current energy use and understand efficiency opportunities, the City should explore installing submeters or energy monitors on specific pieces of equipment. This will allow the staff to better track energy use from different equipment and processes and compare that to industry standards.

- **Hire a professional to do a thorough facility assessment of WWTP and pumps.** A review of the entire WWTP facility, including each process and pumps has the potential to identify significant energy savings potential. Pump stations are sometimes oversized so this analysis could identify how to optimize pump efficiency and size at end of life. In 2023, Focus on Energy is offering a rebate for an assessment. City staff should talk with Energy Advisor to identify opportunities.[1]

- **Work with Focus on Energy to identify rebates for efficiency updates.** Focus on Energy has a water treatment best practice guide that may provide additional guidance on next steps for reducing energy use within the Filter Plant.[2] There are also rebates available for several of these upgrades through Focus. Examples of upgrades include:
    - Implement typical energy efficiency upgrades such as LED lighting upgrades and HVAC replacements.
    - Install variable frequency drives to match motor-output speeds to specific load and avoid running at full power.
    - Assess the aeration system to determine if operating as efficiently as possible and consider potential upgrades to fine bubble aeration, dissolved-oxygen control, or variable airflow-rate blowers.

- **Implement a policy to guide equipment replacement.** Similar to building equipment, the decision at replacement for this equipment impacts energy use for decades. We recommend the City develop efficiency and sizing guidelines for future purchases.

Focus on Energy also has a helpful resource that provides no to low-cost opportunities to save energy at WWTP.[3]

[1] 2023 application for Wastewater Treatment Plant audit rebate: https://s3.us-east-1.amazonaws.com/focusonenergy/staging/inline-files/2023/BIZ-SG-Wastewater-Plant-Energy-Assessment_2023_APL.pdf

[2] Water and Wastewater Treatment Industry. February 2020. https://assets.focusonenergy.com/production/inline-files/2021/BIZ-EE-Best_Practices-Water_Wastewater.pdf

[3] Top 25 Low Cost-No Cost Energy Saving Opportunities. https://s3.us-east-1.amazonaws.com/focusonenergy/staging/inline-files/Wastewater_Low-Cost-No-Cost-List.pdf

SOLAR RECOMMENDATIONS

RECOMMENDATION 1: INSTALL 115-180 KW OF SOLAR

On-site solar can save money and reduce CO_2 emissions by leveraging existing roof or ground space near existing facilities. The analysis examined all City facilities for solar installations and identified five locations that were good candidates for solar installations. Other locations were excluded due to already having solar or lack of space available. The analysis incorporated available space at each facility, monthly historical data for the building, and the utility rates.

Recommendations

1. Install 115-180 kW of solar by 2032 at city buildings offsetting 10 to 15% of electricity use.
2. Consider battery installations to provide resiliency benefits.
3. Collaborate with utility to offset 50% of municipal electricity with renewable energy.

Table 6 illustrates the solar array size recommendations, percent renewable electricity for each site, and the simple payback period. The solar array size is determined by examining roof or ground space, monthly energy use of the building, and cost effectiveness. The payback period is calculated by dividing yearly utility bill savings by the net upfront cost. The energy cost savings represent annual energy cost savings – after the payback year all of these will be direct savings for the city. The CO_2 savings represent annual emissions avoided.

The payback period for the WWTP is significantly higher which reflects the higher cost of ground systems and the lower energy production from the array being oriented west. However, the significant energy use of the facility means that the array would have a significant impact on CO_2 emissions for municipal operations.

Table 6.Solar PV installation recommendations for Edgerton facilities

Building	Size (kW dC)	Percent Renewable Electricity	Payback (Years)	Annual CO_2 Savings (MT)	Annual Energy Cost Savings
Water Building	12	91%	9.6	10.4	$1,755
Library	20	18%	10.0	18.8	$3,205
DPW Garage	20	70%	10.9	17.3	$2,925
Police Station	20	52%	11.8	16.0	$2,705
WWTP	100	16%	23.7	78.2	$7,120

Table 7 includes costs for each array. The estimated upfront cost is based on size and location on roof or ground. The Focus on Energy incentives represent local incentives available and are based on the size (generating capacity) of the array. Cities are also eligible for the Inflation Reduction Act's clean energy tax credits through elective pay, a provision that allows non-taxable entities to receive the credits (see Funding Opportunities for Recommendations). The credit is 30% of the upfront cost and is paid after the array is installed. Net cost represents total cost after the incentives and tax credit is applied.

Table 7. Cost details of solar PV installations for Edgerton facilities

Buildings	Upfront Cost	Focus on Energy Incentives	IRA Tax Credit	Net Cost
Water Building	$30,000	$4,200	$9,000	$16,800
Library	$50,000	$3,000	$15,000	$32,000
DPW Garage	$50,000	$3,000	$15,000	$32,000
Police Station	$50,000	$3,000	$15,000	$32,000
WWTP	$260,000	$13,000	$78,000	$169,000

The full recommendations for each building, including placement of solar panels and input details are included in Appendix 2: Solar Methodology and Full Results.

RECOMMENDATION 2: CONSIDER BATTERY INSTALLATIONS TO PROVIDE RESILIENCY BENEFITS.

Historically, generators have been the common solution for resiliency needs at a building because of their ability to run during power outages and their relatively low upfront costs. However, generators alone are restricted by code from running during normal operations. Instead, battery energy storage systems (BESS) paired with solar PV, operating as a microgrid, are increasingly used as a backup system because they provide benefits during normal operations and provide backup power during emergencies. Microgrids are a group of interconnected loads and distributed energy resources with clear electrical boundaries that can disconnect and connect to the grid.[4]

The primary concern with BESS is cost. However, costs continue to decline, making BESS a viable option especially in buildings where generators do not already exist or at time of generator failure. From 2010 to 2018, battery prices fell by 85%, and costs are predicted to continue to decline at a rate of 18%.[5]

Edgerton is considering adding a resiliency solution to the police station. The City received a quote for a 30-kW generator at around $35,000 and a 48-kW system at $48,000. The project team analyzed BESS and solar PV options as an alternative to addition of a generator. The sizing of the BESS is determined by setting constraints on the percent of building load that must be met for a certain number of hours in a specific season. For this analysis, we included a scenario for a system that must meet 50% load for 12 hours in the summer or 30% load for 12 hours in the summer. These numbers are preliminary, and a more in-depth feasibility study would need to be completed to determine ideal size and costs.

Table 8. includes the battery size and solar PV size for each scenario, the simple payback, and the average resiliency. The simple payback is calculated as the upfront cost divided by the annual energy savings. The addition of a BESS increases the recommended solar size to increase energy production to charge battery. The BESS also allows for use of the solar energy at different times of the day, which changes the economics for a larger system. The larger system reaches 90% of total electricity use and increases annual CO_2 savings from 16 metric tons to 28 metric tons and energy cost savings from $2,700 to roughly $4,900. The average resiliency calculates the number of hours the system could cover for an outage starting at any time of the year. It is higher than 12 hours as building load is lower in the spring, fall and winter and therefore the system can cover outages of longer lengths

Table 8.BESS and solar PV options for Edgerton Police Station

	PV Size (kW dc)	Battery Size	Simple Payback (yrs.)	Average Resiliency (hrs.)
Solar Only	20	-	14.5	-
30% load covered	35	5 kW,12 kWh	16.6	94
50% load covered	35	11 kW,27 kWh	18.6	72

Table 9 provides the cost details for the microgrid options. The upfront costs are split between solar and BESS. Focus on Energy incentives are for solar only, while the IRA tax credits cover both solar and BESS at a 30% rebate on upfront cost. The battery would need to be replaced one time during the 25-year lifetime of the solar, adding additional costs around year 15. The preliminary estimates are for smaller systems than the generator quotes and have slightly lower costs than the generator. More details are in Appendix 2: Solar Methodology and Full Results.

Table 9. BESS and solar PV options for Edgerton Police Station

	Solar Cost	BESS Cost	Focus on Energy Incentives	IRA Tax Credits	Net Cost
Solar Only	$50,000	-	$3,000	$15,000	$32,000
30% load covered	$50,000	$25,560	$3,000	$22,668	$49,890
50% load covered	$87,500	$24,700	$4,875	$33,660	$73,665

[4] Ton and Smith, "The U.S. Department of Energy's Microgrid Initiative." https://www.energy.gov/sites/prod/files/2016/06/f32/The%20US%20Department%20of%20Energy%27s%20Microgrid%20Initiative.pdf

[5] Goldie-Scot, "A Behind the Scenes Take on Lithium-Ion Battery Prices." https://about.bnef.com/blog/behind-scenes-take-lithium-ion-battery-prices/

As costs continue to fall, the most viable options for microgrids are when replacing a generator at time of failure, adding a new resiliency backup source at a building, or during new construction. A full feasibility study that considers the load that should be covered, existing electrical service, and ideal size should be done prior to installation. Figure 11 summarizes a checklist of considerations for resiliency options and microgrids at city facilities.

