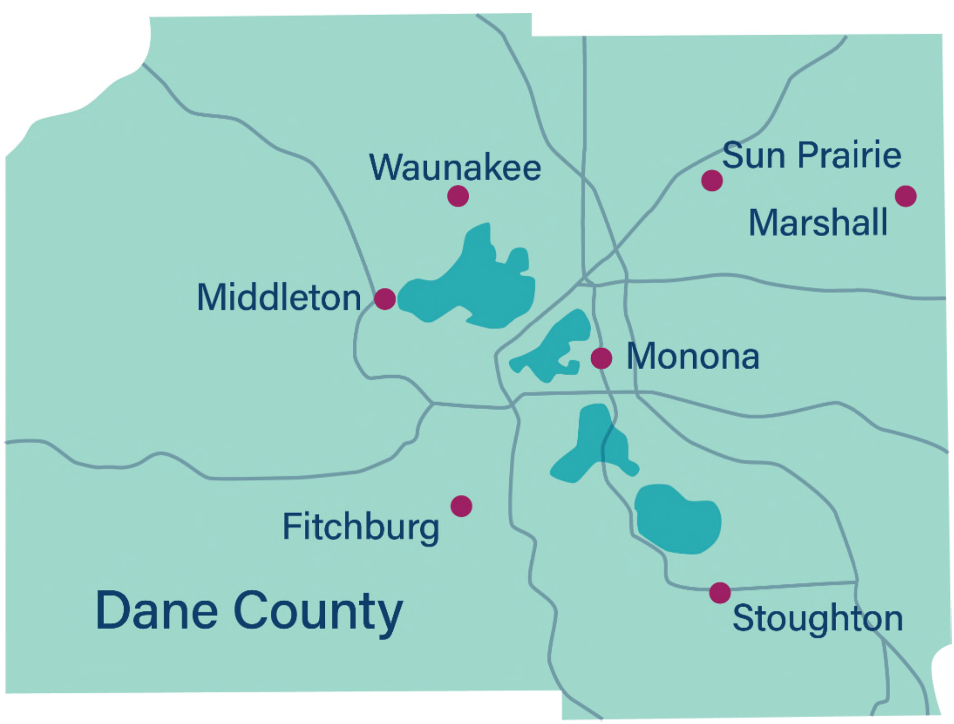
FEBRUARY, 2020

Municipal Energy Plan - Seven Community Collaboration

Community Specific Chapters



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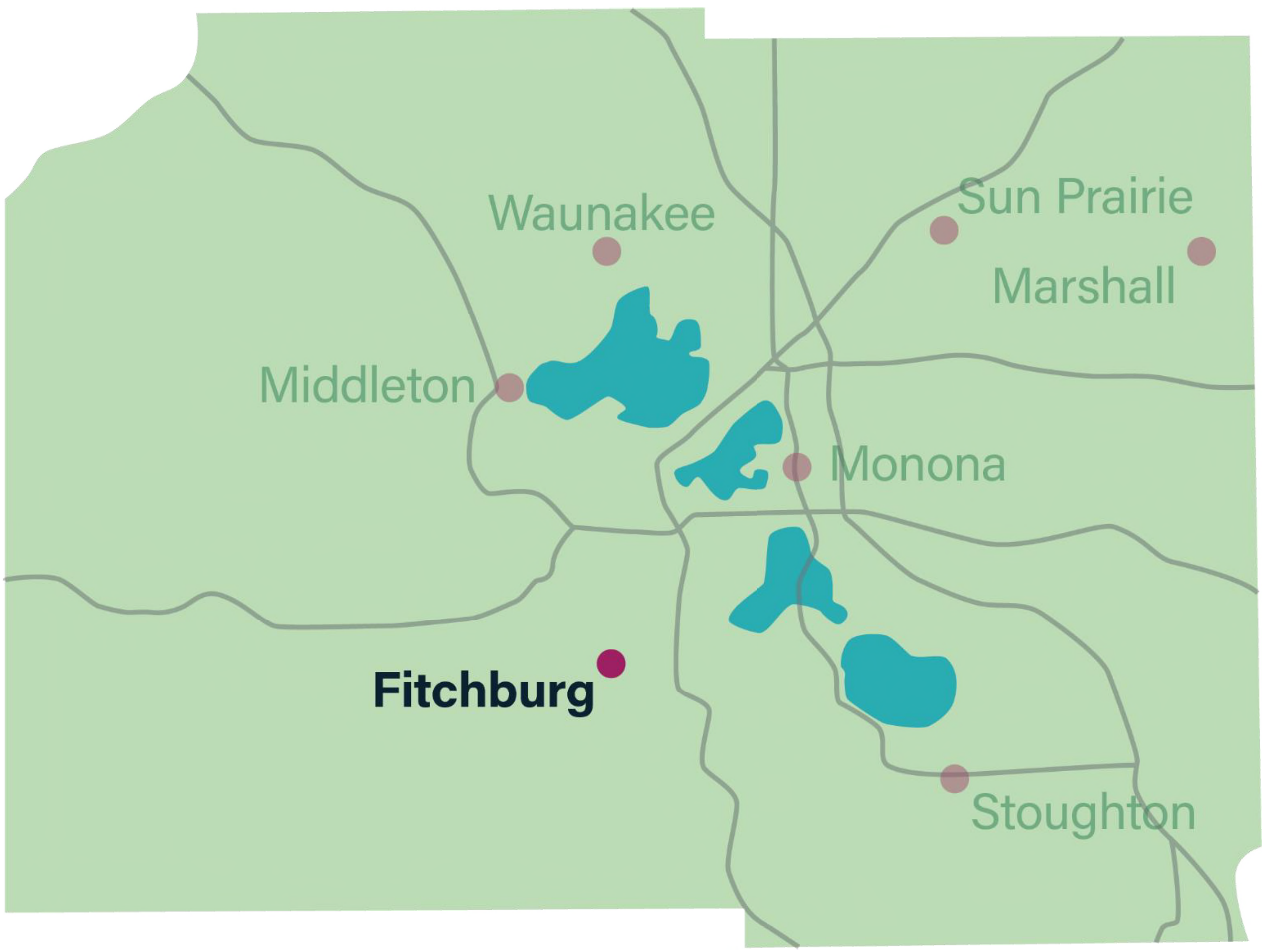
FITCHBURG
COMMUNITY-SPECIFIC MUNICIPAL ENERGY PLAN



