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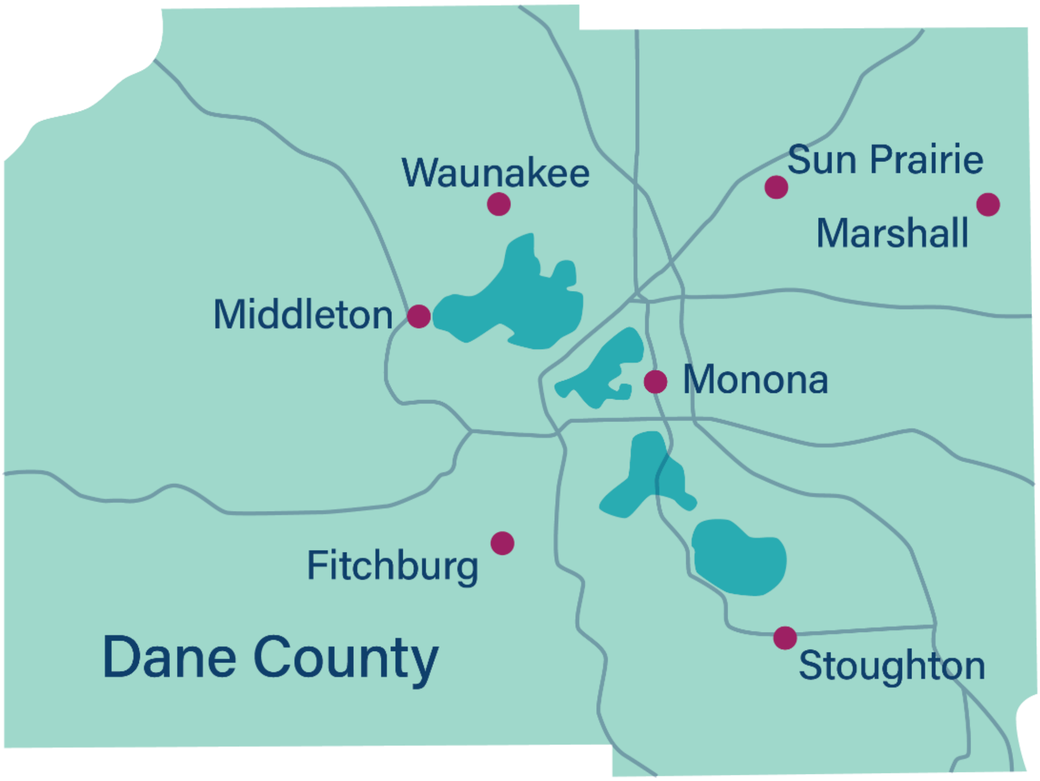
Municipal Energy Plan - Seven Community Collaboration

Main Report



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EXECUTIVE SUMMARY

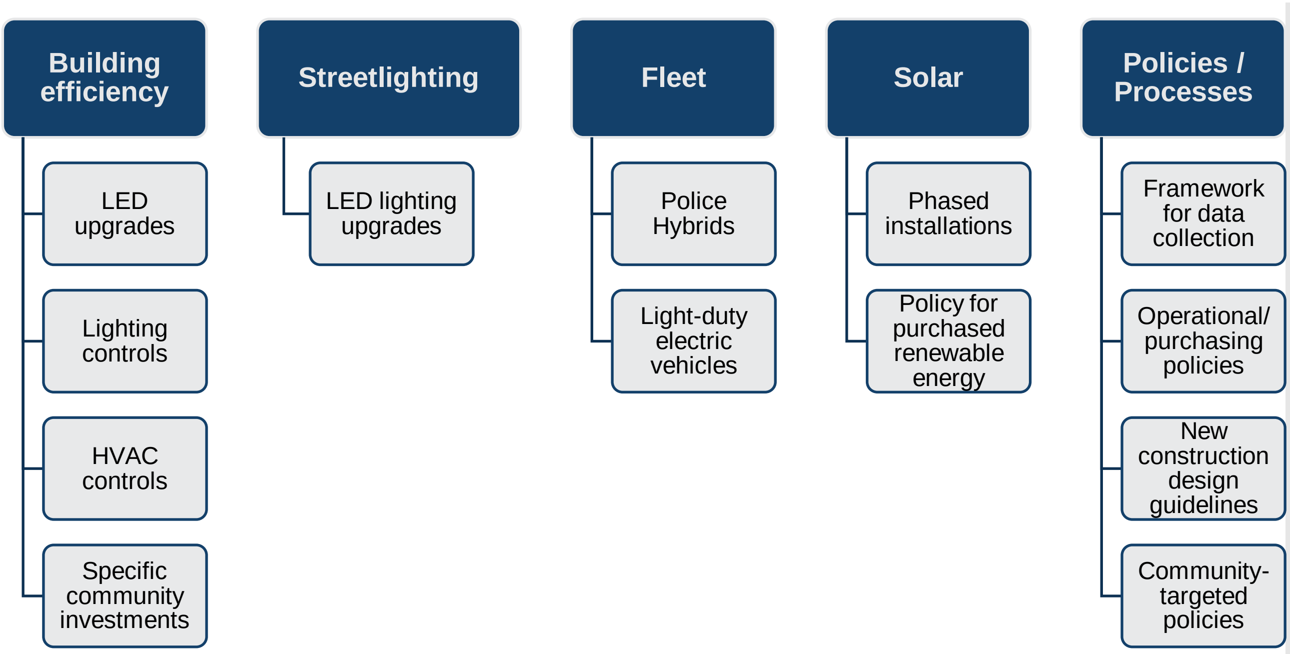
Many of the largest US cities have adopted ambitious goals to reduce their energy and carbon emissions through ambitious goals. Yet not all communities have the same resources to tackle complex issues of reducing overall energy consumption. To leverage the resources that collaboration can provide, seven communities in Dane County (Fitchburg, Marshall, Middleton, Monona, Stoughton, Sun Prairie, and Waunakee) came together to develop energy plans that provide clear guidance on near-term actions for each community. While some of the collaborating communities have made publicly-facing goals and resolutions independently of one another, a group effort allowed for streamlining of the analytic process and provided a process by which to share ideas and inspiration. With funding through the Wisconsin Office of Energy Innovation (OEI) and with project management and technical support provided by Slipstream (a not-for-profit based in Madison), the group embarked on a year-long effort to identify and prioritize near-term actions for reducing energy and carbon. The goal of this collaboration is multifold:

- Develop a baseline energy use profile for municipal operations
- Identify energy savings opportunities to reduce energy and costs to each municipality
- Create a near-term energy plan for each municipality
- Leverage collaborations and lessons learned by working together

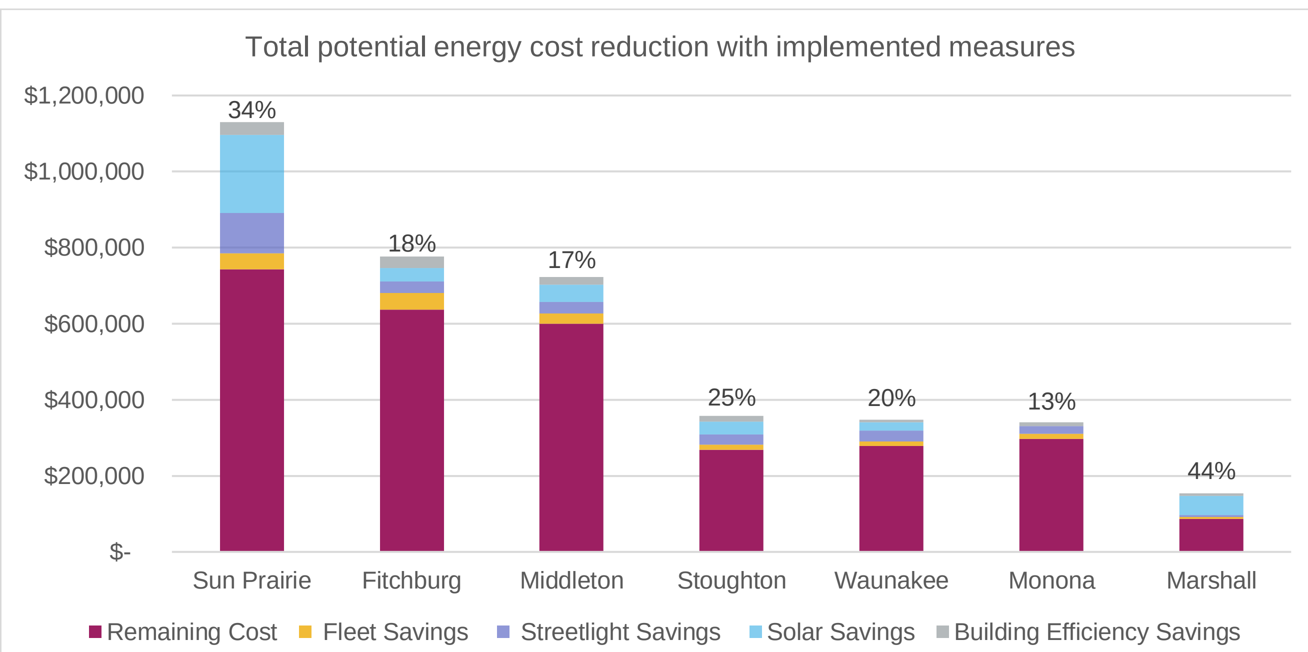
The development of energy plans for each community consisted of three main phases: data gathering, development of baseline energy profiles, and analysis of near-term opportunities. With each community starting at a different point in terms of policies and investments related to energy reduction, Slipstream and the collaborating communities spent the first few months of this effort identifying actions already taken and sharing them with the group. For example, some communities regularly track energy consumption data while others do not. Most communities have invested in solar energy, although to varying degrees. Throughout the year, we held one-on-one meetings to obtain community-specific feedback and in-person group meetings to foster collaboration and share ideas.

To develop the baseline energy profiles for each community, Slipstream gathered data on building and operational energy consumption, fleet vehicles type and usage, and distributed energy investments. The data formats and completeness varied by community and across operational divisions within the communities. We cleaned the data and pulled it together into a standard formula and converted the baseline energy use into baseline costs and carbon emissions.

Finally, we identified near-term opportunities for each municipality to lower energy use, reduce carbon emissions, and save money. While recognizing that not every recommendation can be implemented all at once, all recommendations have strong paybacks and are technologies and actions that can be implemented today. There were several opportunities that apply across all communities, including upgrades to the fleet, basic building efficiency opportunities, and streetlighting upgrades to LED fixtures. After conducting two to three building site walk-throughs per community, we also identified community-specific opportunities, such as building efficiency opportunities unique to a particular community, as well as solar investments. Below we provide a schematic overview of the opportunities we recommend for all participating communities.



The chart below shows the relative impacts on annual costs savings of these recommendations and provides the percent reduction of total energy costs as labels. The potential costs savings range from 13 to 44 percent, suggesting significant opportunity across all communities. This range reflects the variation in available opportunities as well as baseline operation. Not every measure applied exactly to every community, although we found energy savings across every aspect of municipal government.

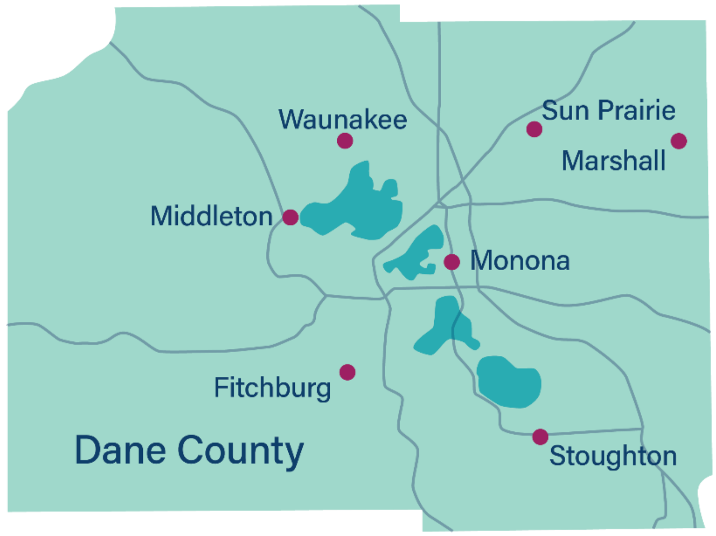


Beyond these potential energy-saving opportunities, the energy plan addresses a number of policies that ensure the longevity of these energy savings and provide the foundation to create even deeper levels of savings. We recommend establishing a framework for data collection that can institutionalize the process for benchmarking and ongoing monitoring of both buildings and fleet data. This is one of the most important policies a community can implement to maintain high functioning buildings, identify future areas of improvement, and track ongoing energy savings. We also detail guidelines that can be implemented to reduce energy consumption in new construction building design. We outline recommendations for both operational policies for existing buildings and purchasing policies to ensure standards are met in municipal operations.

In addition to describing policy-based opportunities to reduce municipal energy consumptions, we also recommend leveraging policies and programs to foster sustainability and energy conservation throughout the community, through encouraging high-performing buildings, fostering solar development and supporting the electric vehicle industry.

Taking these steps will position the seven communities as leaders in creating a sustainable and resilient municipal operation. This energy plan identifies opportunities across many aspects of municipal government and draws on technologies that are currently available to quickly move each of these communities closer to their goals of saving energy, reducing reliance on fossil fuels, and reducing carbon emissions. And together, as collaborating communities, this group of seven communities can use these energy plans as a foundation of knowledge and continue to lean on each other for sharing experiences and lessons learned.