Figure 11. Microgrid consideration checklist

Consider batteries where backup power is needed.	At time of generator replacement or purchase, compare upfront equipment costs, ongoing O&M costs, the potential energy and demand cost savings, and performance requirements to determine best option
Utilize microgrid ready design during renovations and construction	Similar to solar-ready, microgrid-ready spreads out costs and ensures a building is ready for a battery in the future. Key considerations include physical space for a battery and making sure solar inverters are compatible if solar is installed first.
Consider energy efficiency and demand management to decrease solar and storage capacity needs	When sizing a BESS, the baseline load is the single most important factor. If there are ways to decrease total energy use through energy efficiency and demand management, this can allow for a smaller and less costly system.
Consider length of outage system needs to cover	The length of outage for the system to cover is a key input in determining backup system size. It's important to think through functions of the building and how those relate to number of hours a system should cover.
When sizing DER components, determine the critical loads at the facility	The amount of load that must be sustained during an outage is a key factor in the size of storage required. Stakeholders familiar with the building load and needs can estimate which functions should be considered critical load.

RECOMMENDATION 3: COLLABORATE WITH UTILITY TO OFFSET 50% OF MUNICIPAL ELECTRICITY WITH RENEWABLE ENERGY

Onsite solar installations on City facilities will only be able to cover a fraction of city operations electricity. There is limited space at each facility, and some facilities have little to no space due to roof issues or ground space being used for other purposes. To significantly reduce CO_2 emissions in the next decade, we recommend that the City collaborate with the utility, Alliant Energy to explore offsite renewable energy opportunities or other programs.

Under current Wisconsin law, municipalities must primarily work with the utility on offsite renewable energy as developers are limited in ability to sell renewable energy to customers directly. Alliant Energy, Edgerton's main utility, has goals to reach a 50% reduction in greenhouse gas emissions compared to 2005 levels by 2030, 80% reduction by 2040, and have net-zero carbon dioxide emissions from its electricity by 2050.[6] To help meet this goal, Alliant has several renewable energy programs available. Two off-site solar opportunities Edgerton can pursue are below:

[6] Alliant Energy goals are available here: https://www.alliantenergy.com/cleanenergy/ourenergyvision/responsibilityreport/cleanenergyvisiongoals

- **Customer-hosted renewable energy:** Under this program, a customer leases land or property to Alliant Energy and receives monthly lease payments. Alliant then builds and maintains a solar garden on the space and the energy helps power the nearby area. The program includes arrays as small as 200 kW or as large as 2.25 MW (15 acres) of solar on the ground or roof. The benefits of this program are that the City does not have to pay upfront costs, receives a lease payment for the use of land or property, and receives Renewable Energy Credits from Alliant.[7]
- **Janesville community solar:** Alliant Energy is currently building a community solar garden in Janesville and looking for subscribers to the program. Subscribers pay an upfront payment to secure blocks of the solar energy from the array and receive ongoing bill credits for up to 20 years. The estimated payback period is 11 years. The estimated cost of a 250-watt block is $337.[8]

[7] Customer hosted renewable information is available here: https://www.alliantenergy.com/cleanenergy/whatyoucando/customerhostedrenewables
[8] Janesville community solar: https://www.alliantenergy.com/cleanenergy/whatyoucando/communitysolar/communitysolarjanesville

FLEET RECOMMENDATIONS

RECOMMENDATION 1: PILOT 3-4 VEHICLES IN MUNICIPAL FLEET

The City of Edgerton's current fleet includes 13 gasoline-powered vehicles and 11 diesel-fueled vehicles. In addition to those on-road vehicles, Edgerton owns gasoline and diesel-powered non-road equipment, such as lawnmowers and skid steers. Table 10 shows fuel use, miles driven, and miles per gallon in 2021 across all vehicle categories. Police vehicles include large cars and mid-sized SUVs. These vehicles were grouped together to reflect the unique use patterns and shorter replacement schedules. The off-read equipment does not list miles driven as the equipment use is measured in hours of use.

Recommendations

1. Pilot three to four electric vehicles in the municipal fleet.
2. Use the estimated total cost of vehicle ownership to guide vehicle purchasing decisions.
3. Replace non-road equipment with electric alternatives.

Table 10. City of Edgerton municipal vehicle fleet summary (2021 data)

Category	Number of Vehicles	Fuel Purchased (gallons)	Fuel cost	CO_2 Emissions (metric tons)	Miles Driven	Avg MPG
Mid-size Car	1	100	$300	0.84	2,795	28.4
Full-size Pickup	6	2,770	$8,020	23.6	35,905	13.0
Police	4	7,835	27,790	66.4	89,650	11.4
Work Van	2	525	$1,505	4.7	4,880	9.3
Heavy Duty Pickup	4	2,025	$5,820	18.6	17,805	8.8
Large Truck	7	2,070	$5,880	21.2	15,160	7.3
Off-Road Equipment	20	4,100	$11,185	39.4	-	-
Total	**44**	**19,425**	**$60,500**	**174.7**	**166,193**	**10.8**

EVs offer several advantages compared to diesel or gasoline vehicles and have similar performance capabilities as ICE vehicles in the same category. Typical daily mileage for most City vehicles is less than 100 miles and most EVs can drive over 200 miles before they need to be recharged. To identify opportunities for Edgerton to save money and reduce emissions generated by its vehicles, the project team focused on opportunities for Edgerton to replace its existing cars and trucks with electric vehicles (EVs).

Benefits of EVs

Lower fuel cost ($/mile) than gasoline or diesel vehicles.

Maintenance costs 50% lower compared to gasoline or diesel vehicles.

Reduce CO_2 emissions up to 40% with current electricity mix.

Lower energy use while idling reduces engine wear and saves money

To ease into the transition to EVs and address potential concerns about driving and maintaining an EV fleet, the project team recommends that the City of Edgerton start by replacing 3-4 existing vehicles ready for replacement with EV alternatives. This pilot approach would include three components:

- Replace a limited number of vehicles in the City's existing fleet with EV alternatives.
- Install EV charging stations to fuel the vehicles in the pilot
- Train staff to drive and maintain EVs, as applicable.

During the 12-18 month pilot period, the City will track the cost and amount of electricity used to charge the EVs, the maintenance requirements, and any feedback from drivers on their experiences driving the cars. The City can use this information to guide how it adds more EVs into its municipal fleet in the future.

Pilot Component 1: Replace existing fleet vehicles with EVs

The first component of the pilot is to replace 3 to 4 existing vehicles with EV options when the current vehicles reach replacement age. The project team analyzed fleet data to identify which vehicles have cost-competitive electric options compared to conventional vehicles and are near-replacement age.

The project team reviewed available EVs to determine which vehicle categories have market-ready EV alternatives, and then calculated incremental cost and payback periods to identify which categories are feasible for adoption. More details on this methodology are available in Appendix 3: Fleet Methodology.

Table 11 shows the four vehicle categories in Edgerton's fleet for which EVs are available and are currently cost-competitive. The current vehicle column shows an existing vehicle in that category in Edgerton's fleet, and the new gasoline vehicle benchmark lists the approximate cost and fuel efficiency rating for a new conventional vehicle in that category. The EV incremental cost is the difference between the cost of a new conventional vehicle and the cost of a corresponding EV. It includes the expected reduction in cost from the Inflation Reduction Act's Commercial Clean Vehicle credit (up to $7,500) for each vehicle.[9] The cost savings per mile is the reduced per mile cost of fueling and maintaining the EV instead of the conventional vehicle. Miles for financial payback indicates the miles after which the cumulative benefit of the lower cost of driving the EV surpasses the higher cost of purchasing the EV.

Table 11. Potential EV Alternatives by Vehicle Category

Category	Current Vehicle	New gasoline vehicle benchmark	Ex. EV Alternative	EV Incremental Cost	Cost Savings/Mile	Miles for Financial Payback
Mid-size Car	PT Cruiser	34.5 mpg $24,568	Chevrolet Bolt EUV	$0	$0.084	0
Work Van	Chevrolet Express Van	25.5 mpg $44,455	Ford E-Transit	$3,600	$0.095	38,000
Police Patrol	Dodge Charger	23 mpg $42,600	Tesla Model Y	$0	$0.128	0
Full-size Pickup	Dodge Ram 1500	20 mpg $41,800	Ford F150 Lightning	$8,500	$0.123	70,000

Commercially available EVs in the four categories in Table 11 could replace 54% of the City's vehicles. Additionally, six Edgerton vehicles are 11 or more years old and are in a category for which a cost-competitive EV is available.

Instead of an immediate full transition, the Project team recommends initially purchasing 3-4 EVs through the City's regular vehicle replacement process and collecting data and stakeholder feedback to inform how it transitions additional vehicles. Potential candidates for replacement with an EV in the pilot are listed below.

- 2005 Chrysler PT Cruiser
- 2000 GMC Van
- 1997 Chevrolet 1500
- 2018 and 2019 Dodge Chargers (Police patrol vehicles[10])

Replacing the vehicles recommended would result in a 55 to 75% reduction in fuel costs and a 22 to 56% reduction in CO_2 emissions. If outside factors prevent one or more of the recommended vehicles from being replaced with an EV, other similar vehicles in the municipal fleet should be considered as alternative options for replacement.