Wisconsin Office of Energy Innovation Grant

FITCHBURG BACKGROUND

As one of the largest communities in this collaboration, by population and by geographic area, Fitchburg has seen considerable growth over the past two decades. The municipal operations include relatively new buildings with a good level of innovation. The recently constructed public library incorporated geothermal energy for its heating and cooling system. Fitchburg has invested in a significant amount of behind-the-meter solar for multiple city buildings. The City is part of the Energy Independent Communities, which is a voluntary agreement between the State of Wisconsin and communities that adopt the goal of generating 25 percent of their energy from renewable energy sources locally by 2025. The city council recently passed a resolution to reduce municipal-wide energy use by 30 percent and to reach 100 percent renewable electricity by 2030.

This chapter provides a detailed summary of the Fitchburg energy plan. We begin by summarizing Fitchburg's energy profile to provide a baseline understanding of current energy consumption, costs and carbon emissions for 2018. We then delve into our recommendations for near terms investments or action, split out into four categories: building energy efficiency, street lighting opportunities, fleet opportunities, and solar energy opportunities.

COMMUNITY ENERGY PROFILE

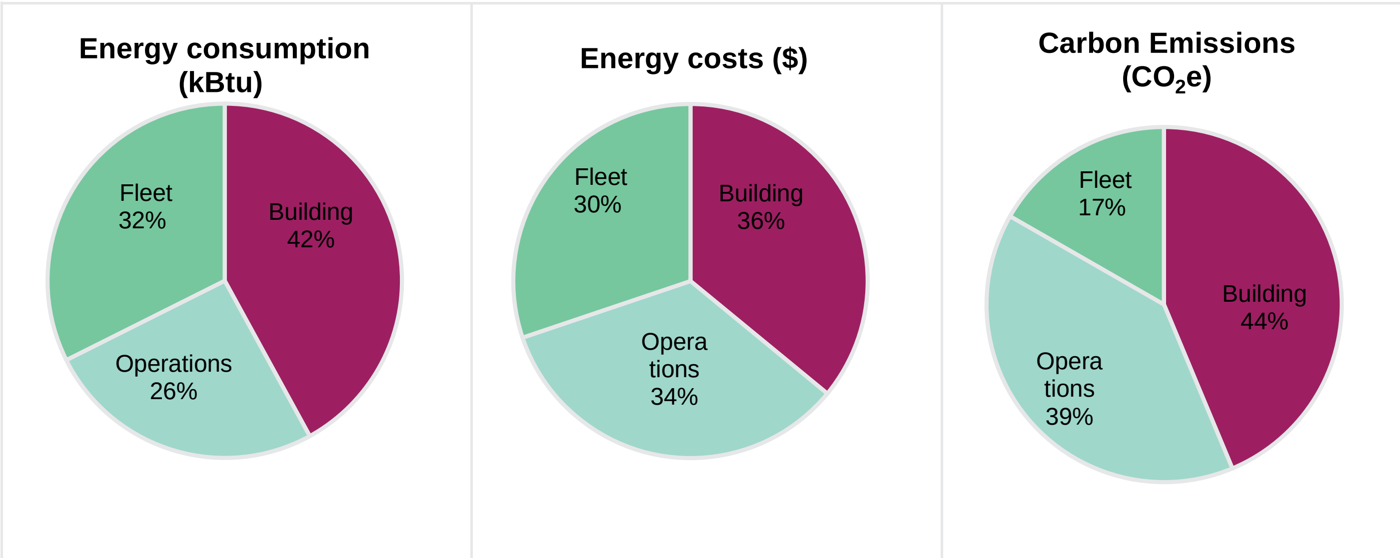
The three main energy inventory elements for Fitchburg's energy profile include buildings, operations, and municipal fleet. Table 1 provides details by category on what was included in development of the Fitchburg energy profile, based on the data provided by Fitchburg staff.