BACKGROUND



In the summer of 2018, seven communities in Dane County (Fitchburg, Marshall, Middleton, Monona, Stoughton, Sun Prairie, and Waunakee) came together as a group to work on a collaborative energy planning process. All seven communities are located within the Madison metropolitan area and share the same regional economy and community. With funding through the Wisconsin Office of Energy Innovation (OEI), these seven communities embarked on a year-long process to develop actionable plans for achieving their energy reduction objectives within municipal operations. Slipstream, a not-for-profit based in Madison, provided the project management and technical consulting to create the energy plans. The goal of this collaboration is multifold:

- Develop a baseline energy use profile for municipal operations
- Identify energy savings opportunities to reduce energy and costs to each municipality
- Create an actionable near-term energy plan for each municipality
- Leverage collaborations and lessons learned by working together

This report summarizes these efforts and provides details and recommendations for each community to consider in the development of their near-term planning priorities and budgeting.

While the community characteristics are distinct in a number of ways, which are described further below, each community came to this collaboration with an openness and willingness to share ideas, expertise, and inspiration. The group met a total of four times in person and each meeting allowed for discussion of potential ideas, lessons learned, and shared experiences.

A NOTE ON THE THREE PARTS TO THE ENERGY PLAN

We divided the energy plan into three parts: a main report, community-specific reports, and appendices. The main report provides background on the project and process, and overarching recommendations that can be applied to all communities in this collaboration. In a separate document, we provide seven standalone chapters (one for each of the collaborating communities) that detail the community-specific municipal energy profile and corresponding recommendations. The appendices in a third separate document provide further detail should the reader want to dive deeper into the calculations and assumptions in the analysis.

INTRODUCTION TO THE COMMUNITIES

Municipal energy planning starts with an analysis of how the local government uses energy, recognition of the energy conservation measures that have already been implemented, and an understanding of the community's larger energy goals. While the seven communities range in population, geographic size and scope of municipal operations (Table 1), the energy consumption for all seven communities primarily comes from public buildings, fleet vehicles, water pumping, wastewater treatment, and street lighting.

Table 1: Municipality overview

Municipality	Population (2017)	Number of buildings	Square feet of buildings	Square miles
Fitchburg	29,485	6	186,669	35
Marshall	3,973	4	49,217	2
Middleton	19,660	10	163,848	15
Monona	8,104	4	98,690	4
Stoughton	13,088	10	274,375	5
Sun Prairie	32,894	9	212,059	12
Waunakee	13,755	8	195,643	6

The seven communities shared many goals for the energy planning process, but also identified individual objectives. As with any group of communities, the levels of past investment in energy efficiency and municipally-owned renewable energy vary amongst the communities. The councils of four of the seven communities have approved resolutions that establish long-term goals for reductions in energy consumption and use of renewable energy both for municipal operations and for the larger community (Table 2). Those communities without formal resolutions regarding clean energy still indicated strong internal and community support for saving energy across buildings and operations, as well as using cost-effective renewable energy to power their municipal operations.

Table 2: Municipal energy goals

		Total energy reduction	Renewable electricity	Renewable energy
Municipal energy goals	Fitchburg	30% by 2030* 50% by 2050*	25% by 2025 100% by 2030	-
	Middleton	15% by 2030 50% by 2050	25% by 2025 80% by 2030 100% by 2035	66% by 2030 88% by 2035 100% by 2040
	Monona	15% by 2030 40% by 2040 50% by 2050	35% by 2025 100% by 2030	65% by 2030 85% by 2035 100% by 2040
	Marshall			60% by 2030 80% by 2035 100% by 2040
	Sun Prairie			25% by 2025

		Total energy reduction	Renewable electricity	Renewable energy
Community energy goals	Fitchburg	30% by 2030* 50% by 2050*		
	Middleton	10% by 2030 40% by 2050	20% by 2025 66% by 2030 88% by 2035 100% by 2040	21% by 2030 80% by 2040 100% by 2050
	Monona	10% by 2030 40% by 2050	35% by 2025 50% by 2030 75% by 2035 100% by 2040	20% by 2030 80% by 2040 100% by 2050
	Marshall			33% by 2030 66% by 2040 100% by 2050

*Per capita reduction in fossil fuel energy use, rather than total energy reduction

OVERVIEW OF METHODS

The development of energy plans for each community consisted of three main phases: data gathering, development of baseline energy profiles, and analysis of near-term opportunities. At the outset of the process, Slipstream conducted individual interviews with representatives from each community to understand their community-specific goals, current successes, and near-term plans already in place. Throughout the year, we held additional individual meetings to receive community-specific feedback and in-person group meetings to foster collaboration and share ideas. Figure 1 summarizes the main steps involved in each phase.

Figure 1: Energy plan development overview

Data gathering

- Gather data including:
  - Utility data (MG&E, WPPI, WE Energies)
  - ENERGY STAR® Portfolio Manager data
  - Community operations, including treatment plants and wells
  - Vehicles and mileage
  - Streetlight data
  - Operational and internal policies

Energy profiles

- Compile data in standard format
- Identify areas of missing information
- Conduct secondary research to develop assumptions
- Create a spreadsheet of compiled data

Opportunities analysis

- Create a list of typical opportunities
- Conduct site visits to identify areas of potential improvement
- Calculate energy and costs savings
- Aggregate savings by energy, cost and carbon
- Identify municipal policies and community-wide resources

The development of energy plans required a significant data gathering effort. Each municipality had data in a variety of formats and had varying levels of access to data. We worked with community representatives to identify the data that they had available and wanted to include in their energy profile and scope of the energy plan.

Once all data was collected, the next major step involved compiling the data into a standard format and identifying areas of missing information. As communities had access to various levels of fleet data, we conducted secondary research to develop assumptions and estimate baseline fuel usage for each municipality. Applying universal cost assumptions and emissions factors for each energy source (found in Appendix A) to all communities we converted baseline energy use into baseline costs and carbon emissions.

The last phase in this process was to identify near-term opportunities for each municipality to lower energy use, reduce carbon emissions, and save money. This included identifying common opportunities among communities, such as upgrades to fleet and streetlights, as well as municipality-specific analyses. The community-specific analysis included building walk-throughs to identify energy efficiency opportunities and a solar analysis to identify potential solar production at municipal buildings. Using common industry assumptions, we calculated the potential energy savings for each identified opportunity and converted the values into cost and carbon savings. As a note, the savings are reported relative to 2018 energy use, but municipalities should consider how growth in the communities may impact overall energy demand in the future.

Our analysis also includes an examination of both municipal policies that can leverage internal operations to advance energy goals, as well as strategies to reduce community-wide energy use.

SUMMARY OF ENERGY CONSUMPTION

The first major step in creating the energy plans was to inventory all the relevant energy uses and compile them into energy profiles. Each community has a detailed energy profile provided in the community-specific chapters below. While each community's energy profile shows a slightly different picture, total energy consumption largely mirrors the size of community. There are three main elements of an energy profile: buildings, operations, and fleet. Examples of operational energy elements include well and water distribution, street lights, non-street lighting, and park and recreational facilities. Not all communities chose to include the same inventory elements in their profile; this was dependent on specific municipal organizational structures, responsibility for municipal services, and availability of data. The community specific chapters provide details on exactly what went into each community's inventory.

During our collaboration meetings, the community representatives expressed interest in seeing side-by-side comparisons of inventory elements. In this section, we offer comparisons to identify trends between the communities.

First, we compare the total electricity and natural gas consumption along with the associated carbon emissions, shown in Table 3. Carbon emissions are calculated using standard assumptions of global warming potential of various fuel sources in Wisconsin; we list the carbon dioxide emissions here and elsewhere in the report as carbon equivalent to reflect the fact that some energy sources emit other greenhouse gases (such as methane) which are normalize to a carbon dioxide equivalent values (see Appendix A for more details). In this table, we excluded data from water distribution or water/waste treatment, because not all communities provided those data and that operation can be energy-intensive and skew a comparative review.

Table 3: Energy and carbon summary by municipality

Municipality	Total electricity (kWh) [1]	Total natural gas (therms)	Total carbon emissions (CO_2e metric tons)	Emission per capita (CO_2e metric tons)
Fitchburg	2,969,760	70,691	3,407	0.12
Marshall	411,565	18,816	512	0.13
Middleton	3,019,066	105,884	3,373	0.17
Monona	1,448,381	70,194	1,778	0.22
Stoughton	773,314	70,669	1,372	0.10
Sun Prairie	4,375,182	118,252	4,866	0.15
Waunakee	1,587,412	68,869	1,933	0.14

* This table excludes energy associated with water and waste treatment and water distribution

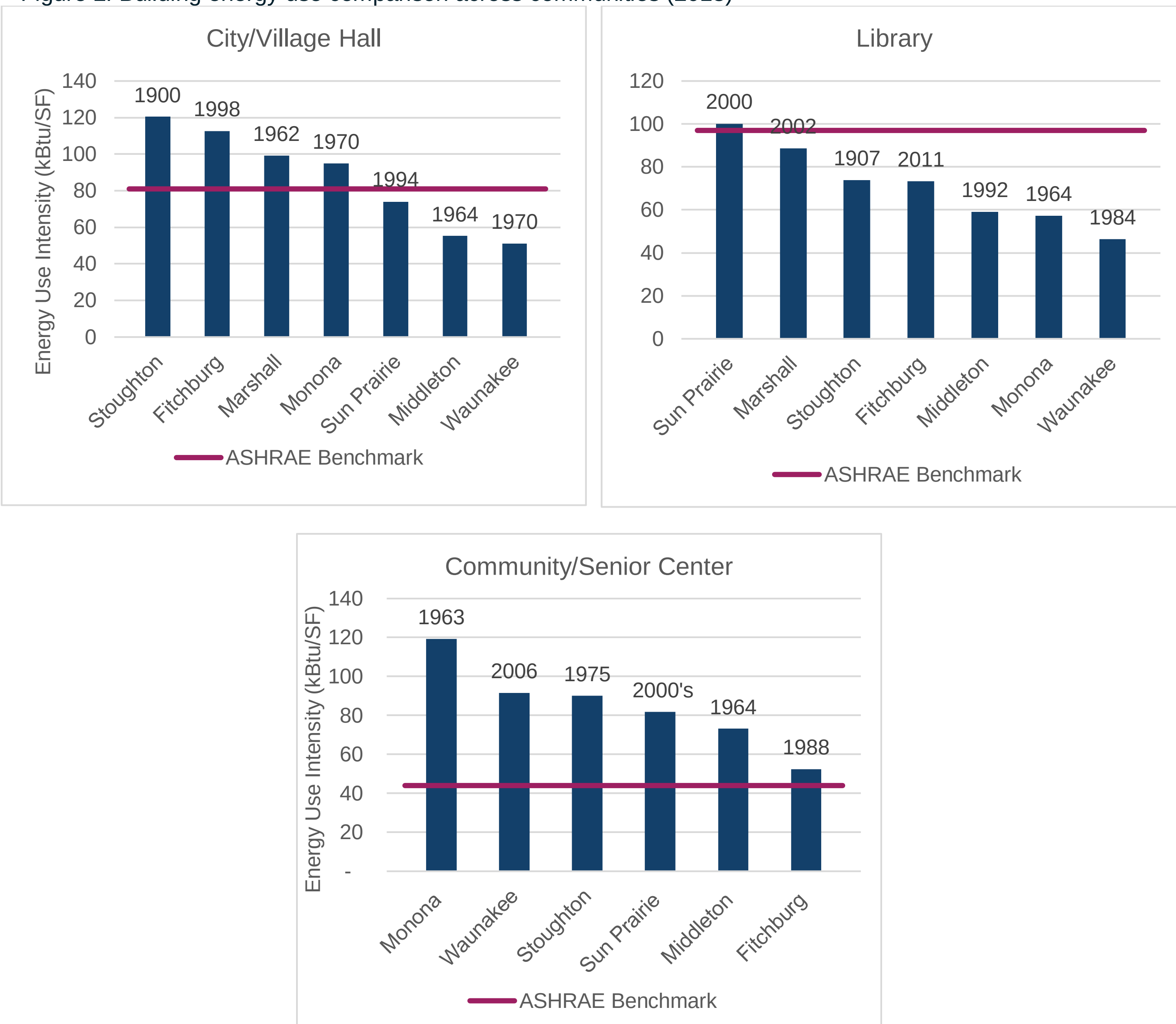
Every community had a village or city hall and a library. Nearly every community had a community or senior center. Figure 2 shows the EUI comparison across these common building types. Because the size of a building drives energy consumption through heating, cooling and plug loads, we compare buildings using a total energy in kBtu (which combines the energy values of electricity and natural gas) normalized by building size. This value, called the energy use intensity (EUI) allows us to understand the relative measured building performance. We also provide the building age; generally older buildings tend to have a higher energy intensity than newer buildings due to more stringent building energy codes. However, this is dependent on upgrades and investments made to the building, as well operations of the building.

The graphs below show an ASHRAE regional benchmark to compare relative building performance of similar buildings.[2] When comparing to the ASHRAE benchmark or to other municipalities, it is important to note that several communities use their city/village halls or community centers for a variety of functions, which may impact the overall EUI. For example, in 2018, Stoughton's City Hall was housed in the same building as the Opera House, which has a significantly different energy profile than a typical city hall (in 2019, the City Hall moved into a separate building). Also, the city halls for Sun Prairie, Fitchburg and Monona also house their police department, which could affect total building energy consumption. For the libraries, most buildings appear to be at or below the ASHRAE benchmark -- this may be driven by a skew in the regional average; for this reason, it is useful to have nearby communities to benchmark local buildings' energy data.

[1] The total electricity consumption lists the amount of electricity that the municipality *purchased* from the utility, rather than the total electricity *used* by the municipality, due to net-metering billing arrangements for those municipalities that have on-site solar. Net-metered solar photovoltaic systems first provide electricity to power operation of the facility where the system is located, thereby reducing the amount of electricity that the facility must purchase from the utility. Solar electricity that is used on-site is generally not shown on the facility's electric statement but is instead reflected in the reduced amount of electricity that it purchases from the utility.