[9] The value of any available Federal tax credits are applied to the EV MSRP to calculate the EV incremental cost.
[10] Due to vehicle use patterns and high-performance requirements, police patrol vehicles have a shorter vehicle replacement cycle compared to other types of vehicles.

Pilot Component 2: Install EV Charging Stations

The City will need to install adequate EV charging stations so that its vehicles can be sufficiently charged to meet their daily service requirements. Level 2 charging stations require 240V electric service and can fully charge a vehicle in 4-10 hours, depending on the battery capacity of the vehicle. Level 1 chargers use standard 120V electric service, but are unable to fully recharge a battery overnight, while Level 3 chargers can fully recharge a vehicle in less than 30 minutes but are much more expensive than Level 2 chargers. Table 12 summarizes levels of EV charging stations.

The costs shown for Level 1 and Level 2 chargers in Table 12 indicate typical ranges for the combined cost of the station hardware, electrical upgrades and electrician labor to install each EV charging port. The hardware cost for Level 2 charging stations is modest; however, installing conduit between existing electrical panels and the location of the charging station, along with upgrading electrical service (if necessary) can add complexity and expense to installing the stations. Due to the wide variation in the costs of installing the high voltage electrical service for Level 3 stations, the cost listed for Level 3 stations only represents the material expenses.

Table 12. EV Charging Station Types

Charger type	Range Miles per charging hour	Uses	Installed cost per port (est.)
Level 1 (120V AC)	~5	Home charging	~$1,200 - $1,500
Level 2 (240V AC)	~25	Home, workplace, and public charging (most common)	~$1,500 - $4,200
Level 3 (DC)	200+	Public charging; transportation corridors	~$20,000 - $150,000 (Hardware only)

Based on the understanding that the pilot vehicles will typically be off-duty overnight, we recommend installing Level 2 chargers at the Police Station and at the DPW Garage. In planning for EV chargers at these locations and other municipal facilities in the future, the project team recommends the following:

- Assess total future electrical service needs when upgrading for new vehicle charging stations. When planning for any electrical service upgrades or laying of new conduit, assess both the near term requirement for the number of needed charging ports and the total potential electric vehicles that may be stationed at the location and the corresponding associated number of charging stations that may be needed in the future. Support long-term cost savings by including future needs in current upgrade plans.
- Consider how many vehicles a single charger can support. In Edgerton, average daily miles driven by non-police vehicles recommended for replacement suggests that EV alternatives may not require daily charging,[11] thus allowing one level 2 charging station to support two or three EVs. However, the City may choose to plan for a worst-case scenario and install one level 2 charger per EV that it purchases so that all vehicles can charge simultaneously. For police vehicles, it is likely that each vehicle needs its own charger.




[11] Statement is based on a finding that the average miles driven per workday for most City vehicles is less than a quarter of the advertised driving range between charges for typical EV models.

Pilot Component 3: Train city staff to drive and maintain electric vehicles

City staff who drive an EV during the pilot may have questions about the vehicle's driving range, how to charge the vehicle, when the vehicle should be charged, and any differences between driving an EV and a conventional vehicle.

To help answer these questions, the City should identify an EV ambassador - either a staff person or a dealership representative. The ambassador can provide a brief EV orientation to discuss the benefits of the vehicles and answer any remaining questions. After the pilot, those staff who drove the pilot EVs may take on the roles of "EV ambassadors" as additional staff start using the electric vehicles. The City should prepare a draft of an internal policy document that outlines rules for using the EVs. At a minimum, the rules should provide for:

- Prohibiting non-EVs from parking at municipal charging stations.
- The conditions (level of charge, frequency, time of day, other) under which a driver should charge a vehicle after use.
- A map of public charging stations in the Edgerton area. The City may also consider creating an account with a public charging station provider, such as Plug Share or Charge Point to facilitate accounting for charging municipal vehicles at public charging stations.
- Protocols for tracking and allocating costs for electricity used to charge vehicles.
- Procedure for reimbursing driver expenses for use of non-municipal charging stations, when needed.

EVs have fewer moving parts than gasoline or diesel vehicles and require less maintenance. City staff who maintain vehicles may be able to reduce time spent on routine maintenance as Edgerton adopts EVs. However, to help alleviate concerns from maintenance staff, we recommend that the City's vehicle maintenance staff receive education on this topic. Most EV manufacturers offer training on maintaining electric vehicles.

As another point of training and education, Edgerton may benefit from contacting other municipalities in Wisconsin that have successfully introduced EVs into their fleets. For example, the City of Madison has emerged as a leader in transitioning its fleet from gas and diesel vehicles to electric models and often offers opportunities for other cities to test their vehicles or discuss their experience.

RECOMMENDATION 2: USE ESTIMATED TOTAL COST OF VEHICLE OWNERSHIP TO GUIDE PURCHASING

The analysis of Edgerton's fleet identified 13 vehicles for which there are cost-competitive EV options that would save the City money in the long-run and reduce emissions. In addition, the EV market is rapidly changing with new models being announced frequently and the cost of new EVs decreasing.

To reflect this changing market and the benefits of EVs, we recommend that the City adopt a vehicle purchasing policy that prioritizes selecting vehicles that offer the lowest total cost of ownership (TCO), rather than the lowest purchase price, while still meeting the City's performance requirements for the vehicle. A TCO-based purchasing policy will ensure that future decisions about fleet transitions reflect the changing costs of EVs vs ICEs and the long-term operational cost savings potential of EVs. The analysis should incorporate the following components:

- Upfront cost differential
- Ongoing fuel costs: cost to charge an EV vs. cost to purchase gasoline or diesel needed for an ICE
- Maintenance costs
- Forecasted resale values of both vehicles

Table 13 summarizes EV vs conventional vehicle considerations across cost categories.

Table 13. EV vs conventional vehicle cost comparisons - upfront and operating

Cost of Ownership Factor	Electric vehicle or conventional vehicle comparison
Purchase Cost	Purchase costs vary by vehicle category
Fuel Cost	Fuel cost per mile is lower for EVs
Maintenance Cost	Studies[12] show approximately 50% lower maintenance costs for EVs.
Resale Value	Some analyses have shown higher resale value for EV, but irregularities in markets for all used and new vehicles from 2020 – 2023 create uncertainty.

A TCO purchasing policy will gradually lead to adoption of EVs across vehicle types. Table 14 shows the annual operating cost saving and emissions reduction potential of replacing all eligible vehicles with EVs that have a lower TCO than conventional vehicles. The operating cost savings includes savings from both reduced fuel costs and reduced maintenance expenses. The CO_2 savings represent 22% of all fleet emissions, and fuel cost savings alone represent 25% savings compared to all current fuel costs.

Table 14. Potential annual savings from adding EVs to City fleet

Vehicle category	Operating Cost Savings	CO_2 Emissions Avoided (MT)
Work Van	$465	0.2
Police Patrol	$11,480	18.5
Full-size Pickup	$4,410	5.1
Mid-size car	$235	0.4
Total	**$16,590**	**24.2**

Another way for a municipal fleet to save money is to optimize the total number of vehicles in the fleet. For example, over half of the vehicles in the City fleet are driven less than 5,000 miles per year. Low annual mileage may create opportunities for Edgerton to use fewer vehicles to complete the same set of services. To optimize fleet size, at the time of purchasing, the City should review the proposed use of the vehicle, as well as the actual use of other similar vehicles to determine whether uses may be consolidated into a single vehicle. A new vehicle would only be purchased if leaders determined that the services for which the proposed vehicle would be used could not be performed with an existing vehicle in the fleet.

[12] Harto, C. *Electric Vehicle Ownership Costs: Chapter 2 – Maintenance.* Consumer Reports. September, 2020. (https://advocacy.consumerreports.org/wp-content/uploads/2020/09/Maintenance-Cost-White-Paper-9.24.20-1.pdf)

RECOMMENDATION 3: STRATEGICALLY REPLACE NON-ROAD EQUIPMENT WITH ELECTRIC ALTERNATIVES

Edgerton owns 20 pieces of on-road and off-road equipment that it uses primarily to maintain the City's lands and walkways. Equipment includes commercial lawnmowers, snowblowers, snow throwers, skid steers, generators, and a street sweeper. The fuel consumption and emissions generation from these machines is significant, highlighting the importance of including in Edgerton's energy plan.

Research has found that electric push and commercial lawnmowers produce 50% and 32% fewer emissions, respectively, than gasoline powered mowers.[13] Based on the potential reduction in emissions from replacing some gasoline and diesel equipment with electric alternatives, we recommend that Edgerton investigate options for a pilot transition.

Electric alternatives are available for several of the types of equipment that Edgerton uses to maintain the municipality's lands, sidewalks, and roads, including:

- 60" (and smaller) Lawn mowers
- Forklifts
- Skid steers
- Street sweepers
- Snow blowers

When evaluating opportunities to replace gasoline-fueled equipment with electric alternatives, the project team recommends that the City assess the factors in Table 15 to identify and prioritize electrification opportunities for 2-3 pieces of equipment. Using the experience from the first few pieces of equipment, the City should then gradually replace all equipment with electric alternatives if performance metrics are met and budget allows.