Table 1: Fitchburg inventory elements (2018 baseline)

Buildings	**Operations**	**Fleet**
City Hall	Non-street lighting	21 Police vehicles
Library	Other operation	6 Administration vehicles
Maintenance	Parks and Rec	16 Parks & Recreation vehicles
Safety Building/Firehouse	Public Works Garage	20 Public Works vehicles
Community Center	Street lights	11 Utility vehicles
New Fire Station	Well/pumps/lifts	16 Emergency vehicles
Police Processing		

Figure 1 illustrates the percent contribution of each source to total energy use, cost, and carbon emissions. The cost and carbon intensity of the different fuels (electricity, natural gas, gasoline, and diesel) can significantly impact the contribution of each source to the total.

Figure 1: Fitchburg energy consumption, cost and carbon emissions (2018)



Breaking these elements down further, Table 2 details the annual energy use, carbon emissions, and energy costs associated with each building and operation use type. The buildings are listed individually; if there were multiple meters per building, we aggregated the values up to the building level. If there were multiple meters for operation data, it was aggregated by use type such as non-street lighting and wells, pumps, and lifts. Fitchburg's City Hall, Fire Station, Library, and Public Works Garage host net-metered PV systems. The amount of electricity used by these buildings, as shown in Table 2, reflects the net electricity that Fitchburg purchased from the utility, with any reductions from solar panel production included as part of that amount. This energy profile excludes a very small amount of energy that the City purchases from Alliant Energy, estimated to be less than 3% of all energy consumed.

Table 2: Fitchburg baseline energy, CO2e and cost data by building and operation use type (2018)

	Use/building	Net Electricity (kWh)	Natural gas (therms)	Carbon emissions (CO_2e metric tons)	Percent of total CO2e	Energy cost
Buildings	City Hall	753,097	26,878	716	16%	$98,965
	Community Center	167,400	6,839	164	4%	$22,515
	Fire Station	167,829	6,122	160	3%	$22,135
	Library	809,193	274	618	13%	$89,175
	Maintenance	93,173	18,559	170	4%	$21,385
	Police Processing	32,080	484	27	1%	$3,820
	Safety Building	139,600	9,763	158	3%	$21,215
Operations	Non-street lighting	139,049	-	106	2%	$15,295
	Other operation	37,365	-	29	1%	$4,110
	Parks and Rec	58,840	1,772	54	1%	$7,535
	Public Works Garage	13,122	-	10	0.2%	$1,445
	Street lights	559,012	-	426	9%	$61,490
	Well/pumps/lifts	1,572,247	-	1,197	26%	$172,940
	Fleet			770	17%	$234,250
	Total	4,542,007	70,691	4,605		$776,275

Figure 2 illustrates how the baseline energy use intensity (EUI) of each Stoughton building compares to the ASHRAE 100-2018 target and benchmark value for similar use buildings. This comparison serves as a helpful benchmarking exercise, but it’s important to note that the ASHRAE values represent a typical building type and do not account for buildings that may house multiple city departments or functions.

Figure 2: Fitchburg EUI benchmarking and comparison to ASHRAE target and benchmark