[2] The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) created *Standard 100-2018 - Energy Efficiency in Existing Buildings* that offers median EUI values as well as energy targets by building type. https://www.ashrae.org/news/esociety/updated-standard-100-published

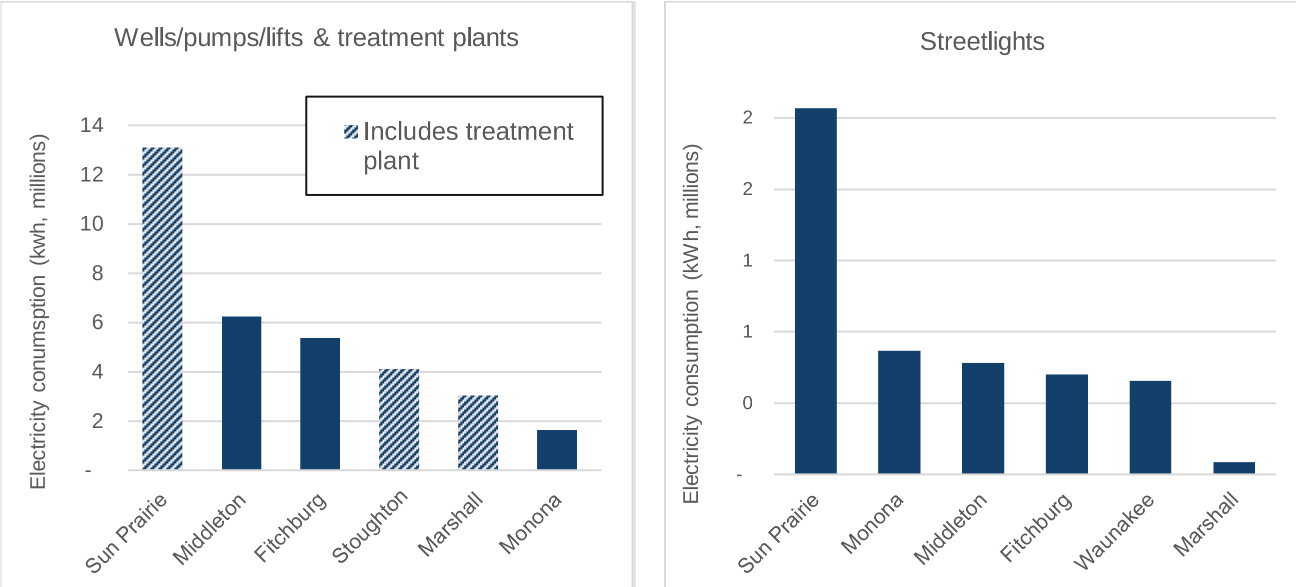
Figure 2: Building energy use comparison across communities (2018)[3]



Similarly, we compared common operational uses of energy. As mentioned above, not all communities reported water-distribution data (such as wells and pumps) and only three communities have wastewater treatment facilities. Waunakee did not include electricity data for their pumping stations and Stoughton did not include electricity data for their streetlights. In Figure 3, we show the comparison between these operations. Sun Prairie's data for both of these operations likely reflect the geographic size of the municipality which translates into the highest total consumption for each of these operations amongst all collaborating communities.

[3] For buildings where solar arrays are installed, electricity use is the net purchased electricity, rather than the gross electricity consumed by building end use processes.

Figure 3: Water distribution/treatment plant and streetlight electrical consumption



OVERVIEW OF RECOMMENDATIONS

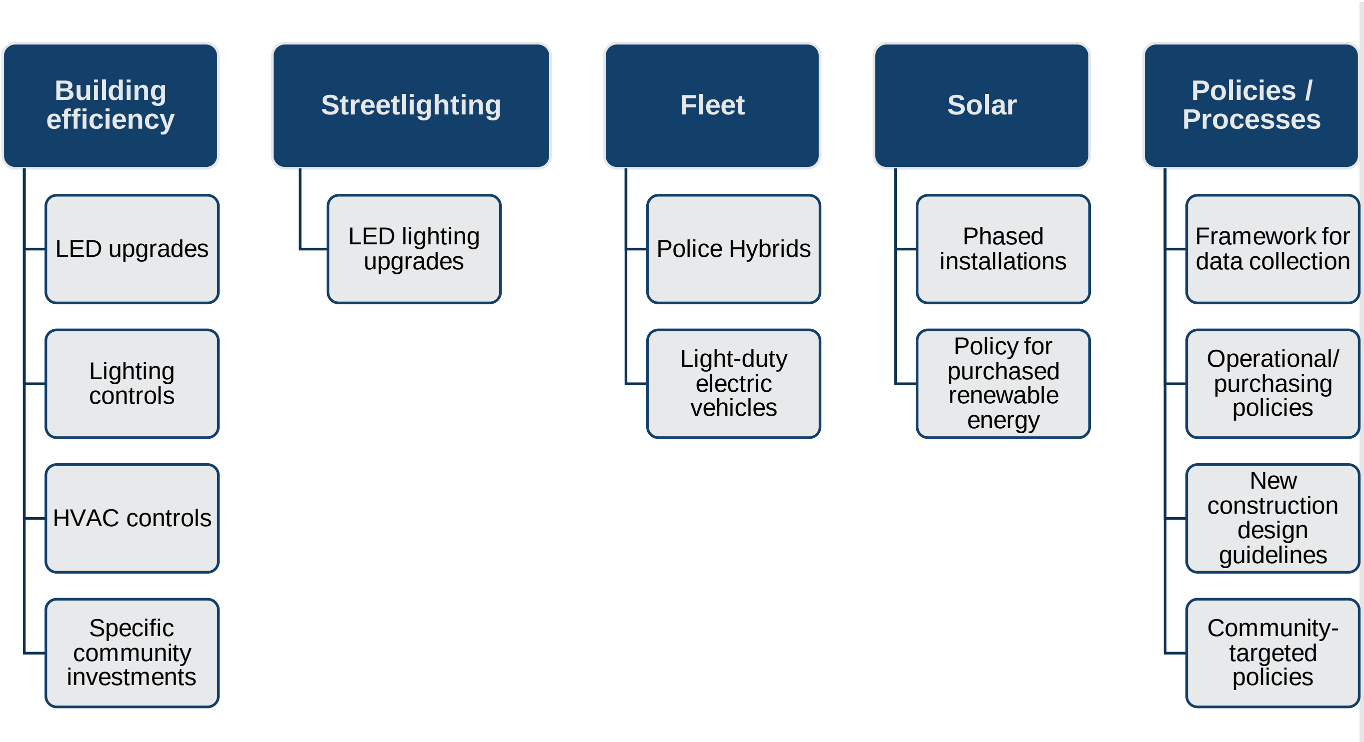
Using the energy profiles as a starting point, we looked at all areas of municipal operations to identify near-term strategies to reduce energy. Our initial brainstorming list of potential energy saving measures included building efficiency measures, street lighting retrofits and fleet upgrades. Recognizing that a number of communities have already invested in distributed energy, such as solar photovoltaics, we also worked with the communities to identify additional opportunities for future solar or other renewable energy development. We prioritized measures based on the following:

- Total energy, cost and/or carbon savings
- Ability to implement in the near-term (1-5 years) timeframe
- Potential for reducing maintenance costs
- Potential for increase non-energy benefits, like municipal staff comfort

Investments in energy efficiency and renewable energy improvements reduce ongoing energy consumption and energy costs. While we describe several very low-cost and short payback investments, most improvements require several years to generate the energy savings required to make the investment cost-effective, and for that reason, we focused our recommendations on investments that will have both a lasting impact and will remain in use for a significant time period.

While each community has a list of measures that are unique to that community (which is outlined in more detail in each community-specific energy plan), Figure 4 provides a summary of the major recommendations that can largely be applied to all communities. The recommendations and values provided in the report below should be considered a planning level of analysis, which identifies relative costs and savings of a particular measure. We recommend that for implementation of this plan, communities conduct a deeper financial analysis that may ultimately result in slightly different cost or savings values.

Figure 4: Summary of energy plan recommendations



Below, we quantify the impacts of implementation of these recommendations in two ways: by annual cost savings (Figure 5) and annual carbon emission reduction (Figure 6). We provide the percent reduction of total as labels for each community. The potential costs savings range from 13 to 44 percent, suggesting significant opportunity across all communities. This range reflects the variation in available opportunities as well as baseline operation. For example, Sun Prairie has the most total absolute number of streetlights, most of which were not retrofitted yet with LED lighting, and therefore that comprised a larger piece of the savings. For Marshall, the smallest of the communities with the lowest baseline energy consumption, the solar potential comprised a significant relative proportion of the municipalities energy reduction, largely due to a sizeable system we analyzed near their wastewater treatment plant. For Monona, our analysis did not include sizing a new solar PV system but rather examined the feasibility of future investments on an existing system, and as such, solar power does not appear in the total energy reduction potential.

Figure 5: Potential annual energy cost savings in dollars and percent reduction

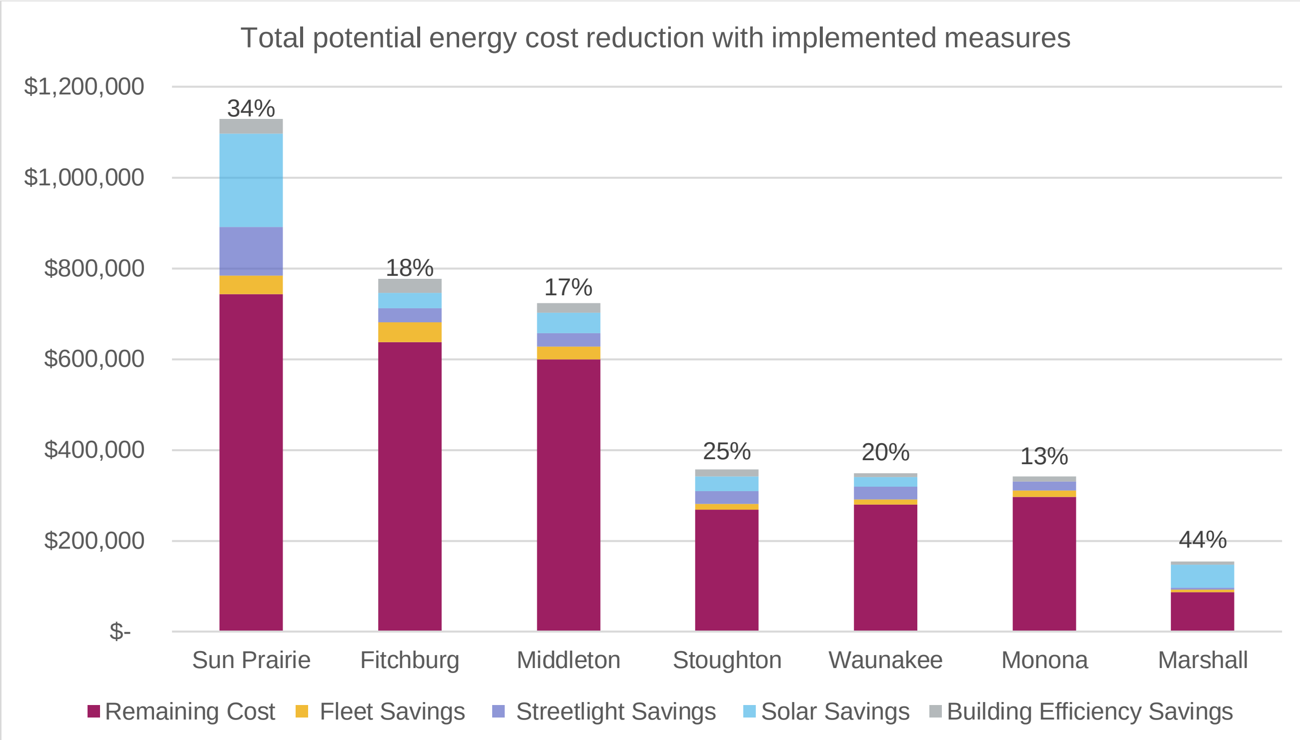
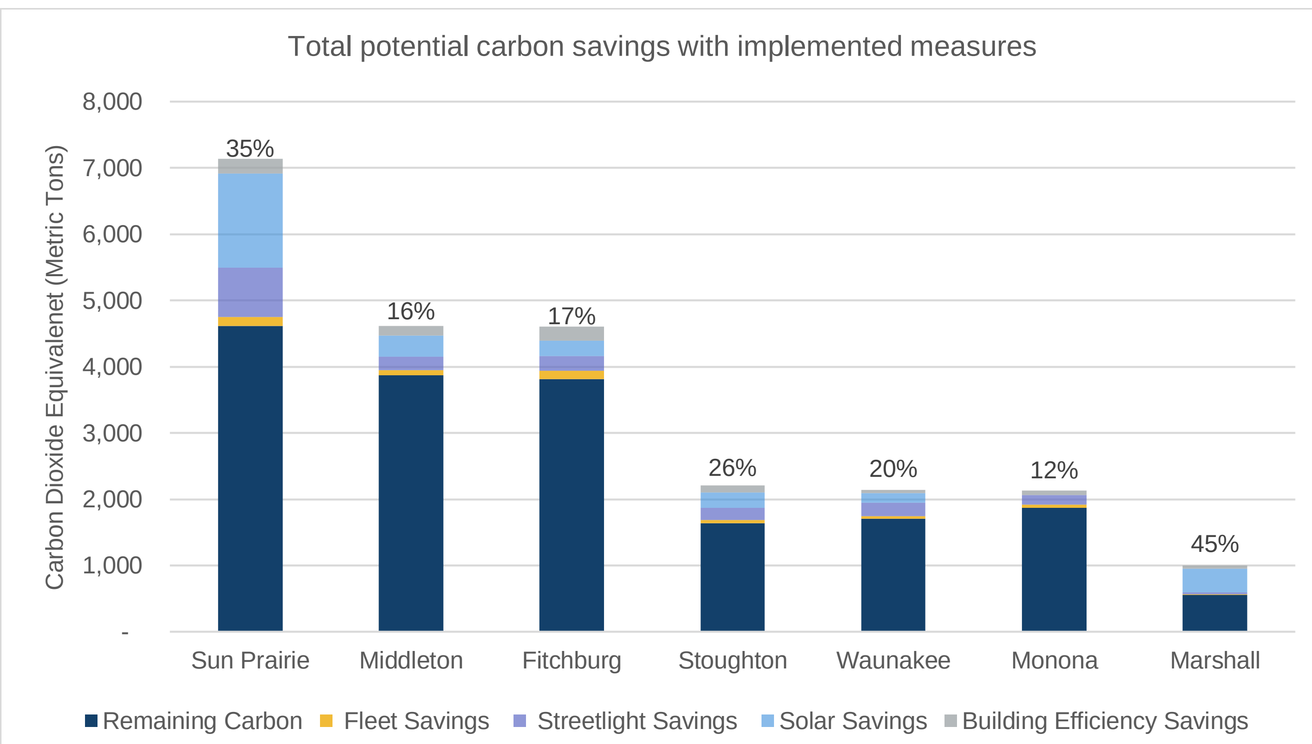