Table 15. Electric equipment evaluation topics

Topic	Questions for evaluation
Battery capacity	The City should engage staff who use the equipment to understand the number of hours of run time that each piece of equipment may need to operate in a day. This information can guide the City in determining the minimum battery capacity to specify when searching for an electric alternative.
Rotational strategies	If battery capacity of electric models would not support needed daily run times, the City may evaluate whether it could rotate gas and electric equipment during the workday to allow time the electric equipment to recharge.
Charging system requirements	Chargers for some types of equipment may be able to connect to a standard wall outlet. However, equipment with larger batteries may need to be recharged using a system that requires upgraded electric service. The City should assess the equipment and installation costs, as well as space constraints, for the charging systems needed for each piece of equipment.

[13] Saidani, M. Kim, H. *Quantification of the environmental and economic benefits of the electrification of lawn mowers on the U.S. residential market.* The International Journal of Life Cycle Assessment. April 27, 2021. http://esol.ise.illinois.edu/static2/pdf/IJLCA2021.pdf

POLICY RECOMMENDATIONS

The recommendations in this section are focused on identifying ways to encourage reductions in CO_2 emissions throughout the community. The recommendations can serve as a springboard for future community efforts.

Recommendations

1. Engage in ongoing collaboration with Rock County communities and Edgerton residents.
2. Provide educational materials for residents.
3. Support community adoption of renewable energy.
4. Adopt municipal new construction guidelines.
5. Determine how the city can support public EV charging.

RECOMMENDATION 1: ENGAGE IN ONGOING COLLABORATION WITH ROCK COUNTY COMMUNITIES AND EDGERTON RESIDENTS

A primary way to institutionalize the city's ongoing commitment to CO_2 reductions is to develop a resident-led Sustainability Commission that drives progress through staff and elected official changes. The Sustainability Commission can be a small group of interested residents that apply and are appointed to the committee. This type of group should have set goals and priorities each year to contribute to sustainability efforts in areas where staff does not have capacity. This may include research on specific initiatives, ownership over certain tasks, or assistance with community engagement and education.

One goal of the joint planning initiative was to allow for collaboration and sharing of lessons learned across municipalities of similar geography and size. Throughout the past year of work, the municipalities have had the opportunity to meet monthly to share updates on sustainability initiatives. The project team recommends that Edgerton work with Evansville and Milton on how to continue the collaboration. Cooperative efforts, such as a quarterly or monthly meeting, where the communities share updates and discuss potential collaboration opportunities may be most valuable and least burdensome. Opportunities for partnership may involve a joint application for a grant or partnership on policy each community is interested in exploring.

The Wisconsin Department of Natural Resources (DNR) supports the Green Tier Legacy Communities (GTLC) network, which is a coalition of city and county governments that are committed to helping their communities become more sustainable. To join, cities need to approve a resolution that formalizes their participation in the charter. Members then commit to annually reporting their progress related to certain sustainability metrics and reporting on the actions that they are taking to advance sustainability in their communities. The Project Team recommends that Edgerton consider joining the GTLC network as another source of collaboration.

RECOMMENDATION 2: PROVIDE EDUCATIONAL MATERIALS FOR RESIDENTS

With the passing of the Inflation Reduction Act (IRA), an unprecedented amount of money is available to residents and businesses to upgrade their homes and buildings, install renewable energy, and purchase EVs. The funding is available through a mixture of federal tax credits and state-administered rebate programs. This money paired with existing Focus on Energy incentives improves cost-effectiveness of residential and business upgrades.

Educating community members on these available incentives is one way to help encourage CO_2 reductions. Recognizing limited staff time available, we recommend that the City consider different partnerships for implementation of education efforts:

1. Partner with Rock County communities to jointly develop educational materials to share with residents.
2. Reach out to Focus on Energy Community team to understand what marketing support they can provide and request that Focus lead presentations to Edgerton about available financial incentives.
3. Consider how a future Sustainability Commission could help with this effort. Finding extra support from dedicated community members may make this more possible.

RECOMMENDATION 3: SUPPORT COMMUNITY ADOPTION OF RENEWABLE ENERGY

Residents and businesses may also want to explore adding solar to their homes or businesses. There are several ways that Edgerton can support increasing the number of renewable energy installations in the community.

Action 1: Consider participating in SolSmart to accelerate private solar adoption

Local adoption of solar can be unintentionally hindered by local zoning or permitting requirements or lack of knowledge about the process. SolSmart is a free national program that helps local governments address existing solar barriers with the goal of accelerating private adoption.[14] The program provides free technical assistance to local governments pursuing certification and provides resources online for free for communities.

To pursue a certification, a city must complete a certain number of steps that remove barriers and encourage solar adoption. These include reviewing permitting requirements, creating an online permitting checklist, or education to community members. The advisors at SolSmart work with each city to understand goals and help them select from a menu of options to reach designation in a way that makes sense for the community. SolSmart also provides templates for many of these actions and offers online resources for free for communities that might not be ready to pursue a designation.

SolSmart research has found that most communities see a 17 to 19% increase in solar deployment after receiving a designation. Currently, 21 other communities in Wisconsin are certified SolSmart communities. The Rock County communities could work jointly on these efforts and share lessons learned as each works to remove permitting restrictions, implement new policies or educational resources.

Action 2: Pursue a joint solar group buy across Rock County communities

A solar group buy is a program designed to lower informational and financial barriers to residential solar adoption in a community. Many cities, counties, and towns in Wisconsin and across the country have overseen group buy programs. Group buys are generally run by a third-party organization at no-cost to the city and provide:

- Solar education to local homeowners and businesses through a series of events or marketing materials.
- A negotiated lower price for solar installations by participants through a sole-source agreement with a single solar installer.

The three communities in this partnership, Evansville, Milton, and Edgerton, could work to implement a joint group buy program to increase the number of potential installations and receive a larger discount across arrays. Local nonprofits that run solar group buy programs include Midwest Renewable Energy Association[15] and Legacy Solar Co-op.[16]

[14] For more information on SolSmart, see here: https://solsmart.org/
[15] See information about solar group buys here: https://www.midwestrenew.org/solargroupbuy/
[16] See information about solar group buys here: https://legacysolarcoop.org/solar-group-buys/

RECOMMENDATION 4: ADOPT MUNICIPAL NEW CONSTRUCTION GUIDELINES

New construction design decisions have a lasting impact on the lifetime operating costs and CO_2 emissions of a building. One way to ensure energy-efficient construction is to develop new construction guidelines for municipal buildings.

These guidelines can serve to spotlight the municipality's commitment to its goals and as a resource for private new construction projects in the city. The components of the guidelines could also be integrated into current tax-increment financing language to require developers that receive funding follow the guidelines. The three-community partnership could work together to develop similar sets of energy guidelines for new construction, which would enable construction professionals to operate more easily across the communities.

New Construction Guidelines

- ✓ Set an aggressive but feasible energy target
- ✓ Consider building certifications (LEED, PHIUS, etc.)
- ✓ Design solar ready building
- ✓ Design to be EV-ready or EV-capable

On the energy efficiency side, a flexible and straightforward way to develop a guideline is to define a targeted EUI by building type for new construction projects. Using technologies available today, research suggests that a low-energy building adds no to little cost compared to a conventional design, especially when considering the energy costs savings that efficient building design will enable.[17] After an EUI target is met through building design, the remaining energy consumption can be met by renewable energy, either at the point of construction or in the future.

Targets could start by using median EUI for similar buildings in the same climate zone (available in ENERGY STAR Portfolio Manager) or target EUIs defined by building industry experts in widely used standards, such as ASHRAE-100. The targets could also directly reference existing building certifications, such as LEED or PHIUS. Over time, these target EUIs can be adjusted to move closer to zero-energy targets. Publicizing these targets may encourage other new construction in the city to aim for similar goals.

A second portion of the guidelines can focus on incorporating EV charging considerations into a building design. This can avoid additional costs in the future for piecemeal electrical upgrades to support higher electrical loads required for EV charging stations. There are three levels of readiness for EV charging that a building can achieve:

- **EV-Capable:** there is sufficient electrical panel capacity for a charging station with a dedicated branch circuit and a continuous raceway from the panel to the future EV parking spot.
- **EV-Ready**: there is adequate electrical panel capacity and raceway with conduit, ending at a junction box or 240V outlet at the EV parking location.
- **EV Charging Installed:** EV charging equipment has been installed at an EV-Ready parking space.

Lastly, the guidelines should consider solar-ready design. A solar-ready building is designed to minimize costs and optimize production of a future solar installation. The added design requirements often add minimal construction costs for a building. The main recommendations are below and can be integrated into design requirements[18]:

- Avoid shading over portions of the roof with potential southern exposure during peak sunlight hours.
- Minimize and/or cluster equipment on rooftop to ensure space is available for solar panels.
- Consider roof type to ensure it can carry extra load from solar panels.
- Place electrical panel near future PV location and keep breaker free for PV circuit.
- Consider running electrical conduit from electrical panel to future PV location.
- Plan locations for inverter components.