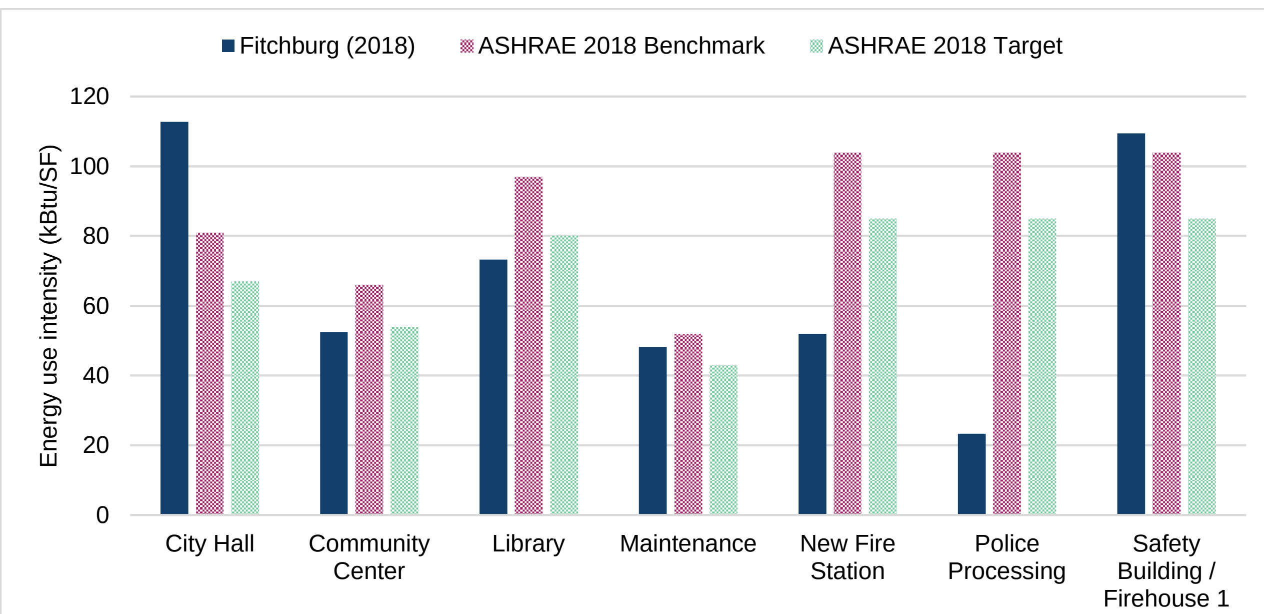


Table 3 illustrates the current renewable energy consumption in the City. On-site solar currently makes up around 9 percent of total electricity use in Fitchburg – leaving significant potential for future development. Currently, there are three 90 kW solar installations (one on the Library, one on the Storage Shed, and one on the new Fire Station), a 55.8 kW solar installation on City Hall, and a 9.9 kW array on the Maintenance Building. The PV array on the Maintenance Building exports the electricity that it produces to MG&E, which pays Fitchburg a set rate per kWh that the system produces. The array on the Maintenance building was installed in 2011 and the export agreement may expire ten years after the interconnection date. Fitchburg will need to review its agreement with MG&E to confirm the expiration date and determine how the City will use the array after the agreement expires. Fitchburg also purchases a portion of the electricity consumed at City Hall and its Public Works building through MG&E's Green Power Tomorrow tariff. Under this program, Fitchburg pays a premium per kWh that it purchases, and MG&E allocates a corresponding portion of the renewable energy that it produces or purchases to the Green Power Tomorrow program.

Table 3: Fitchburg renewable energy summary - current production (as of 2019)

RENEWABLE ENERGY QUICK FACTS	
On-site net metered solar (kWh)	412,673
On-site export-metered solar (kWh)	12,739
Green Power Tomorrow purchases (kWh)	20,826
Total renewable energy purchased/production (kWh)	446, 238
Percent of total gross electricity	**9.0%**

Table 4 illustrates the current vehicle fuel usage, carbon emissions, and fuel cost by department. The police department has the most significant energy footprint, driven largely by the need to idle to maintain car functions while not in motion and the high relative mileage. This significant use presents an excellent opportunity for conversion to hybrid vehicles as will be outlined below.

Table 4: Fitchburg vehicle fuel usage by department (2018)

Department	Number of vehicles	Gallons	CO_2 (metric tons)	Fuel cost
Police	21	32,188	274	$86,700
Public Works	20	20,410	201	$50,360
Emergency Vehicles	16	10,070	132	$42,470
Parks & Rec	16	10,896	101	$30,480
Utilities	11	5,347	55	$21,850
Administration	6	986	8	$2,390
Total	90	79,897	771	$234,250

FITCHBURG RECOMMENDATIONS FOR NEAR-TERM IMPLEMENTATION

Our analysis found energy investments that have a strong return on investment and significant energy savings potential. While the City has made commendable efforts on building-level efficiency, there are additional building upgrades, such as LED lighting retrofits and the implementation of HVAC controls, the City can still make. The upgrades are outlined in more detail below and can reduce municipal carbon emissions by as much as 5 percent. By converting all streetlights to LEDs, the City could cut annual streetlight electricity use in half – reducing utility costs and saving around 215 tons of CO_2e annually. In the fleet department, the City should prioritize converting police vehicles to hybrids as they offer a payback around one year and lead to a 45 percent decline in lifetime carbon emissions. Lastly, by adding solar arrays to 5 sites, the City can reduce total fossil fuel electricity consumption by an additional 7 percent.

Table 5 summarizes the estimated carbon and energy cost savings that Fitchburg would see if they implemented the recommended near-term actions in each major opportunity area and the following sections provide additional detail on each opportunity.

Table 5: Fitchburg impact summary – estimated annual carbon and energy cost savings

Near-term Opportunity	CO_2e Reduction (metric tons)	Percent Carbon Reduction	Energy Cost Savings	Percent Energy Cost Reduction
Building efficiency	213	10%	$30,585	11%
Streetlights	217	51%	$31,350	51%
Fleet	130	17%	$43,605	19%
Solar	235	-	$33,900	-
Total opportunity	795	17%	$139,440	18%

Energy efficiency opportunities

Our analysis focused on near-term measures that not only have an energy or cost savings, but also may reduce maintenance costs, improve occupant comfort, or increase staff productivity. We also considered the ease and cost of implementation when prioritizing our recommendations.

To identify these opportunities, we conducted high-level walk-throughs for two buildings: the Fitchburg City Hall and Community/Senior Center. We took note of major end-uses and process and spoke with building staff to understand building operations. The following provides a walk-through summary for each building with additional detail on energy savings potential below.

Fitchburg City Hall

The City Hall was built in 1989 and houses municipal operations, police department, and TV station.