Figure 6: Potential percentage and total annual CO_2e savings



Beyond these energy-saving potential opportunities, the energy plan addresses policy options that ensure the longevity of these energy savings and provide the foundation to create even deeper levels of savings. We recommend establishing a framework for data collection that can institutionalize the process for benchmarking both buildings and fleet data. This is one of the most important policies a community can implement to maintain high-functioning buildings and identify future areas of improvement. We also detail guidelines that can be implemented to reduce energy consumption when developing designs for new construction projects. We also recommend passing a resolution for a new construction design standard for all new buildings or major renovations or clearly defining an EUI target to which those buildings are designed. And we outline recommendations for both operational policies for existing buildings and purchasing policies to ensure standards are met in municipal operations.

Taking these steps will position the seven communities as leaders in creating a resilient and sustainable municipal operation. In addition to describing policy-based opportunities to reduce municipal energy consumptions, we also recommend leveraging policies and programs to foster sustainability and energy conservation in the community through encouraging high performing buildings, fostering solar development and supporting the electric vehicle industry.

While these energy plans focus on the near-term opportunities commercially available to all communities today, the market for energy-saving technologies is shifting rapidly. There are a number of technologies, such as battery storage, all-electric heavy-duty equipment, and building-integrated solar panels that are unavailable or largely cost-prohibitive today. As communities think about adaptation and resiliency to climate changes effects (such as flooding, high heat days, and other extreme weather), many new technologies will be integral to ensuring that municipal operations function when they are needed most. For example, solar power combined with battery storage can offer continued operation of critical services during a power outage. With that said, we recommend an ongoing review of these technologies and others that may emerge commercially to evaluate whether they have a place in each community.

BUILDING EFFICIENCY

Efficiency and conservation are the first order course of actions when working to reduce overall energy impacts. Ensuring that buildings are functioning optimally and as intended not only saves energy but can reduce operational and maintenance costs and improve indoor environmental quality and occupant comfort. As part of this energy plan, we identified opportunities in existing buildings as well as new construction.

Through the development of the energy profiles, we calculated the EUI of each building, which quantifies total energy (in units of kBtu) per square foot per year. With a calculated EUI, we were able to benchmark each building against typical building EUIs to understand how each building was performing. Using the EUIs, as well as input on age, function, and operation, we selected two to three buildings at which to conduct a site visit. The goal of the site visits was to identify any efficiency improvements that can be gained through low or modest investments. The walk-throughs took note of lighting, heating, ventilation, and air conditioning (HVAC), operations, and comfort levels.

In addition to the measures identified for specific buildings based on the walk-throughs, we identified low-cost energy savings measures that can be applied to most community buildings. Below, we provide detail on those energy savings measures, as well as energy savings practices already implemented by a number of communities that highlight best practices.

Current operations

For each community, we found examples of building and operational efficiencies that may be useful for other communities to adopt, if they have not already done so.

Table 4: Building and operational efficiency - examples of what municipalities are doing now

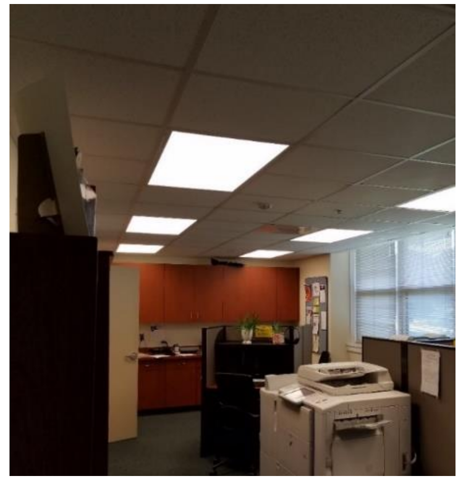
Measure	Description
LED lighting retrofits	Many communities have already begun replacing fluorescent lamps with LED lamps. Sun Prairie and Marshall are testing LED options to understand their look and feel in existing spaces. Sun Prairie is running an occupant survey on LED fixtures and testing ease of installation for facility staff.
High bay and garage lighting occupancy sensors	Many of the public works facilities have high bay lights installed with occupancy sensors to turn off or dim lights.
Near condensing boilers	Most facilities we visited had near condensing boilers, which can improve gas efficiency by 4-8 percent compared to conventional boilers. A full-condensing boiler, if installed, would improve gas efficiency another 4 to 12 percent, but would increase the cost of the equipment by about 20 percent.
Condensing hot water heaters	Most facilities had condensing hot water heaters installed, which can improve domestic hot water heater efficiency by 4-8 percent compared to conventional units.
Defined room temperature setpoints	Middleton has an internal city policy in place for building operators to maintain room temperatures to conserve energy. This includes set back temperatures when buildings are unoccupied.
Building Automation System (BAS) upgrades	Several buildings had modern BAS systems installed for their heating and air conditioning systems. A BAS allows building managers to have a higher degree of control for their systems and ability to troubleshoot problems.

Low-cost energy saving measures

During our building walk-throughs, we consistently found many opportunities to install low or no-cost measures that typically have a good payback and are relatively simple to implement. A number of these measures have already been implemented to some extent in the collaborating communities' buildings. For example, several communities either have recently invested in LED lighting or are undergoing that process. However, there is still opportunity to implement these measures across many of the communities' buildings. Based on feedback and conversations with individual communities, we incorporated these measures into our overall recommendations and calculated aggregated energy and CO_2 savings for the community buildings. The measures are described below with a typical payback period; additional quantification of how these measures can impact each municipality's current energy use is in the community-specific chapters.

Interior and exterior LED lighting retrofits

Typical payback: *2-4 years*



LED lighting is 40 to 50 percent more efficient than fluorescents and also emits higher quality light that offers better glare control and uniformity. Costs for LED bulbs and fixtures have dramatically decreased in the last few years making it more economical than ever to replace old lamps. In addition, improved light quality is linked to improved occupant morale, leading to increased productivity. At the point of upgrading to LEDs, we also recommend incorporating integrated lighting controls, as doing both tasks simultaneously can reduce overall labor costs. Fixtures with integrated controls come with some combination of occupancy sensors, photosensors for daylighting, and smart control systems that allow controls to be easily adjusted remotely. Lighting controls can reduce electricity consumption by optimizing light levels based on occupancy and ambient light levels. See additional detail below.

Lighting occupancy and vacancy controls

Typical payback: *0.5-2 years*

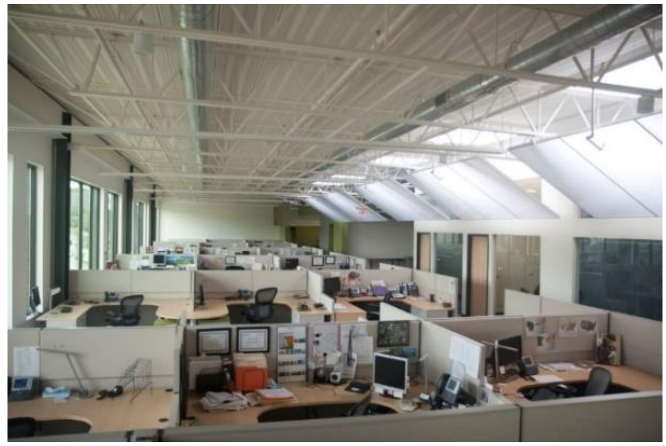
Lighting controls with occupancy or vacancy sensors keep lights off in spaces with no people. As mentioned above, a good time to consider upgrading lighting controls is when you upgrade light fixtures to LEDs. Several new fixtures come with integrated controls, which may provide additional control capabilities including wireless and mobile phone management.

We recommend installing vacancy sensors at the light switch to turn off lights in small rooms like small offices, huddle rooms, toilet rooms, and storage closets. Vacancy sensors must be turned on manually when someone enters such rooms, but automatically switch off after a set time with no occupancy detected. These switches are readily available for as low as $20 each.

Additionally, we recommend installing fixture mounted or wall mounted occupancy sensors in large spaces like open offices, conference rooms, garages, or high-bay storage. These sensors automatically switch on when someone enters the space, and off after no activity has been detected for a set time. Occupancy sensors with wireless controls are particularly helpful for hard-to-reach high bay spaces and garages, so it is easier to adjust settings after they are installed. Consider networked lighting controls which allow for advanced lighting control strategies such as task tuning to further increase savings, functionality, and ease in making changes.

Daylighting controls

Typical payback: *0.5-4 years*

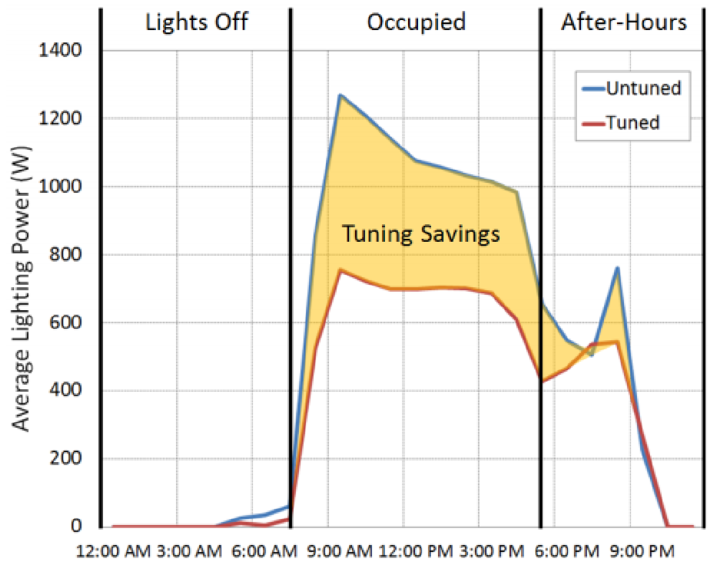


Spaces with plenty of windows or skylights are often well-lit during the day. To take advantage of this daylight, building owners should install daylighting controls to reduce lights when daylight is available. This can be accomplished with photosensors to detect daylight levels in the space. Often these can be mounted on or integrated with the light fixture. Photosensors should only dim the lights (not fully power them off) to help take advantage of overcast days where some additional light is needed. Continuous dimming is recommended with LED lights as this allows for a consistent level of light throughout the day.

Task tuning to optimize lighting output

Typical payback: *0.5 – 2 years*

Figure 7: Example daily energy savings potential for task tuning



LED lights produce higher quality light at a fraction of the energy required by old fluorescent lamps. However, this can result in spaces being too bright, causing some occupant discomfort. Dimmable lighting systems allow building operators to reduce over-lighting by task tuning the lights: adjusting light levels so that illuminance is appropriate for the activity in the space. This also reduces energy used for lighting (see Figure 7). Task tuning, also known as high end trim, is a one-time process that sets a lower maximum output for light levels utilizing LED lights with dimming controls and a simple commissioning process. The commissioner sets the maximum light output to meet the recommended light levels by the Illuminating Engineering Society (IES) for the space.

Exterior lighting controls

Typical payback: *<2 years*

Many facilities already have a timeclock installed to turn on exterior lighting when it gets dark out. Additional energy savings can be achieved by programming the system to turn off exterior lights during early morning hours for facilities that are unoccupied at night. For buildings with 24-hour per day operations, like police stations and fire departments, consider installing motion detectors for exterior light fixtures which would not compromise the safety and functionality of the building. Some lights should be left always on for safety and security. Research shows a strong correlation between safety and security based on lighting placement and quality rather than increased light levels, so leave lights on at exterior doorways and near the building but turn off lights at the far ends of the parking lots. Turning off exterior lights also reduces light pollution and light trespass (light cast in areas where it is not wanted).

Air handling unit supply air temperature reset

Typical payback: *0-2 years*

Supply air temperature reset is a control strategy that allows an airside system that distributes air for heating and cooling to modulate the supply air temperature based on outside air temperature, worst-case room demand, or a combination of the two. When it is cold out, or there are not a lot of people in the building, you can raise the ducted air temperature to save energy. We recommended resetting the temperature up at least 5 degrees when it is cold outside. This control sequence can be set up through air handling unit packaged controls or through the BAS. Work with your controls or mechanical contractor to help set up this control strategy.

Boiler hot water temperature reset

Typical payback: *1-3 years*

Hot water reset is an energy saving control strategy for near-condensing or condensing hot water boilers. A hot water reset control loop measures the outside air temperature and lowers the hot water temperature when it is warmer outside and raises the hot water temperature when it is colder outside. Full-condensing boilers are designed to handle low hot water temperatures and save more energy. If you have near-condensing boilers, consult your installation manual or your mechanical contractor for the ideal return temperature as you can damage the boiler if the hot water return temperature is too low.