[17] New Building Institute, 2019, Zero Energy Commercial Building Targets, https://newbuildings.org/wp-content/uploads/2019/09/ZeroEnergyCommercialBuildingTargets.pdf

[18] L. Lisell. 2009. "Solar Ready Buildings Planning Guide." https://www.nrel.gov/docs/fy10osti/46078.pdf

RECOMMENDATION 5: DETERMINE HOW THE CITY CAN SUPPORT PUBLIC EV CHARGING

As electric vehicles become more common, there may be increasing demand for charging stations at publicly available locations for both residents and travelers. Currently, there are no public EV charging stations in the City.

EV charging stations are being installed by multiple parties across the United States, including private businesses, state governments, local governments, and utilities. Studies show that residents who purchase EVs and live in owner-occupied single-family homes will primarily charge their vehicles at home.[19] However, public charging stations are important infrastructure to support EV adoption for multiple reasons, including:

- Making EVs accessible for residents who live in a multifamily and/or rented property.
- Reducing range anxiety for all EV owners.
- Supporting economic development by allowing visitors to recharge while they patronize local businesses.

The project team identified several ways that the City can support development of robust public charging infrastructure in Edgerton.

Engage with Wisconsin DOT to optimize their placement of EV chargers near Edgerton. The Wisconsin Department of Transportation approved the Wisconsin Electric Vehicle Infrastructure (WEVI) Plan in September 2022. The WEVI plan identifies I-90 exits 160 (US-51 and WI-73) and 163 (WI-59), near Edgerton as gaps in current EV charging infrastructure in the State's transportation corridors. Wisconsin DOT is currently accepting feedback about how to prioritize providing support for adding public EV charging within the coverage gaps that it has identified. The City should engage with the Wisconsin DOT to ensure placement encourages travelers to stop in Edgerton for charging. This can lead to additional visits at local restaurants, grocery stores, and retail locations.

Explore EV charging infrastructure incentives for residents or businesses. Most Edgerton residents who purchase EVs will primarily charge their vehicles at home or at work. Some Wisconsin electric utilities, including MG&E, Barron Electric Cooperative, and East Central Energy offer financial incentives for home installation of EV chargers. Neither Alliant Energy nor Rock Energy Cooperative currently offer financial support for customers who install EV chargers. The City could engage with the two utilities to investigate opportunities for the utilities to introduce programs to support EV charger installations in Edgerton.

Consider appropriate areas for installations of chargers. Municipal facilities that residents visit for an extended period of time, such as the library and the Edgerton Pool, may be ideal locations for public charging stations. The City may explore opportunities to offer public EV charging stations at these locations. Additionally, the City can work with property owners and businesses to encourage installation of chargers close to multifamily buildings, as residents of these properties may be least able to access EV charging at home.

Work with partners to determine and install an optimal mix of level 2 and 3 charging. A mix of Level 2 and 3 charging across the City is needed to support the array of charging needs of Edgerton's residents and visitors. Level 3 chargers are essential for long-route drivers that may be passing through Edgerton, while Level 2 chargers are ideal for in-town drivers. Level 3 chargers should be located close to Highway 51 or I-90 and/or close to retail and restaurant locations in the City, while Level 2 chargers should be close to multifamily housing and at places where visitors usually spend an hour or more.

[19] Wood, E. Rames, C. Muratori, M. Raghavan, S. Melaina, M. U.S. Department of Energy Office of Energy Efficiency & Renewable Energy. *National Plug-In Electric Vehicle Infrastructure Analysis*. 09/2017. https://www.nrel.gov/docs/fy17osti/69031.pdf

FUNDING OPPORTUNITIES FOR RECOMMENDATIONS

The cost of the upgrades identified in this energy plan is substantial and may be a barrier to implementing some of the recommended measures. This section is intended to provide an overview of funding opportunities for the various upgrades identified in the report.

INFLATION REDUCTION ACT

The Inflation Reduction Act (IRA) represents an unprecedented amount of funding for energy and climate actions. The IRA channels a substantial amount of its funding through tax credits and rebates for renewable energy and fleet. Through this funding, it also includes a provision, direct or elective pay, that makes non-taxable entities eligible for the tax credits. The alternative vehicle tax credits have a limit per vehicle but there are no limits on total amount of projects rebated in a year or total amount of money the City can receive in a year. All credits are available starting for any projects implementing in 2023 and extend to 2032.

One item to point out is that commercial vehicles must be purchased from a qualified manufacturer.[20] This is less restrictive than the requirements for residential purchases of EVs.

Table 16. Eligible tax credits for direct pay/elective pay

	Renewable Energy	Alternative Vehicles
Energy Plan Items	Solar installations	Electric vehicle or PHEV purchases
Amount	30% of upfront cost	30% of vehicle cost (or 15% for PHEVs) or incremental cost compared to ICE
Limit	-	$40,000 for vehicles over 14,000 lbs $7,500 for vehicles under 14,000 lbs
Bonus	10% if meets domestic content requirements for steel and iron	-
Restrictions	-	From a qualified manufacturer

The IRS has released initial guidance on how entities can receive direct pay. The set of steps are listed below.[21] More guidance is expected to be released by the end of the year.

Figure 12. Inflation Reduction Act direct pay – steps for receiving credit

[20] A list of qualified commercial vehicles is here: https://www.irs.gov/credits-deductions/manufacturers-for-qualified-commercial-clean-vehicle-credit
[21] More information is available here: https://www.irs.gov/pub/irs-pdf/p5817.pdf

FOCUS ON ENERGY

Alliant Energy participates in Focus on Energy statewide incentives for renewable energy installations and energy efficiency upgrades and installations. It's recommended that the City provide a copy of this report to its Energy Advisor and ask for assistance in identifying the best way to access rebates. The amount available depends on the measure and often specific characteristics of the equipment, such as the size of the solar system or efficiency of the new building equipment.

OTHER GRANTS AND OPPORTUNITIES

Other grants and opportunities through the state government or federal government also could potentially provide funding for installation of these projects. The Office of Energy Innovation released a scoping memo for the next round of the Energy Innovation Grant Program and is awaiting final approval from the PSC before opening the next round of funding. The City could consider applying to receive funding for implementation from this source.[22]

[22] Office of Energy Innovation Program Design and Budget Memo.
https://apps.psc.wi.gov/ERF/ERFsearch/content/searchResult.aspx?UTIL=9709&CASE=FG&SEQ=2023&START=none&END=none&TYPE=none&SERVICE=none&KEY=none&NON=N

APPENDIX 1: BUILDING DESCRIPTIONS

EDGERTON LIBRARY

Size: 17,800 ft²

Age: Original construction in 1907 with significant addition and renovation in 2006.

Existing heating and cooling system: Two rooftop unit air handlers with cooling and furnace sections. One large natural-gas-fired boiler for reheat. Constant volume air distribution system.

Electricity Use: ~142,000 kWh/yr

Natural Gas Use: ~9,700 therms/yr

Weather-normalized Site EUI: 89 kbtu/sf. Slightly above regional median for comparable buildings

Over the past several years, the library has undergone a LED retrofit and installed double pane windows to reduce energy use. The building also replaced the air conditioning units in 2018. However, during the site visit, staff expressed significant complaints regarding the heating and cooling system, saying it has "never functioned properly." The system consists of two constant-volume RTUs supplemented by booster hot water coils at each zone. This configuration results in a significant amount of simultaneous heating and cooling, where the rooftop unit cools the air and then the booster hot water coils reheat the air. As a result, electricity usage is higher than expected during the winter, spring and fall when cooling is not needed.

Table 17 summarizes the recommended measures by priority level and provides potential cost, energy, and carbon savings. The low priority items are not recommended due to relatively low savings potential and high payback period. The total savings row includes the savings from high priority, medium priority, and EOL measures. The payback period for end-of-life measures is not included as it depends on incremental cost compared to the other option being considered at replacement time.

Table 17. Edgerton Library recommended energy actions

Improvement Measure	Priority		First Cost	Annual Utility Cost Savings		Simple Payback	Annual Energy Savings		Annual Carbon Savings	
			$	$	(%)	Years	Electric Savings (%)	Gas Savings (%)	Tons CO_2e	%
Maintenance refresh		High	$0	$300	1%	-	1%	1%	1.2	1%
Retrocommissioning		High	$9,000	$1,100	5%	8	5%	5%	6.4	5%
Variable speed HVAC fans		Med	$8,900	$1,500	7%	6	11%	-5%	6.8	5%
Additional lighting controls		Med	$7,700	$500	2%	18	3%	-1%	2.0	2%
Roof insulation upgrade		EOL	$28,900	$2,100	9%	-	6%	18%	13.2	10%
New packaged RTU equipment		EOL	$66,800	$1,200	5%	-	0%	18%	8.5	7%
Boiler upgrade		EOL	$95,000	$1,000	4%	-	6%	0%	4.8	4%
Demand-controlled ventilation		EOL	$8,100	$300	1%	-	-1%	6%	2.2	2%
ENERGY STAR residential appliances		EOL	$1,600	$30	0%	-	0%	0%	0.1	0%
Total Savings - High, Medium, EOL			**$ 226,000**	**$ 8,030**	**36%**	**-**	**31%**	**42%**	**45.2**	**35%**

High Priority: Maintenance Refresh

Next Step: Implement any steps that can be done by facilities staff.