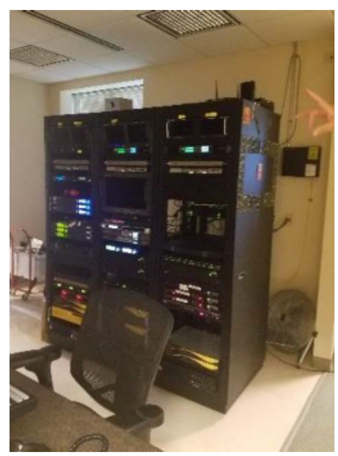
Observations:

- Most lighting is fluorescent or metal halide, can lights have been retrofitted with LEDs.
- There is difficulty cooling the TV Station data server.
- The main hallway is relatively dark.
- Police garage lights are always on.
- Lighting in open offices tend to burn out.
- Boiler plant is completely off in the summer.
- There are some cold spots in open office areas in the summer.

Recommendations:

LED retrofit: Upgrade metal halide and fluorescent lamps to LEDs. Fitchburg's facilities staff had concerns about how occupants may react to the look of LED lamps. One way to address that would be to test different LED fixtures and conduct an occupant survey on how it looks. Sun Prairie has done a similar test at their City Hall. It's also an opportunity to correct lighting levels in the main hallway. LED lights also have longer service than fluorescent lamps.

Lighting controls: When upgrading to LED, consider adding occupancy controls in various rooms, particularly for small rooms. Large meeting rooms with multiple occupancy sensors would work as well. Consider integrated light fixtures, complete with occupancy sensors and photosensors. Garage lights should have occupancy sensors or integrated fixtures as well.



TV station lighting and equipment: Consider upgrading all TV lighting to LEDs for large savings. Electronic Theatre Controls, the lighting contractor for Fitchburg's TV station, can provide more information on the potential savings from upgrading to LEDs. Consider moving the AV data server into a smaller room with a dedicated split system. Servers require 24/7 cooling and should be placed away from exterior windows that can cause large heat fluctuations.

Boiler hot water: A previous energy audit recommended turning off the boiler plant in the summer to save energy, which saves about $5,000 a year. However, the building air system was designed to reheat during the summer to temper the air, which has led to occupant cold calls. A possible reason for using so much heating energy is that the two installed boilers can't modulate to low enough heating level. There are two recommendations: (1) implement hot water temperature reset to lower hot water temperature in the summer and (2) install small, full condensing boiler to operate in the summer.

Fitchburg Community Center

The Fitchburg Community Center was built in the 1980's. It is connected to the City Hall and was expanded in 2009.

Observations:

- LED lights have been installed in senior center and some other spaces.
- Boilers upgraded in 2008. Not many occupant complaints regarding heating, ventilation, and air conditioning (HVAC) system since then.

Recommendations:

LED retrofit and lighting controls: Complete upgrade to LED. Consider vacancy sensors for small rooms and occupancy and daylighting sensors for some of the conference and meeting rooms. Consider light fixtures that can be purchased with integrated occupancy controls and photosensors.

HVAC controls: Check if there are simple control sequences that can implement through the BAS to save energy. Refer to the supply air temperature reset and demand-controlled ventilation (DCV) strategies outlined in the main report.

Energy Saving Potential

For each measure identified, we calculated the total savings and payback. Calculations were based on a combination of resources, including the Wisconsin Technical Reference Manual, the International Energy Conservation Code, and internal research and expertise. References and assumptions for energy saving calculations and cost data are in Appendix E. For more complicated measures, we developed simple energy models to quantify levels of impact. For details and definitions on the measures, please refer to the Main Report of the energy plan that has descriptions of the measures.

Table 6 provides detail on the energy efficiency opportunities for each building and includes energy costs savings and simple payback. Measures are organized by simple payback to identify measures that will recover capital costs quickly. As Table 6 shows, LED lighting are estimated to have the most significant savings. While the measures are listed below separately, we recommend that lighting controls be implemented with LED upgrades to reduce total upfront costs. The savings listed below for controls are based on a building already upgraded to LEDs and the incremental costs below assume that the controls and LED upgrades are completed at the same time. Controls implemented on their own would have a higher upfront cost. The next two measures with a large energy saving potential are the air handling unit (AHU) temperature reset and hot water temperature reset. We did not model adding a summer boiler to City Hall, but expect that installing a boiler will *increase* the building's energy consumption compared to current operation, although will likely result in greater staff comfort and would use less energy than the last energy audit determined was used for boiler heat in the summer.