Demand-controlled ventilation (DCV) controls

Typical payback: *2-4 years*

Outdoor air is required to be brought into the building to provide fresh air to occupants and to remove contaminants. However, this air needs to be heated or cooled to room temperature, using a significant amount of energy. DCV controls reduce the supply of outdoor air when there are fewer occupants in the building and increase ventilation when there are more occupants in the building. This is often done by using a CO_2 sensor, which is a good indicator of human occupancy. These sensors can be placed in the return duct of single zone units or in the space of large open offices and conference rooms. Consider linking lighting occupancy sensors to HVAC BAS systems to implement DCV for small rooms, which can reduce outside air even further and achieve more energy savings. High CO_2 levels can lead to drowsiness, and CO_2 sensors can be used to help bring in fresh outside air to remove the CO_2. Upgraded ventilation systems improve indoor air quality, leading to increased productivity of occupants.

Computer power management

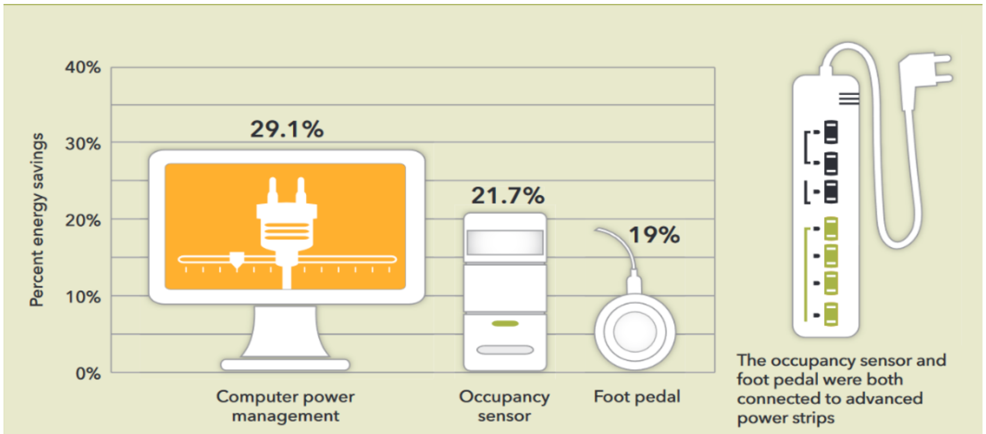
Typical payback: *0.5-1.5 years*

In Midwest office spaces, plug loads account for approximately 28 percent of the energy used.[4] There are a few basic solutions that can be employed to reduce plug load energy. Computers can account for

[4] Seventhwave. *Power down, power off: Beginning to capture the untapped energy savings in office plug loads*, Retrieved from: https://slipstreaminc.org/sites/default/files/documents/research/powering-down-powering.pdf

as much as 66 percent of workstation energy use. Computer power management (CPM) can reduce energy use from computers by 30 percent. CPM automatically puts computers and monitors in low power mode after a period of inactivity. Recommended CPM strategy is for IT staff to configure work stations to shut down, sleep, or hibernate after 30 minutes of idle. The cost to implement CPM is only the cost for your IT department to implement, as most computers come with CPM.

Figure 8: Percent energy savings from computer power management



Even more savings can be gained by using advanced power strips at workstations. These power strips can automatically turn off peripheral devices when the computer workstation is turned off. Some strips have occupancy sensing or current sensing capabilities to save even more energy. The US Environmental Protection Agency's (EPA's) ENERGY STAR® program provides additional valuable resources and recommendations.[5]

More in-depth energy saving measures

On our walk-throughs, we observed opportunities that go beyond the simple low- or no-cost categories above. While these are addressed more specifically in the community-specific municipal energy plans where they are applicable, they are useful to share to all the collaborating communities in case similar issues arise in the future.

Retrocommissioning for HVAC and lighting controls: For several buildings we visited, there were system control configurations that could be improved just by having someone review the control sequences and operations. We recommend retrocommissioning to address these issues. Retrocommissioning is a process that brings in a third-party commissioning agent to review lighting and HVAC controls. The commissioning agent will then make or recommend improvements that lead to a more comfortable building and more energy savings.

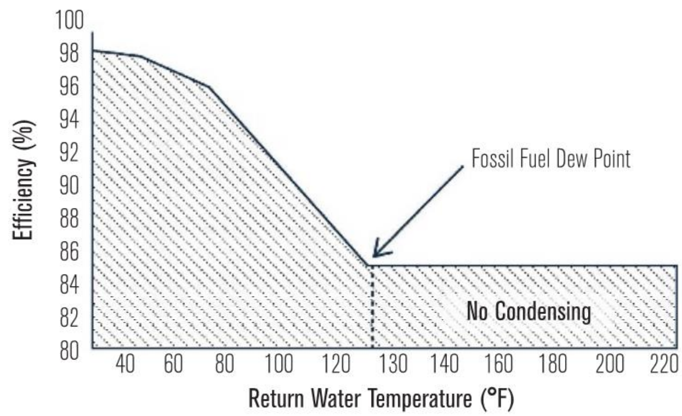
HVAC comfort and control: Some of the buildings we visited had occupant comfort issues related to the HVAC system. This typically stemmed from an HVAC control system issue, although other times it was an unforeseen issue in design. Older buildings generally had difficulty replacing old equipment in mechanical rooms that weren't designed to allow for the removal of large pieces of equipment, leading to systems unable to maintain space temperatures because they were past their service life.

[5] ENERGY STAR®. Ways to reduce IT costs. Retrieved from https://www.energystar.gov/products/reduceitenergycosts

HVAC equipment and controls issues generally require an energy audit or mechanical engineer to examine the issue and recommend the best course of action, as these issues often have multiple root causes and a variety of solutions. Changing building automation control sequences is generally easy and costs very little to implement, while adding new sensors or controllers starts to add cost. Full equipment replacement can be very costly.

Condensing boilers: Many buildings replaced their old boilers with new near-condensing boilers. These are more efficient, but where possible, we recommend installing *full* condensing boilers when replacing old boilers. Near-condensing boilers claim only 84 to 88 percent efficiency, while full condensing boilers claim 92 to 96 percent efficiency. That may not seem significant, but boiler efficiency gains are optimized at low hot water return temperatures, which near-condensing boilers cannot achieve – they can only take hot water return temperatures down to about 130 degrees without damaging the boiler (Figure 9).[6] Full condensing boilers allow hot water return temperatures as low as 80 degrees, which enables full efficiency savings.

Figure 9: Flue gas condensation temperature and boiler efficiency



Because the only way to achieve full boiler energy savings is to lower hot water supply temperature, existing buildings should implement a hot water reset schedule mentioned above. New buildings should be designed so that hot water is returned to the boiler as low as 130°F during the winter.

Server room cooling: IT closets are cooling-only loads and should be located in the building core area which will typically also be cooling-only. This simplifies HVAC design, reduces energy use, improves thermal comfort. In our walk-throughs, we found one instance of an IT closet on the perimeter due to space utilization requirements. Because servers require constant cooling, we recommend they be served by their own air conditioning system separate from the main building heating and cooling system. Small split systems are great solutions for IT closet and server room cooling.

Resources for Building Energy Efficiency

Focus on Energy provides a number of rebate options as well as custom incentives. Joel Roltgen (jroltgen@cesa10.k12.wi.us) has spoken to many of the community representatives already and is eager to assist.

EPA's ENERGY STAR® provides resource for reducing energy consumption in buildings, specifically listing appliances and equipment that are proven to use less energy than comparable appliances or equipment

ASHRAE Standard 100 – Energy Efficiency in Existing Buildings includes informative appendices for energy-saving measures and building operation practices.

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[6] Vanwormer, C. et al. (2018). Best Practices for Condensing Boilers, *ASHRAE Journal*. Retrieved from http://cleaverbrooks.com/about-us/news/articles/2018/condensing-boilers.pdf

STREETLIGHTING

Streetlights are a significant source of operational energy consumption in every community in this collaboration, comprising between 7-36 percent of total electricity consumption. Converting all streetlights from high-intensity discharge (HID) to light emitting diode (LED) fixtures can cut streetlight electricity in half. LEDs have significantly longer lifetimes, which leads to additional lifetime savings by reducing maintenance costs. The lights also reduce light pollution through better glare control, offer improved lighting quality through different color renditions, and can improve pedestrian and driver safety.

We recommend that each municipality converts all streetlights to LEDs. The impacts of converting to LEDs differ for lights of different wattage. In general, as the wattage increases, the payback improves because the annual energy savings are more substantial. For example, a municipality can expect to see a discounted payback of 7 to 11.5 years for a 70-watt fixture and a discounted payback of 3 to 3.5 years for a 400-watt fixture. For more details on these results and the calculations, see Appendix B.

These saving calculations assume that the municipality owns the lights and would receive the benefit of reduced maintenance costs, although there are some municipalities in this collaboration that have payment arrangements with their utility for streetlights that are owned by that utility. While utility-owned lights would see the same lifetime energy savings, the cost savings are more difficult to estimate as utilities differ in their billing arrangements. However, the option to convert utility-owned lights does exist for all municipalities; We Energies, MG&E, WPPI utilities, and Alliant all offer LEDs as an option for streetlights.

The following summarizes key steps to take to make the switch to LED streetlights:

1. **Discuss LED options with your utility.**
   For utility-owned lights, an important first step is to discuss the options for LED streetlights. Consider the following:
   - How do their rates account for LEDs' lower energy use?
   - How does the municipality ensure that LEDs replace all burned out fixtures?

2. **Adopt a policy or guideline that ensures LEDs replace all fixtures at burnout.**
   This could include a policy that states that fixtures are replaced one-by-one at burnout or a policy that states an entire block or area will be replaced with LEDs when one light in the area burns out. By converting a larger area at one time, the municipality can save on labor cost.

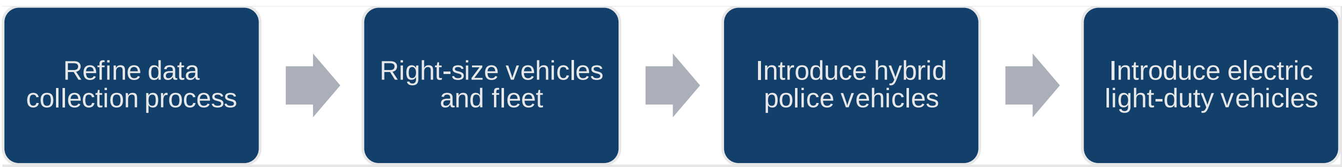
3. **Assess funding opportunities for a widespread replacement**
   A widespread replacement of LEDs could save the municipal money through discounts for a bulk purchase and more targeted labor. Municipalities commonly plan gradual replacements – converting neighborhood by neighborhood. Focus on Energy also provides financial assistance for governments that own their own streetlights and want to upgrade to LEDs.[7]

[7] The Focus on Energy 2019 catalogue (page 36) details rebates offered for LED streetlights owned by municipalities: https://focusonenergy.com/sites/default/files/inline-files/2019_Lighting_Catalog_Interactive.pdf

FLEET

The relative impact of fleet energy use on a municipality's total energy use and emissions increases as the community improves the efficiency of its buildings. Historically, widespread options to address this impact have not existed. However, the market for alternative fuel vehicles is rapidly developing and the ability to track vehicle patterns is improving, creating a growing opportunity to address transportation emissions. Figure 10 illustrates our general recommendations for fleet.

Figure 10: Fleet recommendations - right-sizing vehicles and adoption of alternative vehicles



As a first step, taking inventory of the municipal vehicles' annual miles driven and main use can identify vehicles that are not fully utilized. This could lead to a reduction in the size of fleet – which may increase miles driven by each vehicle and improve the economics of adopting alternative fleet vehicles. Additionally, this inventory could identify vehicles that may be larger than necessary for the functions they perform, which could reduce fuel use in the future. A good example of a city policy prioritizing the right-sizing of fleet is Seattle's 2018 Executive Order on Reducing the City Fleet.[8]

We recommend that cities prioritize replacing police vehicles with hybrid patrol vehicles. When upgraded as part of a community's planned replacement schedule, hybrid police vehicles offer a payback under one year and can reduce total CO_2 emissions from those vehicles by 40 to 50 percent (see Table 5). Three main factors contribute to the favorable payback period: the annual miles driven by a police vehicle, the amount of time idling which powers onboard operations, and the relatively low incremental cost. Given the short payback time and the similar functionality to conventional police vehicles, each municipality Each municipality should explore adopting a policy that stipulates that any new police vehicle is a hybrid.

Federal tax credit and leasing vehicles

The federal government currently offers up to a $7,500 tax credit for electric vehicles. By using a municipal lease program, cities can make use of this credit and reduce the upfront cost of the vehicles. This can reduce the cost differential and lead to a payback period within the vehicle's lifetime.