We recommend a basic maintenance refresh be done every couple of years. It can be primarily carried out by facilities staff or local contractors and have an immediate impact on energy consumption. Items for the library include:

- Check/replace door seals; make sure windows operate and seal properly.
- Upgrade book return slots or insulate them to reduce infiltration to surrounding areas of the building. A small electric heater could also be added, which would allow the door to the room to be closed.
- Air seal exterior walls and ceilings around accessible plumbing, electrical, and HVAC penetrations.
- Air seal and insulate attic hatches if needed.
- Investigate to make sure supply and return ductwork in the unconditioned attic is air sealed and properly insulated. If not, use mastic or foil-backed mastic tape to air seal ductwork and improve insulation levels in attic.

High Priority: Retrocommissioning

Next Step: Focus on Energy provides incentives and a list of qualified contractors for retrocommissioning or building tune-ups. Contact an Energy Representative to understand potential programs and to enroll.[23]

We recommend that the Library explore retrocommissioning to address multiple HVAC issues affecting comfort and energy use. Retrocommissioning is a process of servicing and repairing existing heating and air conditioning equipment to restore it to nearly its original level of performance. Retrocommissioning for the library would include: boiler and RTU tune-ups, air duct sealing and cleaning, ventilation system testing and balancing, economizer and damper functional check, replacing air handler filters, and verifying thermostat setbacks.

The retrocommissioning specialist should also investigate implementing a new economizer control sequence. This would include increasing the lockout temperature and allowing the air conditioning compressors to operate during economizer control. Another consideration would be to implement a supply air temperature reset based on a trim-and-respond sequence to raise the supply air temperature if most of the heating coils are on.

The retrocommissioning process would also result in a report recommending additional system improvements.

Medium Priority: Variable Speed HVAC Fans

Next Step: Consult an engineer or HVAC controls specialist to investigate feasibility.

Retrofitting variable speed controls (variable frequency drives) or switched reluctance motors could be implemented to reduce the operating speed of the RTU fans. Experiment by lowering fan speed to 60% to 80% of full speed and see if it satisfies the load for most of the year. Consider implementing an automatic reset control sequence to increase fan speed if the air conditioning cannot keep up during the hottest days.

Medium Priority: Lighting Controls

Next Step: Determine current functionality of LED bulbs; discuss with Focus on Energy representative as controls are eligible for incentives.

Some areas of the library already have occupancy sensors, but other areas do not. We recommend that the library install automatic daylighting dimming controls which also include occupancy sensing if existing LEDs are dimmable. Occupancy sensors would be most useful in smaller enclosed areas such as study rooms, offices, back rooms, and lavatories that do not already have automatic controls. To avoid nuisance switching, large open areas of

[23] Information on Focus' retrocommissioning incentives are here: https://focusonenergy.com/business/building-optimization

the library may be better suited with the current manual on/off switching arrangement with the addition of automatic daylight dimming only near windows.

End of Life: Roof Insulation Upgrade

Next Step: Have an engineer or contractor review current insulation and determine improvement plan.

We recommend roof insulation be improved to R-35 or better next time the waterproof roof membrane is replaced. Original portions of the library constructed in 1907 likely has little to no insulation. Our team was unable to verify existing attic insulation values during the visit and the drawings are unclear on whether there is any insulation between the trusses in the main building areas. It would be worth assessing existing insulation levels in this area and planning to upgrade when the roof is replaced.

End of Life: HVAC Updates (boiler replacement, new packaged RTUs, demand-controlled ventilation)

Next Step: Have a consulting engineer review current HVAC system and determine improvement plan.

The best remediation for the current HVAC system would be to replace the system with a modern variable air volume (VAV) system or other multi-zone system, such as a variable refrigerant flow (VRF) heat pump. Either would be a major retrofit, especially since the RTUs are relatively new. If the library does not pursue an electrification strategy that would replace both heating and cooling equipment, we recommend new condensing boilers and new RTUs at end of life. More details on each component are below:

Replacement boilers: The library's existing 1,400 MBh boiler is nearing end of life. If not pursuing an electrification option, we recommend replacing the single boiler with two smaller high efficiency fully condensing boilers. Having two boilers will allow the library to better match the heating load and will offer redundancy. Have detailed heating load calculations performed to determine if the boilers can be downsized. The boilers should be re-piped to a variable primary configuration, if possible. With condensing boilers, add outdoor air temperature reset controls on a trim-and-respond sequence to adjust the hot water temperature based on outdoor temperature. Variable speed hydronic pumps may be an option at this time as well.

High efficiency packaged rooftop equipment: Refer to Wisconsin Focus on Energy guidelines for minimum IEER cooling efficiency values.

Demand-controlled ventilation or other controls: With a HVAC system redesign in the future to improve zoning and implement higher efficiency heating and cooling units, demand-controlled ventilation (DCV) would be feasible and economical to consider. These controls would automatically slow down ventilation fans during times of low occupancy, reducing energy costs for heating, cooling and fan energy.

End of Life: ENERGY STAR appliances

Next Step: Review ENERGY STAR list before purchase of a new refrigerator or other major appliances[24]

When the refrigerator in the break room reaches end of life, we recommend replacement with an ENERGY STAR model. ENERGY STAR should also be implemented for other appliances at replacement.

[24] A list of qualified ENERGYSTAR products is here: https://www.energystar.gov/products/products_list

EDGERTON PUBLIC WORKS

Size: 9,000 ft²

Age: 1975

Existing heating and cooling system: 4 gas unit heaters in garage and maintenance bay; electric baseboard heating in office, bathrooms and breakroom, 1 window air conditioner in office.

Electricity Use: ~34,000 kWh/yr

Natural Gas Use: ~8,400 therms/yr

Weather-normalized Site EUI: 109 kbtu/sf. Above regional median for comparable buildings

The Edgerton Public Works Garage is a well-maintained building with opportunities for energy savings. The garage has some roof insulation and occupants generally set low temperatures in the winter to save energy. However, there are opportunities to lower EUI through lighting upgrades and better insulation.

Table 18 summarizes the recommended measures by priority level and provides potential cost, energy, and carbon savings. The payback period for end-of-life measures is not included as it depends on incremental cost compared to the other option being considered at replacement time.

Table 18. Edgerton Public Works recommended energy actions

Improvement Measure	Priority		First Cost	Annual Utility Cost Savings		Simple Payback	Annual Energy Savings		Annual Carbon Savings	
			$	$	(%)	Years	Electric Savings (%)	Gas Savings (%)	Tons CO_2e	%
Garage Door Weather Sealing		High	$1,900	$500	5%	4	1%	7%	3.5	5%
Install LED Bulbs		High	$3,300	$500	4%	7	11%	-1%	2.0	3%
Install Occupancy and Daylight Controls		High	$1,800	$100	1%	26	2%	0%	0.3	0%
Air Sealing		Med	$7,000	$1,100	10%	6	4%	15%	7.6	11%
Infrared Heaters in Maintenance Bay		Med	$2,000	$200	1%	19	0%	2%	0.8	1%
Wall Insulation Upgrade		Low	$13,400	$400	3%	42	3%	3%	1.9	3%
Roof Insulation Upgrade		EOL	$14,600	$500	4%	-	4%	4%	2.7	4%
Packaged Terminal Heat Pump for Office		EOL	$1,100	$500	4%	-	10%	0%	2.2	3%
ENERGY STAR Fridges		EOL	$2,000	$100	0%	-	1%	0%	0.1	0%
Total Savings - High, Medium, EOL			**$ 33,700**	**$ 3,500**	**32%**	**-**	**32%**	**27%**	**19.2**	**29%**

High Priority: Garage Door Weather Sealing

Next Step: Purchase and install spring-loaded garage door hinges. Focus on Energy provides an incentive.[25]

We recommend installing spring-loaded garage door hinges to reduce air leakage around the overhead doors in the garage. The hinges fit most commercial doors and reduce the gaps between the wall and door to reduce air leakage.

High Priority: Install LED Lighting and Occupancy and Daylight Controls

Next Step: Receive quote for integrated replacement; discuss with Focus on Energy representative to understand potential rebates for LEDs and controls.[26]

[25] Lighting rebates are available on page 4: https://s3.us-east-1.amazonaws.com/focusonenergy/staging/inline-files/2023/BIZ-Summary_of_Services_and_Incentives.pdf

[26] Lighting rebates are available on page 4: https://s3.us-east-1.amazonaws.com/focusonenergy/staging/inline-files/2023/BIZ-Summary_of_Services_and_Incentives.pdf

We recommend installation of LEDs, and consideration of installation of daylighting and additional occupancy controls. LEDs have a significant savings potential compared to compact fluorescent lights, and implementing daylighting and occupancy controls at the time of install can lead to additional savings and is the most cost-effective time to add controls.