Table 6: Energy saving measures for Fitchburg walk-through buildings

Building	Cost	Electric savings (kWh)	Gas savings (therms)[1]	Total energy savings	Cost savings	Simple payback (years)
City Hall						
HVAC AHU reset	$290	5,540	600	1.6%	$970	0.3
Lighting controls - daylighting	$130	3,800	-80	0.1%	$370	0.3
Lighting controls - occupancy	$320	8,950	-200	0.2%	$860	0.4
Lighting controls - garage	$170	4,070	-90	0.1%	$390	0.4
HVAC boiler reset	$1,220	0	2,060	4.1%	$1,240	1.0
LED lighting - task tuning	$950	5,660	-130	0.1%	$550	1.7
DCV - assembly space	$1,820	1,840	980	2.0%	$790	2.3
LED lighting retrofit - interior	$22,000	83,680	-1,870	2.0%	$8,090	2.7
DCV - office space	$2,580	1,240	620	1.3%	$510	5.1
City Hall Total	**$29,480**	**114,800**	**1,890**	**11.5%**	**$13,760**	
Community Center						
Lighting controls - daylighting	$80	2,370	-50	0.2%	$230	0.3
Lighting controls - occupancy	$200	5,580	-120	0.5%	$540	0.4
HVAC AHU reset	$190	2,840	310	3.1%	$500	0.4
LED lighting - task tuning	$490	3,530	-80	0.3%	$340	1.4
LED lighting retrofit - interior	$10,060	31,700	-710	2.9%	$3,060	3.3
DCV - assembly space	$1,490	1,000	530	4.3%	$430	3.5
HVAC boiler reset	$1,220	0	570	4.4%	$340	3.6
DCV - office space	$260	80	40	0.3%	$30	7.6
Community Center Total	**$13,990**	**47,100**	**480**	**16.1%**	**$5,470**	
Grand Total	**$43,470**	**161,900**	**2,370**		**$19,230**	

Finally, while we did not visit every building in Fitchburg's municipal operations, we did see similar building types in the other communities' walk-throughs. For those buildings for which we were unable to conduct walk-throughs, we asked community representatives to provide some details on particular end-uses in each building. By using that feedback and leveraging information gathered during other communities' site visits, we were able to estimate savings for the other Fitchburg buildings. These savings are summarized in Table 7. However, these results are not based on a site walk-through and should be confirmed based on further review of building equipment and conditions.

Table 7: Energy saving measures for Fitchburg – non-site walk-through buildings

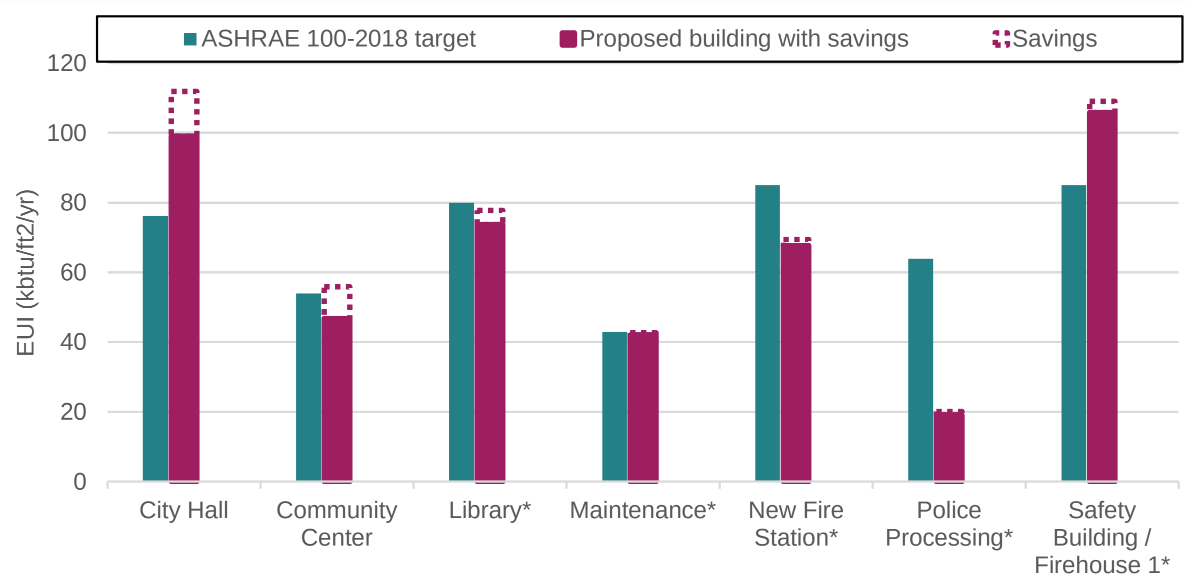
Building	Cost	Electric savings (kWh)	Gas savings (therms)	Total energy savings	Cost savings	Simple payback (years)
Library						
HVAC AHU reset	$100	19,380	0	2.2%	$2,130	0.0
LED lighting retrofit - interior	$7,930	25,000	0	2.9%	$2,750	2.9
Library Total	**$8,030**	**44,380**	**0**	**5.1%**	**$4,880**	
Maintenance						
Lighting controls - daylighting	$50	1,560	-30	0.1%	$150	0.3
Lighting controls - garage	$290	7,000	-160	0.5%	$680	0.4
LED lighting - task tuning	$1,420	4,000	-90	0.3%	$390	3.7
LED lighting retrofit - interior	$4,380	10,350	-230	0.7%	$1,000	4.4
Maintenance Total	**$6,140**	**22,910**	**-510**	**1.6%**	**$2,210**	

[1] Negative values reflect an increase in heating demand due to interactive effects – in all cases, total savings is still positive.