The Climate Mayors started an Electric Vehicle Purchasing Collaborative to reduce electric vehicle costs for cities, counties, and state governments. The portal below has information on how to purchase vehicles at the negotiated prices: https://driveevfleets.org/

While the technology is commercially available for light-duty electric vehicles and PHEV (Plug-In Hybrid Electric Vehicles), we calculated that the operational savings do not surpass the higher upfront cost within the vehicle's lifetime, but the savings will reduce CO_2 emissions by 35 to 40 percent. Additionally, if a municipality

[8] City of Seattle. Executive Order 2018-05. Retrieved from: https://durkan.seattle.gov/wp-content/uploads/sites/9/2018/09/09.24.18-Fleet-EO.pdf

consolidated the vehicles in its fleet and increased the annual mileage of each vehicle, the payback period would improve. Argonne National Lab provides a calculator that compares lifetime cost and CO_2 of specific makes, models, and model years of vehicles.[9]

Table 5: Lifetime cost analysis - police and light-duty vehicles[10]

	Vehicle	Incremental vehicle cost	Annual cost savings	Lifetime savings	Payback period	Lifetime CO_2 reduction
Police	**Hybrid Patrol SUV**	$3,500	$1,640	$10,200	**1.2**	41%
	Hybrid Patrol Sedan	$3,500	$2,170	$14,560	**1**	55%
	Electric Motorcycle	$390	$825	$8,600	**<1**	35%
Light-duty	**Passenger Vehicle**	$8,600	$350	-$3,700	-	43%
	Plug-in Hybrid SUV	$10,000	$215	-$7,000	-	35%
	Plug-in Hybrid Van	$9,000	$240	-$5,650	-	35%

We also completed a lifetime cost analysis for compressed natural gas heavy-duty vehicles and hybrid pickup trucks. Based on the long payback period, we recommend waiting for more cost-effective options to come to the market. Several manufacturers offer CNG alternatives, but the incremental cost of the vehicle is high compared to the annual cost savings. Additionally, these vehicles must follow strict safety protocols for storage and maintenance and need access to a compressed natural gas fueling station, which are not widespread. Both would raise the upfront cost associated with the vehicles – which would make the lifetime savings even lower.

Table 6: Lifetime cost analysis - pickups and heavy-duty vehicles[11]

	Vehicle	Incremental vehicle cost	Annual cost savings	Lifetime savings	Payback period	Lifetime CO_2 reduction
Pickups	F150 Plug-in Hybrid[1]	$20,000	$565	-$12,160	-	22%
	F250 + Hybrid	$9,000	$370	-$3,875	-	21%
Heavy-Duty	Low Upfront Cost	$10,000	$299	-$6,500	-	21.6%
	Medium Upfront Cost	$35,000	$299	-$31,500	-	21.6%
	High Upfront Cost	$50,000	$299	-$46,500	-	21.6%

[9] US Department of Energy. Vehicle cost calculator. https://afdc.energy.gov/calc/
[10] See Appendix C for more details on the assumptions behind these calculations.
[11] See Appendix C for more details on the assumptions behind these calculations.

A second option for heavy-duty vehicles is to change the fuel type from diesel to a 20 percent biodiesel (B20) blend. B20 can be used directly in existing heavy-duty vehicles and has the potential to reduce CO_2 emissions by around 15 percent. While our analyses did not explicitly look into this option, the city of Madison's fleet management has recently tested biodiesel on their fleet with good results.

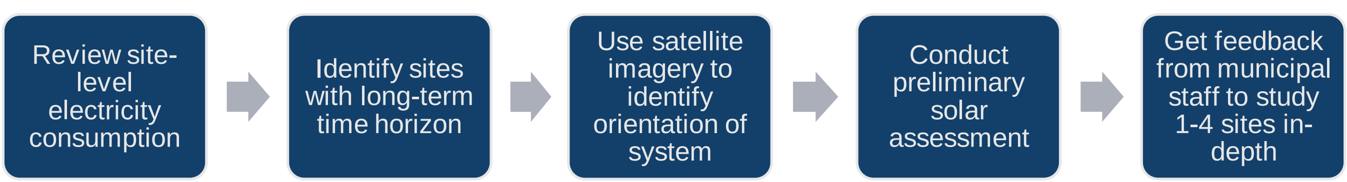
Emergency vehicles and other equipment do not currently have widespread alternatives, but we did review idling technologies as well as electric lawn equipment. Idling technology includes battery and diesel auxiliary power units for ambulances and firetrucks which power on-board equipment when the vehicle is not moving. However, this technology ranges from $12,000 to $14,000 per vehicle and the current vehicle use by municipalities in this collaboration does not result in a great return on investment. Additionally, reviews of the technology's performance are mixed.[12]

Electric lawn equipment is a rapidly developing market with electric options available for handheld devices as well as large commercial mowers. As there was a wide range of types of equipment owned by each municipality, we did not perform a cost analysis of this technology. However, the electric options will offer significant operational savings, including energy cost and maintenance, over conventional equipment. The payback periods vary widely, depending on the features of the equipment. For example, a commercial electric lawnmower could have an incremental upfront cost above a traditional riding mower anywhere between $7,000 and $15,000. We recommend that cities explore these options and continue to watch the market as new electric options develop.

SOLAR

All communities in the collaboration have invested in at least one solar photovoltaic system, either installed or planned, and all indicated an interest in adding additional on-site solar arrays to generate electricity for municipal operations. To facilitate this process, we conducted a survey of many of the facilities that were owned by each municipality to identify potential opportunities to site a solar array at that location. These findings are intended to assist each community in prioritizing sites and allocating funds for solar arrays in future capital budgets. We provide an overview of the opportunity identification process below:

Figure 11: Opportunity selection process for solar photovoltaics



We began our analysis by reviewing site-level electricity consumption and conferring with municipal staff to understand the long-term planning horizon for each site. Since moving solar panels can be costly, we prioritized sites which did not have plans to be replaced or redeveloped in the foreseeable

[12] Owens, R & Laughlin, M. (2016). *Case Study – Idling Reduction Technologies for Emergency Service Vehicles*. Retrieved from Argonne National Laboratory website: https://publications.anl.gov/anlpubs/2016/03/125155.pdf

future. To identify high-potential sites, we used satellite imagery to review each location. The review ruled-out sites at which trees or neighboring buildings would compromise the electricity production of the array. It also ruled out buildings with roof layouts, including both orientation and roof-mounted equipment, that would unduly limit the solar production at the site. For the remaining sites, we conducted a first-order analysis to understand initial estimates of the annual solar production at each site. We used Project Sunroof to conduct an initial survey of the available space at each location for installing a solar array. We also generated high-level cost estimates for the potential projects using market data, along with potential project rebate amounts from WPPI or Focus on Energy where available.

With these initial findings, we solicited feedback from the municipal representatives, each of which selected up to five sites for further opportunity analysis. We utilized National Renewable Energy Lab's (NREL's) System Advisor Model to create a detail model of the solar array at each site, and we aligned production to consumption to avoid over-production at the site, which is either prohibited or disincentivized by each of the electric utilities serving the communities. We estimated the financial performance of each system by comparing the initial net cost of the system (total cost less estimated rebates) to the value of the electricity to be produced by the system during its first year of operation and throughout its thirty-year lifetime. We assumed a value of solar electricity of $0.11/kWh, as well as a discount rate of 2 percent with no anticipated increases in the cost of electricity, and annual system degradation of 0.50 percent.[13]

Table 7: Summary of potential solar sites by municipality

Municipality	Number of sites analyzed	Total capacity (kW)	Estimated annual production (kWh)	Percent of municipal energy consumption	Estimated total first year savings
Fitchburg	5	224	308,207	6%	$33,905
Marshall	2	337	468,635	48%	$51,550
Middleton	3	137	182,351	4%	$20,060
Stoughton	3	143	180,984	10%	$19,910
Sun Prairie	2	1,277	1,699,511	24%	$186,945
Waunakee	2	118	146,143	8%	$16,075

Renewable energy purchases

The three utilities that provide electricity service to the seven communities: MG&E (Fitchburg, Monona, and Middleton), WPPI (Stoughton, Sun Prairie, and Waunakee), and WE Energies (Marshall) each offers tariffs through which customers may choose to purchase renewable electricity. As an alternative, or supplement, to installing solar PV arrays on municipally-owned properties, communities may consider purchasing renewable energy through one of the renewable energy rates or tariffs offered by their electric utility.

[13] The $0.11/kWh value is based on average total costs per kilowatt hour of electricity consumed in the area. This assumption reflects an average value, while the actual value of electricity produced will depend on the terms of the applicable utility rate, as well as on the amount and pattern of consumption at a building.

What is a renewable energy tariff?

When a customer purchases electricity through a renewable energy tariff, the source of the electrons flowing through their wires does not change. Instead, under most renewable energy tariffs, the customer purchases renewable energy credits (RECs) along with the electricity that they use, or the utility retires the RECs associated with purchased electricity on behalf of the customer (see Table 8). Buying a REC certifies that the purchaser owns the renewable energy attribute of the electricity and that no other entity (such as the electric utility) can receive credit for the renewable component of that energy. Retiring a REC indicates that the associated renewable energy has been used and that the attributes/benefits of that electricity will not be transferred to another party or allocated toward other purposes.

Table 8: Local renewable energy tariffs

Utility	Tariff	Energy source(s)	Highlights
MG&E	Shared Solar	Specific local solar array	• Customer purchases share of electricity produced by local solar array • Up-front cost, then fixed cost of $0.109/kWh for up to 25 years. • Max purchase is 50% of annual consumption. • Utility retires RECs for customer.
	Green Power Tomorrow	IA and WI wind farms WI solar arrays	• Additional cost of $0.01/kWh • Option to purchase up to 100% of electricity through this rate • REC ownership not specified
	Renewable Energy Rider	Develop new solar array or access existing array	• Customer purchases share of electricity produced by array • Option to purchase up to 100% of electricity through RER. • Negotiated pricing with utility • REC ownership determined by contract
WE Energies	Energy for Tomorrow	Regional wind, solar, and biomass. Locations not specified.	• Additional cost of $0.02007/kWh. • Cost decreases to $0.01872/kWh if purchasing >= 70,000 kWh/month • Option to purchase up to 100% of electricity under this rate. • REC ownership not specified
WPPI	Choose Renewables	Wind, biomass, and solar facilities in WI, MN, and IA	• Additional cost of $3.00/300 kWh block • Purchase up to 100% of electricity under this rate • WPPI retires REC on behalf of customer

Why purchase RECs?

Most states (including Wisconsin) have regulations that impose a Renewable Portfolio Standard (RPS) on electric utilities. The RPS requires utilities to include a certain percentage of renewable electricity within their overall portfolio of electric generation sources. To comply with the RPS, utilities may develop renewable energy projects themselves, or they may purchase RECs from third parties.

When a customer purchases electricity through a renewable energy tariff, they generally also purchase the associated RECs (see Table 8) and therefore ensure that the renewable energy is not double-counted, both as part of its RPS compliance and as a unit of energy sold to the customer. If the renewable energy tariff includes the sale of RECs with the purchased electricity, the customer's renewable electricity should be additional to the amount of renewable electricity that the utility is required to generate or purchase to comply with the RPS. As of 2018, MGE and WPPI have significantly exceeded their RPS requirement, which suggest that market forces, rather than RECs or the RPS, are pushing them towards renewables, even in the absence of customers purchasing through renewable energy tariffs.[14]

Purchasing RECs is a strategy that a municipality can consider in order to achieve its goal of using a certain percentage of renewable energy to power its operations. This can be especially important if the municipality is limited by space and available capital. While this energy plan does not explicitly endorse purchasing RECs, we understand it is an option that many municipalities consider and we provide an overview of some of the benefits and downsides of RECs for each municipality to consider (Table 9).

Table 9: Benefits and downsides of renewable energy credits to meet energy goals

Benefits	Downsides
Reduces or eliminates first-cost of renewable electricity	No visibility to the community
No staff time needed for procurement or project management	Reduced opportunity for municipality to lead community by example
Claim renewable energy attributes of purchased electricity	Reduced transparency on source of renewable electricity
Overcomes solar siting limitations	Renewable energy frequently is not generated within the community
Some tariffs incorporate fixed annual cost increases, reducing customer exposure to cost escalation risk	Require ongoing payment for renewable energy

[14] The Public Service Commission of Wisconsin. The Wisconsin Renewable Portfolio Standard. https://psc.wi.gov/Pages/Programs/RpsCompliance.aspx (last accessed 11/26/19).

MUNICIPAL POLICIES

The creation of this energy plan is just one step in ensuring that the recommendations developed are enacted. Throughout the energy planning process and as the Slipstream team met with communities individually and as a group, we identified areas where internal municipal policies can be addressed to not only ensure continuity in the energy planning process but also address efficiencies that can be gained within the communities.

POLICY CHECKLIST

- ✓ Does your community track its energy data?
  - ✓ Utility bills?
  - ✓ Fleet fuel purchases?
- ✓ Do you have a municipal benchmarking policy?
- ✓ Are there policies to ensure efficient building operations and purchasing sustainable products?
- ✓ Is there a new construction design guideline for municipal buildings?
- ✓ Has the municipality identified a staff lead who will ensure policy moves forward?

We recommend considering all the recommendations as part of a holistic energy management plan, which includes policies for tracking data on an ongoing basis, developing a method for benchmarking all municipal data, and consideration of internal policies that will address the longevity of this plan and the ability to meet energy goals. The policy checklist and the graphic provide an overview, and the sections below offer additional details.

Establish framework for data collection

One of the more challenging aspects of the energy planning process is pulling together the right data for the development of energy profiles. The challenge comes from aggregating data that is often obtained from multiple sources within each community. For example, utility billing data may be stored in one department, while fleet purchases may be stored elsewhere in municipal operations. Even though these data may be difficult to gather, when tracking progress to meet goals (whether that be renewable energy goals or simply verifying savings from an energy investment), it becomes vital to consistently gather these data on a regular basis.

We recommend that each community work within its own framework to institutionalize the data collection process. This includes answering the following questions:

- **Who will collect data?** This person should include data collection as part of their job responsibilities.
- **Where will it be tracked?** While the raw or original data might be located in disparate parts of the municipal operations, the data should be stored in a network location that is readily available to staff and easily retrieved in case of staff turnover.
- **When or how often?** Ideally, the data should be tracked on a monthly basis, especially for building level energy data (more on that in benchmarking below).
- **How will data be processed?** As part of this energy planning process, Slipstream has developed a database for each community. This can serve as a foundation for data processing; however, ultimately the data processing should be customized to what works for each community. Two collaborating communities (Monona and Middleton) already use EPA's

ENERGY STAR® Portfolio Manager, which is a free online tool that is used to track building level data.