Medium Priority: Air Sealing

Next Step: Consider where facility staff can seal areas or hire a consultant to inspect and make recommendations.

We recommend that the City perform air sealing on the garage to lower air leakage. Air sealing can be done with caulk, spray foam, or weather-stripping materials. The measure can significantly lower gas usage and would increase comfort for the building.

Medium Priority: Infrared Heaters in Maintenance Bay

Next Step: Replace gas unit heaters in maintenance bay with infrared heaters. Focus on Energy provides incentives for infrared heaters.[27]

We recommend infrared heaters over gas unit heaters in the maintenance bay for additional comfort and energy savings. Infrared heaters are ideal for buildings with a high leakage rate; heat is targeted directly towards where it is needed and therefore can be more efficient in heating applications. No fan is needed for circulating air, eliminating fan energy and leading to quieter operation.

EOL: Packaged Terminal Heat Pump for Office

Next Step: Discuss replacing the existing window unit and baseboard heating system with packaged terminal heat pumps with Focus on Energy. Incentives are available for qualifying products.

We recommend replacing the air conditioners that are nearing the end of their service lives with new ENERGY STAR® certified heat pumps. Prioritize replacing the oldest air conditioners first. The City could also consider heat pump options to replace existing furnaces and AC units at the same time. Determining a replacement plan before failure will allow for better budgeting and easier implementation of heat pumps.

EOL: ENERGY STAR Fridges

Next Step: Review an ENERGY STAR list before purchase of new refrigerator or other new appliances.[28]

When any appliances fail, we recommend replacement with an ENERGY STAR model.

EOL: Roof Insulation

Next Step: Have an engineer or contractor inspect current insulation and determine how much additional insulation should be added where feasible.

We recommend that the City improve the envelope of the garage with roof insulation of R-35 or better the next time the roof is replaced. The building appeared to have some roof insulation, but the metal ribs were uninsulated.

Low Priority: Wall Insulation

Next Step: Have an engineer or contractor inspect current insulation and determine how much additional insulation should be added where feasible.

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[27] See incentives for infrared heaters here: https://s3.us-east-1.amazonaws.com/focusonenergy/staging/inline-files/2023/BIZ-Summary_of_Services_and_Incentives.pdf

[28] A list of qualified ENERGYSTAR products is here: https://www.energystar.gov/products/products_list

Adding insulation to the walls as part of a remodel of the facility's exterior could save energy and improve comfort in the building. However, this installation would be costly and only have moderate savings, leading to a long payback period. We recommend this measure is only considered as part of a larger remodel of the facility.

Low Priority: Tie Garage Exhaust Fans with CO/NOx Sensors

Next Step: Add CO/NOx sensors in the garage and tie garage exhaust fans to the sensors.

We recommend adding gas monitors in the enclosed garage and tying garage exhaust fans to the sensors to allow for sufficient ventilation when needed. The gas monitors for garages detect Carbon Monoxide (CO) and Nitrogen Dioxide (NO_2) gases emitted by vehicles. CO is a colorless, odorless, tasteless, flammable gas that is slightly less dense than air. NO_2 is a highly poisonous nonflammable gas. This measure has no energy savings associated with it but improves safety of the building.

APPENDIX 2: SOLAR METHODOLOGY AND FULL RESULTS

SOLAR METHODOLOGY

The project team identified solar opportunities by reviewing energy use profiles and roof space available by building. The project team focused on buildings with the largest electricity consumption and available and feasible roof or ground space. For example, the pool was excluded due to lack of space and inconsistent energy use patterns.

For the other buildings, the team started by identifying the space available by reviewing the buildings with Google satellite mapping and through discussions on roof age or space available. The satellite images provide the direction the array would face and degree tilt. South-facing arrays offer the most cost-effective opportunities for solar arrays, followed by east or west facing arrays. The degree tilt represents how angled the panels. On average, matching the degrees of tilt for the panels to the degrees latitude of the solar array will produce the most electricity over the course of a year. If a building's roof is not tilted at this angle, panel mounting can apply a tilt; however the amount of tilt must be balanced against shading effects created between rows of panels.

The roof or ground space available was combined with monthly energy data and utility bill rates and entered into a technoeconomic tool, ReOpt, to find the most cost-effective solution. ReOpt takes inputs of a building's energy loads, utility rate, and based on inputs and constraints from the user optimizes the sizing of solar PV.

The analysis assumes that the net metering limit is 20 kW dC. This is the current limit set by the utility[29] and any solar installation below this size receives the full utility retail rate (the same as what is paid) for any overproduction of solar that is sent back to the grid. Any solar size above 20 kW dC receives the buyback rate (or wholesale rate) instead. The buyback rate is lower than the retail rate and changes yearly. Both rates are only applicable when the amount of solar produced at a certain time is higher than the building's consumption. The remainder of the time the solar production is saving money as no energy must be purchased from the grid.

Other assumptions include:

- The lifetime of the system is 25 years. This is a conservative estimate with estimates ranging from 25 to 50 years.
- The upfront cost of the system is $2,500/kW for roof systems below 50 kW; $2,200/kW for systems between 50 kW and 100 kW; ground systems are assumed to be 30% more expensive than roof systems.
- Roof loading and electrical panel space needs to be verified by a trained design professional.
- Operations and maintenance costs are low per year. Inverters need to be replaced at year 15.

Table 19 includes a definition for each output.

Table 19. Solar analysis output definitions

Output	Definition
System Size	Total solar photovoltaics size in kW DC
Payback (years)	Calculated as total upfront cost (after incentives) divided by first year cost savings
Percent Renewable Electricity	Total electricity produced divided by total energy consumption
Lifetime CO_2 Savings (metric tons)	Avoided grid electricity use multiplied by a grid hourly emissions factor
Total Energy Savings	Total energy bill savings over the lifetime of the solar panels (25-years)
Total Upfront Cost	Total initial upfront cost ($2500/kW multiplied by system size)
Focus on Energy Incentives	Focus on Energy Business rebates
IRA Tax Credit	30% direct pay through Inflation Reduction Act
Total Cost	Total initial upfront cost minus rebates and tax incentives

[29] There are currently Wisconsin Public Service Commission cases that are considering the requirement for utilities to offer net metering in the future. The cases have not been decided and each utility would then need to submit their own request for new rates. If that occurs, the payback period and annual energy savings may change slightly but other results will be constant.

BESS METHODOLOGY

For the Police Station, we completed an analysis of potential microgrid solutions to provide resiliency benefits by looking at battery energy storage system (BESS) paired with solar PV. For this analysis, we used the same technoeconomic tool, ReOpt to estimate needed BESS and solar PV size. In ReOpt, the user inputs the technologies of interest, actual building load data, utility rates, and resiliency constraints. The resiliency constraints include the portion of total building load that should be covered by the microgrid during an outage, and the time of year when an outage occurs. For those specific inputs, the tool finds the least-cost option that satisfies the goals and provides the recommended system size. The full resiliency analysis uses that system configuration to estimate resiliency across all hours of the year. It simulates an outage at each hour of the year and then models how many hours in a row the system could cover the required load amount.

The BESS cost is split into two components: energy capacity cost and power capacity cost. The energy capacity represents the cost of the battery pack while the power cost includes the costs for the interconnection of the system, such as the inverter and balance of the system. The two costs are additive and together represent the total cost of the BESS. The costs of each component are assumed to be $500/kWh and $1,000/kW.

$$Total\ BESS\ Cost = Energy\ storage\ cost\ \left(\frac{\$}{kWh}\right) * \ energy\ storage\ (kWh) + Power\ capacity\ cost\ (\$/kW)\ *\ power\ capacity\ (kW)$$

Table 20 includes definitions for the BESS analysis. This analysis should be viewed as preliminary and more in-depth design work would need to be done before determining final sizing and cost information.

Table 20. BESS analysis output definitions

Output	Definitions
Battery Size	Lists the two components of battery size. Power storage (kW) determines the rate at which it charges or discharges or power capacity Energy storage (kWh) is amount of energy that a battery can store or capacity.
Average Resiliency (hours)	Across all hours of the year, the average outage duration that the system could sustain. Measured by simulating an outage at each hour of the year
Total Battery Upfront Cost	Total battery cost - adds together power capacity and energy storage cost
Battery Replacement Cost	The lifetime of a battery is assumed to be 15 years roughly, so this represents the cost to replace battery components. It is assumed that prices continue to decline.

Department of Public Works

Available roof space: ~3,360 (only about 2,000 needed)

Utility rates: Flat rate of $0.124/kWh; no demand charge.

Wholesale (buyback) energy rate: $0.0599/kWh off-peak, $0.0768/kWh regular, $0.1028/kWh on-peak

Orientation: Southeast facing with 20% tilt

Annual energy use: ~34,000 kWh

Table 21 presents the recommended DPW solar array. The roof has room for more panels but due to the high EUI, we recommend this size to allow for decreases in electricity use. More panels could be added if EV charging was added onsite.