Building	Cost	Electric savings (kWh)	Gas savings (therms)	Total energy savings	Cost savings	Simple payback (years)
New Fire Station						
HVAC AHU reset	$190	2,690	290	2.5%	$470	0.4
Police Processing						
LED lighting retrofit - interior	$1,850	5,730	-130	5.2%	$550	3.3
Safety Building / Firehouse 1						
Lighting controls - occupancy	$30	920	-20	0.1%	$90	0.4
Lighting controls - garage	$230	5,480	-120	0.5%	$530	0.4
LED lighting - task tuning	$70	420	-10	0.0%	$40	1.8
LED lighting retrofit - interior	$5,920	26,580	-590	2.4%	$2,570	2.3
Safety Building / Firehouse 1 Total	**$6,250**	**33,400**	**-740**	**3.0%**	**$3,230**	
Grand Total	**$22,460**	**109,120**	**-1,090**		**$11,350**	

Figure 3 shows the EUI of each building if all energy efficiency measures are implemented along with an ASHRAE Standard 100-2018 benchmark value for comparison. The figure shows that the energy measures outlined for the City Hall and Community Center help bring them much closer to the ASHRAE 100 benchmark values for their respective building types.[2] The Fitchburg Library is a newer building and already meets the target EUI, but some improvements could still be made. We expect that the other buildings would see small energy reductions, but we conservatively estimated energy savings as we did not conduct a walk-through for these buildings.

Figure 3: Fitchburg building EUI savings



* denotes buildings for which a walk-through was not performed. See accompanying text above for additional detail

[2] For buildings with multiple functions, we used a blended target EUI to account for the different use types within the building.

Street Lighting Opportunities

Converting streetlights to LEDs has a large energy saving potential. In addition to reduced energy use annually, LEDs also last longer and thus reduce lifetime maintenance costs. The lights can also improve lighting quality, improve perception of safety, and reduce light pollution.

Table 8 illustrates the lifetime energy savings, carbon savings and cost savings associated with converting one high-pressure sodium fixture to a LED fixture. This standard lifetime analysis assumes that streetlights are owned by the municipality and serves to illustrate potential savings from a conversion. The upfront cost in Table 8, which includes both labor cost and material cost, is estimated from conversations with city officials who have implemented LED retrofits in the last few years. The Wisconsin Technical Resource Manual estimates the cost per fixture to be slightly higher. However, as LED costs are rapidly decreasing, we opted to use cost estimates from recent installations in an attempt to accurately represent current costs. The cost savings reported represent avoided maintenance costs and avoided energy costs. Table 8 illustrates that the higher the wattage of the fixture, the more economically beneficial it becomes to convert the fixture to a LED. Appendix B provides more details on the assumptions made for these calculations.

Table 8: LED lifetime cost analysis – cost per fixture

Lighting type	Lifetime energy savings (kWh)	Lifetime CO_2e savings (metric tons)	Upfront cost	Lifetime cost savings	Payback period (years)
70 W	3,430	2.6	$249	$275	6.8
100 W	7,750	5.9	$249	$670	3.9
150 W	9,480	7.2	$299	$800	3.6
250 W	16,070	12.2	$399	$1,315	3.3
400 W	23,800	18.1	$499	$1,930	3

Table 9 illustrates the potential electricity, carbon, and energy cost savings from converting all streetlights to LEDs. Based on the wattage of current streetlights, we calculated the energy use from LED-equivalent bulbs and subtracted this from 2018 streetlight electricity usage. Using this energy savings value, we applied a standard carbon factor and electricity rate to estimate the carbon and cost savings.

As a note, the cost savings reported below represent potential energy cost savings, assuming a standard kWh charge for electricity usage. However, almost all of Fitchburg's fixtures are owned by MGE or Alliant and the city is under a payment arrangement with the utility for the use of those fixtures in the City. Thus, the exact costs savings for upgrading those fixtures owned by MGE or Alliant may ultimately be different based on the rate structure. Our analysis did not attempt to replicate the payment structures under those agreements. Rather, this analysis can serve as the basis of conversations with MGE or Alliant about how to structure the LED rates in order to yield similar cost savings for the City.

Table 9: Fitchburg streetlights - annual savings

STREETLIGHT ANNUAL SAVINGS	
Number of lights	1,016
Energy savings (kWh)	285,000
CO_2e savings (metric tons)	217
Energy cost savings	$31,350

Fleet Opportunities

The market for alternative fuel vehicles is rapidly developing. In the next five years, several new options will exist for municipal fleets, but at this point, the largest two opportunities are police and light-duty vehicles. A few niche alternatives exist for other vehicle types, but each of them has a substantial incremental upfront cost – making them less of a viable option. Based on conversations with the collaborating communities, we left these high incremental cost options out of our final recommendations, but our completed analysis can be found in the main report.