- **What data should be tracked?** For building and operational energy data, utility bills should be tracked along with any investment that may affect energy consumption. For fleet data, it's important to link fuel purchases and (where appropriate) odometer readings when purchasing fuel. Alternatively, odometer readings may be recorded on an annual basis.

Benchmarking buildings

Going hand in hand with data collection is the concept of benchmarking. Benchmarking is the practice of comparing the measured performance of a building to itself or peers with the goals of measuring and motivating performance improvement.[15] Once you have the data and are tracking it on a regular basis, building performance can be compared to previous years to identify outliers. And it also can be used to understand how one municipal building compares to other similar buildings. These comparisons can identify areas that need attention or where there are opportunities to implement energy efficient practices to lower overall energy use. In fact, research states that buildings who benchmarked saw, over a 3-year period, an average of 2.4 percent annual energy savings.[16]

There are several tools already available to assist with benchmarking municipal buildings. ENERGY STAR® Portfolio Manager is a free tool that two collaborating cities (Middleton and Monona) already use to track utility bill data. The tool provides a centralized location for data collection and the ability to benchmark against a national sample of similar building types.

Measurement and verification of building systems is the process for quantifying the impacts of an energy savings measure. As the amount of data available increases, both in terms of granularity of building data and amount of historical data, the ability increases for measurement and verification of investments made in energy efficiency. For example, if several years of EUI data for a building are available, it creates a baseline against which current performance can be measured. As efficiency measures are implemented, data can be tracked to confirm that the savings align with predicted values.

Benchmarking fleet data

Each municipality had varying amounts of fleet data available, and most did not have a centralized system in place to track vehicle usage. As vehicles are spread across several departments and sometimes used by a few individuals, closely tracking usage can be difficult. However, vehicle data is important in understanding baseline energy use and tying it to particular vehicles can help cities understand current usage patterns and identify efficiency opportunities, such as the total number of municipal vehicles.

The optimal way to track vehicle data is to collect vehicle miles driven and gallons of fuel used by vehicle. These data accounts for emergency vehicle idling time and allows for the review of individual usage patterns. While these data can be tallied manually, with drivers recording the odometer and

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[15] Definition is based on the US Office of Energy Efficiency and Renewable Energy's definition found here: https://www.energy.gov/eere/slsc/building-energy-use-benchmarking (accessed 11/15/2019)
[16] EPA. (2012*). Data Trends: Benchmarking and Energy Savings*. Retrieved from: https://www.energystar.gov/sites/default/files/buildings/tools/DataTrends_Savings_20121002.pdf

gallons purchased at each fill-up, we recommend using an automated option to ensure data accuracy and ease of implementation. Table 10 summarizes the main two automated options available for municipalities. Vehicle telematics provide the most data and would be most valuable in identifying efficiencies, but the cost may be a barrier. Fleet cards offer a no-cost way to track data, but it is important that cards remain consistently with the same vehicle and employees understand the importance of inputting the correct odometer reading.[17]

Table 10: Fleet data tracking options - fleet cards versus vehicle telematics

Fleet card	Vehicle telematics
Free service that provides cards specific to each vehicle Use like credit cards at gas stations – must enter odometer reading and pin	Installed on individual vehicles GPS and on-board diagnostics automatically report data
Data recorded: - Mileage - Fuel Usage	Data Recorded: - Mileage - Fuel use - Idling periods - Routes - Maintenance needs
Dependent on user-inputted mileage Cards can be lost/transferred between cars	Can be costly

[17] As a point of example, Slipstream tracks vehicle mileage and fuel use with WEX fleet cards. WEX is a free service and does not require staff time to manage. Additional services include Speedway SuperFleet and P-Fleet, among others. Slipstream does not endorse or recommend any fleet card services or providers.

New construction design guidelines

Every municipality in this collaboration has plans for growth to accommodate increasing space utilization needs, whether that includes purchasing and moving into existing buildings or planning for new construction build-outs. These building infrastructure changes provide an opportunity to not only identify ways to keep operational costs down through lower utility costs but also provides a chance to spotlight municipal leadership and commitment to their energy goals. Decisions made at the point of new construction or major renovation can have a lasting impact on lifetime costs and functionality of the building.

New Construction Design Considerations

- ✓ Set an aggressive but feasible energy target
- ✓ Design the building to be resilient of climate change impacts, include back-up energy storage and incorporate flood risk or increased cooling needs
- ✓ Design with distributed energy generation or design or solar ready building, which optimize orientation and roof properties
- ✓ Include submeters to facilitate detailed benchmarking
- ✓ Consider building certifications (LEED, Living Building Challenge, Well certification)
- ✓ Include electric vehicle charging stations with sufficient capacity for growing EV market
- ✓ Incorporate sustainable purchasing into the materials and design of the building

We recommend that each community develop a policy that defines new construction or major renovation standards and adheres to a targeted EUI. One way to do that is to develop a net-zero new construction resolution for municipal buildings. As defined by the Department of Energy, net zero buildings combine energy efficiency and renewable energy generation to consume only as much as can be produced onsite through renewable resources over a specified period of time.[18] A key aspect of achieving net zero building status is to design it to use as little energy as possible, thereby making it less expensive to meet that energy consumption with renewable energy sources.

Another way that may be more amenable to municipal policy is to define a targeted EUI for new construction or major renovations. Buildings can be designed to have very low energy consumption using technologies that are readily available today. Research suggests that these technologies add low or no costs above a conventional design, especially when considering the energy costs savings.[19],[20],[21] When a building is designed at the outset with energy performance in mind, costs can be controlled through focusing on the most impactful design elements. After an EUI target is met through design of the building, the remaining energy consumption can be met by renewable energy, either at the point of construction or in the future.

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[18] US Department of Energy (2015). A Common Definition for Zero Energy Buildings. Retrieved from: https://www.energy.gov/sites/prod/files/2015/09/f26/bto_common_definition_zero_energy_buildings_093015.pdf

[19] Hu, M. (2019). Do zero energy building cost more? - An empirical comparison of the construction costs for zero energy education building in United States. *Sustainable Cities and Society*.

[20] Carbonnier, K. (2019). *Zero Energy Commercial Building Targets*. Retrieved from: https://newbuildings.org/resource/zero-energy-commercial-building-targets/.

[21] Lesniewski, L., L. Matthiessen, P. Morris, S. Tepfer. (2013) The Power of Zero: Optimizing Value for Next Generation Green. Retrieved from: https://www.integralgroup.com/wp-content/uploads/2013/09/Power-of-Zero.pdf

Table 11 shows recommended EUI targets for new net zero energy buildings specific to both building type and climate. These targets are based on   We recommended setting a target year that all municipal new construction must meet the zero energy EUI targets. Using that as an end goal, adopt interim and gradual EUI targets until hit the net-zero EUI goal is met in the target year.

Table 11: Net zero energy building - example target EUIs

Building type	Zero energy target EUI
Medium Office	25
Small Office	18
Public Assembly	31
Fire Station	33

To help ensure new construction meets these targets, include the EUI targets in bid requests to architects, engineers, and contractors. The design and construction team should be able to identify how they will meet energy targets in their proposals. We recommend including energy modeling within the scope of any new construction project to estimate total building energy consumption and fully understand the relative impacts of design decisions as you go through the design process.

Operational policies for efficient buildings

The second main factor, other than building design, impacting building energy consumption is the operation of a building. This encompasses a wide range of opportunities, from HVAC operation to individual occupant behavior. Operational policies can have impacts beyond energy use, most notably the potential to impact occupant comfort and productivity.

We recommend that each community develop policies that define clear rules and standards for the operation of municipal buildings and are conveyed to building occupants to avoid potential for negative feedback. Occupants should be assured that building managers are finding the right balance between energy performance and occupant comfort and safety. To that end, we recommend that along with operational policies, each municipality set up the appropriate communications channels so that building occupants can provide ongoing feedback.

Figure 12 summarizes the main operational standards that we recommend be included in a comprehensive operational policy. Other examples of operational policies used by municipalities include Middleton's building temperature policy, which provides setpoints during occupied and unoccupied times. Finally, we recommend building managers have access to the thorough ASHRAE Standard 100-2018 Energy Efficiency in Existing Buildings. It includes steps and recommended measures for building operations, maintenance, and recommended building efficiency measures.

Figure 12: Recommended operational policies

Operational Policies		
	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
	Lighting systems	Promote or incentivize occupants to turn off switched lights when not in use.
		Develop and communicate purchasing policy (see below) about replacing bulbs and fixtures
	Plug loads	Develop a policy that prohibits or limits the use of individual fridges, space heaters , printers, and other peripheral equipment at workstations
		Implement computer power management on worker's computers using a 30 minute or less delay before putting computers to sleep. Consider ways to reduce the number of monitors at each work station

Purchasing policies for new equipment

In addition to the operational policies, there are opportunities to increase building efficiency at every point of purchase with any piece of equipment that uses energy. It may not make sense to replace all these pieces of equipment *prior* to their end of life; however, when the time comes for replacement, every municipality should be prepared. **We recommend that purchasing policies be put in place such that all municipal employees that are responsible for purchasing such equipment have a clear guideline as to what is an acceptable purchase to meet the municipal energy goals.** Figure 13 details the equipment that we recommend including in a comprehensive purchasing policy.

Figure 13: Recommended purchasing policies

Purchasing Policies		
	Heating, ventilation, and air conditioning (HVAC) systems	Install new air conditioning units with a SEER or IEER rating listed in Consortium for Energy Efficiency (CEE) Tier 2 or better.
		Install new fans and pumps with EC motors or direct driven variable speed drives (VSDs).
		Chillers should meet the Wisconsin Building Energy Code IPLV chiller efficiency ratings. Consider chillers with VFD driven screw compressors and magnetic bearing chillers for higher efficiency.
		Install full-condensing boilers and gas heaters with listed efficiency of 92% or higher.
		Consider installing or upgrading the building automation system when major equipment is replaced.
	Lighting systems	LED lights should meet DLC QPL premium performance requirements.
		Consider purchasing fixtures with integrated controls to automatically dim or shut off lights based on occupancy or daylight.
		Consider Lighting networked controls that meet DLC Networked Lighting Control System QPL.
	Plug loads	Implement an ENERGY STAR purchasing policy for all appliances, including refrigerators, computers, office equipment, kitchen equipment, washing machines, and clothes washers.
		Use laptops instead of desktops at employee workstations.
		Consider advanced power strips to turn off peripheral equipment, like monitors and task lights, when computers are turned off.

COMMUNITY-WIDE RESOURCES

While this energy plan focuses primarily on municipal operations, everyone in the collaboration recognized the importance of understanding how they can provide leadership and drive innovation in their communities. In addition to policies to impact municipal energy use, municipalities should consider leveraging these community-wide resources to encourage residents to adopt low-energy practices. The new construction guidelines can be extended to all buildings within the municipal boundaries, and the municipality can work through other policy levers to encourage residents to build green. The municipality can take an active role in supporting solar investments by its community members. Similarly, the municipality can adopt policies that encourage resident adoption of electric vehicles.

Encourage sustainable construction

There are several options, beyond mandates or stricter building codes, available for municipalities to encourage sustainable new construction in the community. These may target energy efficiency, on-site renewable energy, or general sustainable practices. Several other cities have started to implement ordinances or incentives to encourage this. Some examples include:

- Specific language in tax incremental financing (TIF) policies that states energy efficient buildings, or buildings that meet a green certification, will be prioritized for funding.
- TIF incentives for renewable energy projects on any building within the TIF district.

- Requirement that any redevelopment or economic development project within a TIF district must participate in the municipality's voluntary benchmarking program.
- Requirement that any recipient of financial assistance prepare a report on the cost-effectiveness of including solar power on the building.
- Fee reductions or expedited review processes at no additional cost for green buildings.
- Allowed departure from code standards if it makes it easier to meet certification requirements.
- Free technical assistance from an advisory group on innovative designs, sustainable technologies, and new technologies.
- A reduced tax rate for a year if the building exceeds efficiency standards by a certain amount.

Below we provide examples of cities who have adopted incentives or ordinances that encourage sustainable construction:

Middleton, WI – Uses TIF incentives to encourage renewable development on building and has incorporated language to identify sustainable features as a TIF-eligible cost. The City also offers a TIF incentive for any renewable energy project within the TIF district. The incentive covers any cost of the project remaining after the federal tax credit is applied.