Table 21. Department of Public Works recommended solar array

Metric	System Information
System Size (kW DC)	20
Payback (years)	10.9
Percent Renewable Electricity	70%
Lifetime CO_2 Savings (metric tons)	432
Lifetime Energy Savings	$73,160
Total Upfront Cost	$50,000
Focus on Energy Incentives	-$3,000
IRA Tax Credit	-$15,000
Total Cost	$32,000

Water Building

Available roof space: ~3,360 (only about 1,300 needed)

Utility rates: Flat rate of $0.124/kWh; no demand charge.

Wholesale (buyback) energy rate: $0.0599/kWh off-peak, $0.0768/kWh regular, $0.1028/kWh on-peak

Orientation: Southeast facing with 20% tilt

Annual energy use: ~16,000 kWh

Table 22 presents the recommended solar size for the Water Building, which covers 90% of current electricity use.

Table 22. Water Building recommended solar array

Metric	System Information
System Size (kW DC)	12
Payback (years)	9.6
Percent Renewable Electricity	91%
Lifetime CO_2 Savings (metric tons)	259
Lifetime Energy Savings	$43,895
Total Upfront Cost	$30,000
Focus on Energy Incentives	-$4,200
IRA Tax Credit	-$9,000
Total Cost	$16,800

Library

Available roof space: ~1,950 square available

Utility rates: Time of use. $0.06880/kWh on-peak, $0.13680/kWh regular, $0.17430/kWh on-peak
No demand charge

Wholesale (buyback) energy rate: $0.0599/kWh off-peak, $0.0768/kWh regular, $0.1028/kWh on-peak.

Orientation: South facing with 30% tilt

Annual energy use: ~142,000 kWh

Table 23 provides system information for the recommended library array. The array maximizes the amount of space available on the roof and minimizes payback period.

Table 23. Library recommended solar array

Metric	System Information
System Size (kW DC)	20
Payback (years)	10.0
Percent Renewable Electricity	18%
Lifetime CO_2 Savings (metric tons)	470
Lifetime Energy Savings	$80,165
Total Upfront Cost	$50,000
Focus on Energy Incentives	-$3,000
IRA Tax Credit	-$15,000
Total Cost	$32,000

Wastewater Treatment Plant

Available ground space: ~43,000 square feet of ground.

Utility rates: Time of use. $0.0519/kWh off-peak $0.08604/kWh regular, $0.08604/kWh $11.95/kW demand charge

Wholesale (buyback) energy rate: $0.0599/kWh off-peak, $0.0768/kWh regular, $0.1028/kWh on-peak

Orientation: West facing on slanted hill

Annual energy use: ~ 462,000 kWh

Table 24 provides system information for various solar array options at the Wastewater Treatment Plant. All the options use the available space on the hill by the treatment plant but vary in size. The two arrays at or above 100 kW have an upfront cost of $2,600/kW while the array below 50 kW has a cost of $3,250/kW. Although the costs of the first two arrays are much higher, we recommend one of those arrays to offset more of the WWTP electricity. The City can consider a phased approach to installations as well.

Table 24. Wastewater Treatment Plant recommended solar arrays

Metric	Ground Maximum	Ground 100 kW	Ground 45 kW
System Size (kW DC)	160	100	45
Payback (years)	23.6	23.7	29.6
Percent Renewable Electricity	25%	16%	7%
Lifetime CO_2 Savings (metric tons)	3127	1955	880
Lifetime Energy Savings	$288,290	$178,005	$80,100
Total Upfront Cost	$416,000	$260,000	$146,250
Focus on Energy Incentives	-$19,000	-$13,000	-$7,500
IRA Tax Credit	-$124,800	-$78,000	-$43,875
Total Cost	$272,200	$169,000	$94,875

Police Station

Available roof space: ~4,250

Utility rates: Flat rate of $0.12/kWh; no demand charge.

Wholesale (buyback) energy rate: $0.0599/kWh off-peak, $0.0768/kWh regular, $0.1028/kWh on-peak

Orientation: Southwest facing with 20% tilt

Annual energy use: ~42,000 kWh

Table 25 illustrates two arrays at the police station – a 20 kW and 35 kW system. The 20-kW system is recommended as it minimizes payback period. The 35-kW system covers 90% of electricity and has a higher payback period.

Table 25. Police Station recommended solar array

Metric	20 kW System	35 kW System
System Size (kW DC)	20	35
Payback (years)	11.8	14.5
Percent Renewable Electricity	52%	90%
Lifetime CO_2 Savings (metric tons)	401	702
Lifetime Energy Savings	$67,630	$94,440
Total Upfront Cost	$50,000	$87,500
Focus on Energy Incentives	-$3,000	-$6,500
IRA Tax Credit	-$15,000	-$26,250
Total Cost	$32,000	$54,750

The project team also completed an initial resiliency analysis for the Police Station BESS. The team assumed either 50% or 30% of the entire building load would need to be covered for 12 hours and modeled a summer outage to determine initial system size. A summer outage was used as it is the most common in Wisconsin. Table 26 summarizes the results of the analysis, illustrating the battery size, payback periods, average resiliency and total costs. A more in-depth feasibility study and design process would need to be done to confirm ideal sizing and costs.

Table 26. Police station solar PV + BESS alternatives

Metric	50% Load Covered	30% Load Covered
PV System Size (kW DC)	35	35
Battery Size	11 kW,27 kWh	5 kW,12 kWh
Payback (years)	18.6	16.6
Percent Renewable Electricity	90%	90%
Lifetime Energy Savings	$99,050	$96,713
Battery Replacement Cost	$9,992	$4,516
Average Resiliency	72	94
Total Solar Upfront Cost	$87,500	$87,500
Total Battery Upfront Cost	$24,700	$11,160
Focus on Energy Incentives (Solar Only)	-$4,875	-$4,875
IRA Tax Credit (Solar + BESS)	-$33,660	-$29,600
Total Cost	$73,665	$64,185

APPENDIX 3: FLEET METHODOLOGY

The analysis measured the current annual energy, cost, and emissions impacts of the City of Edgerton's municipal fleet. It also applied data on current vehicles to performance metrics of new gasoline, diesel, and electricity-fueled vehicles to recommend a strategy through which the City can cost-effectively reduce the energy used and emissions generated by its vehicles. The methodology used to calculate data on current vehicles and prepare recommendations for fleet vehicle replacements is described below.

1. Calculate key performance indicators (KPIs) for municipal fleet vehicles.
    - Collected data showing the number of gallons and cost of fuel purchased for each vehicle, as well as the fuel type (gasoline, diesel, or other) during a 12-month period
    - Collected data showing the number of miles driven by each vehicle during the same 12-month period.
    - Applied data for fuel use, fuel type, and miles driven to calculate the pounds of CO_2 emitted by each vehicle
    - All City-owned vehicles were assigned to one of seven categories: Large Car, Full-size Pickup Truck, Heavy-duty truck, Small SUV, Mid-size SUV, Large Truck, Street Sweeper, and "Other." [Other includes lawnmowers, and fuel trucks.]
    - Calculated the annual fuel use, fuel cost, miles driven, and CO_2 emissions for all of the City's vehicles, then segmented each metric for each vehicle category.
2. Surveyed the market to identify all electric vehicles available in the existing vehicle categories in the City's fleet.
    - Limited findings to eliminate vehicles that are not yet in production or had limited market share, making them difficult for the City to obtain.
    - Within each vehicle category, identified a cost-effective EV option that met minimum driving range requirements and had a strong fuel economy (kWh/100 miles) rating to use for opportunity analysis.
    - Used the commercial clean vehicle tax credit qualified manufacturer list to reduce the assumed cost of each EV by the value of any Federal tax credit for which it may be eligible. Through the Inflation Reduction Act, municipalities have access to tax credits through a direct pay provision.
3. Surveyed the market to identify a leading gasoline or diesel-powered vehicle in the existing vehicle categories in the City fleet that the City would be likely to consider for purchase during its normal vehicle retirement and replacement process.
    - Identified cost and fuel economy metrics for each selected vehicle.
4. Used previous gasoline, diesel, and electricity costs to calculate the cost of fuel used to drive one mile by the selected EV and by the selected gasoline or diesel vehicle in each vehicle category.
5. Applied research by Consumer Reports[30] to estimate the average per mile maintenance costs for EVs and gasoline or diesel-powered vehicles.

[30] Harto, C. *Electric Vehicle Ownership Costs: Chapter 2 – Maintenance.* Consumer Reports. September, 2020. (https://advocacy.consumerreports.org/wp-content/uploads/2020/09/Maintenance-Cost-White-Paper-9.24.20-1.pdf)

6. Calculated the potential cost savings per mile that the City could obtain by purchasing an EV in place of a gasoline or diesel vehicle. If the net purchase cost of the EV exceeded the cost of the gasoline or diesel vehicle, calculated the number of miles after which the per mile cost savings from driving the EV would surpass the incrementally higher purchase of the EV.