Milwaukee, **WI** – Created an ordinance requiring that all recipients of financial assistance of $1 million, or more, from the City, must prepare a report on the cost-effectiveness of including solar power, or other sustainable features, into the building.[22]

Rochester, MN – Includes explicit text in its TIF policy stating that projects will be more strongly considered if they meet a green building certification standard. The policy also sets environmental standards that all redevelopment and economic development projects must meet. For example, the City requires a resilient design, or the inclusion of strategies that consider potential shocks, such as extreme rainfall. Another innovative requirement is that the building must participate in Rochester's voluntary benchmarking program for 3 years. The entire policy is available in Appendix D. This policy is based off St. Paul's sustainable building policy, which includes similar language.[23]

City of Rochelle, Illinois – The city of Rochelle considers the sustainability of the building design when approving projects in TIF districts. The City uses a numerical scoring guide in reviewing projects and each project must accumulate at least 125 points for consideration. One measure, worth 10 points, is the use of "higher standards of building design, materials, and

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[22] City of Milwaukee, Ordinance, https://milwaukee.legistar.com/LegislationDetail.aspx?ID=2735765&GUID=E2B13282-E96F-4F40-B6BC-ECB9596A2696&Options=&Search=&FullText=1
[23] Saint Paul, Sustainable Building Policy. http://www.sustainablebuildingpolicy.umn.edu/saintpaul/legislation.html

energy efficiency such as meeting LEED certification, ENERGY STAR®, etc."[24] The city of Milton, Wisconsin has adopted similar language in their TIF policy.[25]

Shoreline, WA – Provides incentives for new construction that are "deep green," or meet the most stringent building certifications. The policy offers two types of incentives: (1) a potential fee reduction or expedited review at no additional cost and (2) allowed departure from code standards, in order to increase the ability to meet certification requirements. The program includes tiers of incentives, with higher incentives offered for more stringent certifications. To qualify for the incentives, the applicant must submit the project registration with the certification agency. The applicant must then have a 3rd party submit a verification letter and submit the final certification once the project is complete.[26]

Seattle, WA - Offers a number of incentives for green buildings, defined as one that receives a green building certification. In addition to expedited permit review and departures from the city building code, the City offers technical assistance from an advisory committee. The committee provides guidance on innovative designs, sustainable technologies, and emerging new technologies.[27]

Charlottesville, VA – For buildings that exceed the building code energy efficiency standards by 30 percent or meet a green building certification, the City offers a reduced tax rate of 50 percent of the building value for one year.[28]

Foster solar development

There are a number of ways in which municipalities can help encourage solar investment by residents and businesses of the community. SolSmart is a program which assists local governments in establishing regulatory and ordinance structures that catalyze the development of solar energy projects. Administered by the U.S. Department of Energy (DOE), SolSmart focuses primarily on removing barriers to solar projects within the larger community, but also includes resources to advance municipal use of solar energy.

Local governments may seek certification through SolSmart at one of three levels (bronze, silver, or gold), which are awarded based on the level of the local government's accomplishments in creating solar-friendly policy tools. SolSmart participant communities receive technical assistance from SolSmart staff and contractors. To date, 20 Wisconsin local governments, including Fitchburg and Madison, have earned SolSmart designation.

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[24] City of Rochelle, IL. Tax Increment Financing Assistance Policy. https://www.cityofrochelle.net/department-documents/building-zoning-planning-division-forms/6392-tif-assistance-policy/file.html
[25] City of Milton, WI. Tax Incremental Financing Policy & Application. http://www.milton-wi.gov/DocumentCenter/View/368/TIF-Policy?bidId=
[26] City of Shoreline, WA. Deep Green Incentive Program, http://www.shorelinewa.gov/Home/ShowDocument?id=31411.
[27] City of Seattle. Green Building Standard. http://www.seattle.gov/sdci/permits/green-building
[28] City of Charlottesville, Green Building Incentives and Resources, https://www.charlottesville.org/community/community-initiatives/a-green-city/green-building-incentives#ee_taxrate

Regardless of whether a government chooses to pursue a certification, SolSmart provides a publicly-available, searchable listing of solar resources for local governments, which includes examples of ordinances on permitting processes, solar access rights, and solar design guidelines, among many others. Following are selected examples of policy framework tools:

- Renewable Energy Ordinance Framework – Solar PV (DRAFT)[29]
- Unified Solar Permit example[30]
- Solar easement and access permit examples[31]

Support burgeoning electric vehicle industry

Adoption of electric vehicles by residents and businesses will reduce transportation emissions and fuel use in the participating communities. Market research has revealed that a primary barrier to increased market penetration by EVs is a lack of charging infrastructure (Electric Vehicle Supply Equipment – EVSE).[32] Individuals and businesses express concern that they will be unable to use their EV in the same way that they use their gasoline-powered vehicle because they will not be able to conveniently charge their EVs. Communities can catalyze increased EV adoption by their residents and businesses by creating and facilitating the development of strategically located EVSE within their municipality.

EVSE can be located at residences, workplaces, commercial centers, and public facilities. Potential owners may feel most confident in purchasing an EV if they can reasonably expect to charge their vehicle, as needed and conveniently during their regular daily routines. Currently there are three categories of EV charging equipment in use today, as outlined in Table 12.[33]

Table 12: Types of electric vehicle charging stations

Type of EV charger	Charging speed (Approximate)	Cost	Possible locations
Level 1: Standard 120 V outlet	125 miles in 20 hours	$0	• Residences
Level 2: Charging station with 240V connection	125 miles in 5 hours	$1,000 - $10,000 +Installation Costs	• Residences • Work places • Commercial centers

[29] Delaware Valley Regional Planning Commission (2015). *Renewable Energy Ordinance Framework Solar PV*. Philadelphia, PA. (Retrieved from https://www.dvrpc.org/EnergyClimate/ModelOrdinance/Solar/pdf/2016_DVRPC_Solar_REOF_Reformatted_Final.pdf)
[30] New York State Energy Research and Development Authority (2016). *NY State Unified Solar Permit*. Albany, NY. (Retrieved from https://www.solsmart.org/resources/new-york-state-unified-solar-permit/)
[31] American Planning Association (~2012). *Small Scale Solar Energy Systems*. Chicago, IL. (Retrieved from https://www.solsmart.org/media/small_scale_solar_energy_systems.pdf)
[32] Cox Automotive. (2019). *Evolution of Mobility: The Path to Electric Vehicle Adoption.* Atlanta, GA. Retrieved from Cox Automotive website: https://d2n8sg27e5659d.cloudfront.net/wp-content/uploads/2019/08/2019-COX-AUTOMOTIVE-EVOLUTION-OF-MOBILITY-THE-PATH-TO-ELECTRIC-VEHICLE-ADOPTION-STUDY.pdfhttps://chargehub.com/en/electric-car-charging-guide.html
[33] Charge Hub. (2019) 2019 Guide On How To Charge Your Electric Car With Charging Stations. Retrieved from Charge Hub website: https://chargehub.com/en/electric-car-charging-guide.html

Type of EV charger	Charging speed (Approximate)	Cost	Possible locations
Level 3: DC Fast Charger*	125 miles in 30 minutes	$15,000 - $100,000 +Installation costs[34]	• Commercial centers • Transit corridors

*Not all EVs are able to use Level 3 chargers.

Some level 2 and level 3 chargers include point of sale tools to allow the business or unit of government that owns the charger to recuperate costs. While there are multiple types of payment arrangements possible for publicly-available charging stations, to ensure efficient use, it is recommended that users of the charging station pay based on the time that they occupy the EVSE parking space and/or based on the amount of electricity used.

Municipalities can foster EV adoption by enabling residents and visitors to charge at home, at work, and while patronizing businesses or recreating. Table 13 introduces options that municipalities may leverage to increase EV use in their communities. The Drive Electric MN program also offers guidance on EVSE siting.[35]

Table 13: Strategies to catalyze EV adoption

Location	Charging availability	Options for municipalities
Home Charging – Single Family	Occupants of single-family homes may install level 2 chargers at their residences.	Use zoning and permitting processes to encourage or require the installation of electrical wiring needed to make new and remodeled homes EVSE-ready
Home Charging – Multifamily	Residents may not have access to outlets for level 1 charging and/or may not be allowed to install a level 2 charger.	Use incentives and/or zoning requirements to encourage owners of multifamily properties to install level 2 chargers for use by residents.
Work place	Employees may want to charge during the work day, but may not have access to a convenient public location	Conduct outreach to employers regarding the value of installing EVSE as a means of attracting and retaining employees.
Commercial Centers	Patrons may need to charge while completing errands	Engage managers of grocery stores, other shopping destinations, and hotels and demonstrate value of installing EVSE as a strategy to attract customers and encourage them to shop for the duration of time needed to charge their EV.
Public Facilities	Visitors to parks, libraries, and municipal centers may wish to charge during their stays.	Municipalities may install level 2 or 3 chargers for use by the public at facilities that it owns. Municipalities may also consider options for providing EVSE for use by their employees.

[34]US DOE Vehicle Technologies Office. (2015) Costs Associated With Non-Residential Electric Vehicle Supply Equipment. Retrieved from US DOE website: https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf

[35] Drive Electric MN. (2019) Charging Station Site Selection Guidelines. Retrieved from https://www.driveelectricmn.org/wp-content/uploads/2019/10/electric-vehicles-charging-site-selection.pdf

To advance EV charging in all types of locations, municipalities may collaborate with the electric utilities that serve their community. Collaboration opportunities may include educating residents and businesses on the benefits of owning an EV and sharing information on incentive programs and tax credits for purchasing EVs and/or EV charging infrastructure.

All of the electric utilities that serve the member communities offer optional residential time-of-use electric rates. EV owners who charge their vehicles during off-peak hours may be able to reduce their electric bills by converting to a time of use rate. Municipalities should consider partnering with their electric utilities to share information with residents about this opportunity.

To reduce cost barriers to installation and to conduct research on EV charging patterns, MG&E offers the Charge@Home program, as well as a parallel program for multifamily and business customers. Under the program, MG&E installs, owns, and maintains a Level 2 charger at the customer's home or business. The customer pays a monthly fee for the charger in addition to its regular electricity charges.

Municipalities may also support effective use of EVSE at commercial centers and public facilities by enforcing the appropriate use of EV parking spots and charging stations. The following strategies and tools were developed by other units of government and have been designed to promote EVSE installations:

- Direct installation of EVSE
  - Install publicly available EVSE in municipal parking lots (St. Louis Park, MN)
- Incorporate development of publicly available EVSE into the municipality's Climate Action Plan and Capital Improvement Plan (St. Louis Park, MN – page 14).[36]
- Zoning and Permitting
  - Building code standards requiring that new commercial construction and residential construction be built to be ready for development of EV infrastructure (Atlanta, GA)[37]
  - Zoning requirements for multifamily and commercial parking facilities that require EV charging facilities at lots with at least 50 spaces (Boca Raton, FL).[38]
  - Award points for inclusion of EVSE in review of proposed private-sector projects (Golden Valley, MN).[39]

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[36] Great Plains Institute, LHB, Orange Environmental (2018) *St. Louis Park Climate Action Plan 2040 Setting a course toward carbon neutrality.* Retrieved from City of St. Louis Park, MN website: https://www.stlouispark.org/home/showdocument?id=8214

[37] City of Atlanta. (2019). City of Atlanta Code of Ordinances. Retrieved from https://library.municode.com/ga/atlanta/codes/code_of_ordinances?nodeId=PTIIICOORANDECO_APXBELCOAM_CHIAD_S101TISC_101.9ELVECHINRERENERECO

[38] City of Boca Raton. (2017). City of Boca Raton, Florida Ordinance. Retrieved from https://www.myboca.us/DocumentCenter/View/10355/Ord-5420-PDF?bidId=

[39] City of Golden Valley. (2019). City of Golden Valley, Minnesota City Code. Retrieved from https://library.municode.com/mn/golden_valley/codes/code_of_ordinances?nodeId=PTIILADE_CH113ZO_ARTIIIZODI_DIV3PLUNDEOVDI_S113-123PLUNDE

- Summary of Best Practices in Electric Vehicle Ordinances (Great Plains Institute, on behalf of the National Renewable Energy Lab).[40]
- Streamlined EVSE permit application template. (Alternative Fuels Data Center).[41]

- Workplace Charging
    - Alignment with best practices for local governments in effectively catalyzing public EV adoption (Santa Clara, CA). Examples of signage for enforceable EV parking is included in Figure 14 and additional examples are provided in the footnoted link.[42]
    - Review of best practices for EVSE charging at workplaces (New York State Energy Research and Development Authority).[43]
    - Guide to workplace charging planning, installation, and operation (CALSTART).[44]

Figure 14: Examples of parking signs to place restrictions or time limits on charging spaces

[40] Cooke, C. and Ross, B. (2019) *Summary of Best Practices in Electric Vehicle Ordinances*. Retrieved from Great Plains Institute website: https://www.betterenergy.org/wp-content/uploads/2019/06/GPI_EV_Ordinance_Summary_web.pdf
[41] Department of Energy (2012). *Permit for Charging Equipment Installation Electric Vehicle Supply Equipment (EVSE).* Alternative Fuels Data Center. Retrieved from AFDC website: https://afdc.energy.gov/files/pdfs/EV_charging_template.pdf
[42] ICF. (2018). *Plug in Electric Vehicle Best Practices Compendium.* City of Santa Clara, California website: https://www.sccgov.org/sites/dnz/Documents/Task-1A-EV-Best-Practices-Compendium.pdfhttps://www.sccgov.org/sites/dnz/Documents/Task-1A-EV-Best-Practices-Compendium.pdf
[43] Energetics Incorporated (2015). *Workplace Electric Vehicle Charging Policies Best Practices Guide.* Retrieved from New York State Energy Research and Development Authority website: https://www.nyserda.ny.gov/Researchers-and-Policymakers/Electric-Vehicles/Resources/Best-Practice-Guides-for-Charging-Stations
[44] Tomic, J. and Pitkanen, W. (2013). *Best Practices for Workplace Charging.* Retrieved from CALSTART. Pasadena, CA website: https://calstart.org/template-reports-analyses-report-name-date-3/.

NEXT STEPS

This collaboration main report along with the community specific plans (provided in a separate document) provides details that will help municipalities reduce their overall energy consumption and carbon emissions. We identified opportunities across many aspects of municipal government and drew on technologies that are currently available to quickly move each of these communities closer to their goals of saving energy and reducing carbon emissions. Moving forward on these recommendations will position the seven communities as leaders in sustainable municipal operations.

The group of seven communities should continue to lean on each other for sharing experiences and lessons learned. In our last meeting, the group committed to checking in on a regular basis to provide updates and share ideas and inspiration. Moreover, there may be opportunities for future partnerships to seek funding to implement the measures identified in this plan. By working together, the communities may reach a scale and purchasing power that can benefit all, such as in bulk purchasing of equipment or contractor services.

Slipstream leaves this plan in the hands of each community to drive these opportunities forward. Recognizing that not everything can be done all at once in municipal operations, this plan provides a solid foundation upon which to prioritize the next steps in meeting each municipality's goals.