Table 10 illustrates the payback period for police vehicles and light-duty vehicles, assuming 14,000 miles driven for police vehicles and 3,500 miles driven for light-duty vehicles. As the numbers illustrate, hybrid police vehicles present a great opportunity for conversion – with a payback period around one year and a lifetime carbon reduction of between 35 and 50 percent. Although light-duty vehicles have negative lifetime savings, increasing the miles driven per vehicle would greatly improve these numbers. Once a vehicle hits around 10,000 to 15,000 miles driven a year, the cost of an electric car breaks even with a conventional car. For more details on the lifetime cost calculations, see Appendix C.

Table 10: Fitchburg lifetime cost analysis - relevant alternative fleet vehicles

		Vehicle Lifetime	Incremental vehicle cost	Annual cost savings	Lifetime savings	Payback period	Lifetime CO_2e reduction
Police	Hybrid patrol SUV	8	$3,500	$1,640	$10,200	**1.2**	41%
Police	Hybrid patrol sedan	8	$3,500	$2,170	$14,560	**1**	55%
Police	Electric motorcycle	8	$390	$825	$8,600	**<1**	35%
Light duty	Passenger vehicle	15	$8,600	$350	-$3,700	-	43%
Light duty	Plug-in hybrid SUV	15	$10,000	$215	-$7,000	-	35%
Light duty	Plug-in hybrid van	15	$9,000	$240	-$5,650	-	35%

Table 11 illustrates the savings from converting all light-duty and police vehicles in the Fitchburg municipal fleet. The three departments have at least one vehicle that can be converted. The transition to hybrid police vehicles leads to the largest benefit – around a 45 percent reduction in both carbon emissions and fuel costs.

Table 11: Fitchburg annual potential fuel savings - adoption of light-duty and police vehicles

		CO_2e (metric tons)		Fuel cost	
Department	Number of vehicles	Current	Alternative	Current	Alternative
Police	20	274	152	$86,700	$47,465
Administration	4	8	7.6	$2,390	$1,655
Parks & Recreation	2	101	93	$30,480	$26,845

Solar Energy Opportunities

The solar energy analysis included an in-depth look at five different sites in the city of Fitchburg. The arrays on the Fire Station, Community Building, and Well 5 are roof panels while Well 10 and Well 11 had ample land available and are therefore ground-mounted arrays. Ground-mounted solar arrays offer a high degree of visibility for the project within the community. Visibility of the system enables the City to effectively lead by example in its transition to renewable energy. At the same time, system visibility of a ground-mounted array also may affect the neighbors of the site and the community by creating a visual change and affecting potential current and future use of the site. Fitchburg may seek to engage the owners of the neighboring properties during the project development process in order to identify any concerns and build support for the project.

Table 12 summarizes the electricity potential of each array. The recommended PV system size for each location considers the site's current electric consumption and the size and configuration of an array that each site could support. MG&E currently allows for advantageous net metering of distributed solar PV arrays if the overall system capacity does not exceed 100 kW AC. All recommended systems are sized below the 100-kW threshold. If Fitchburg proceeds with installing arrays at one, or more, of the sites identified, the City's selected solar installation contractor will need to conduct a detailed analysis of the site and recommend a system configuration per the contractor's professional expertise. By adding these solar arrays, an additional 7 percent of the City's electricity use could be offset, bringing renewables above 16 percent of the City's total electricity use in 2018. Appendix F provides more detail on each array.

Table 12: Fitchburg summary of solar potential by site

Site Name	Address	Annual consumption (2018, kWh)	Potential PV capacity (kW DC)	Estimated production (kWh)	Savings
Community Building	5510 Lacy Rd	167,400	37.2	46,131	28%
Fire Station	5791 Lacy Rd	139,600	65.1	92,315	66%
Well #5	6042 McKee Rd	584,164	23.3	31,501	5%
Well #10	2689 Granite Cir	249,014	66.9	94,532	38%
Well #11	5212 Lacy Rd	284,557	31.0	43,728	15%
Total		**1,140,178**	**223.5**	**308,207**	**27%**

Table 13 provides a summary of estimated costs of the recommended PV arrays. The estimated cost for the systems of $1,818 per kW is based on current data for the Dane County market for commercial PV installations. A seven percent premium was added to the cost of the installation on the Community

Building to reflect installation challenges that may be encountered due to the complexity of the building's roof. Since the cost estimates reflect market data, exact costs may vary by solar contractor.

Focus on Energy offers rebates for commercial-scale solar installations through a competitive request for proposal under its Renewable Energy Competitive Incentive Program (RECIP). The RECIP grants, which are not guaranteed, typically provide rebates that cover between 10 percent and 40 percent of the system cost. This analysis conservatively assumes a 15 percent rebate amount.

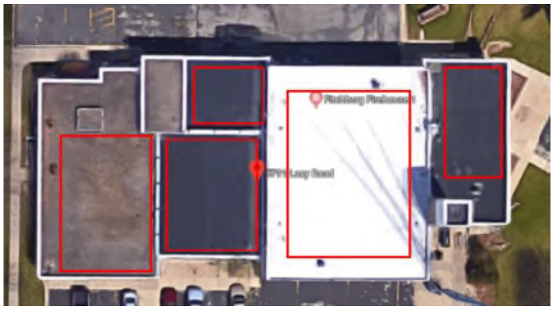
Table 13: Estimated cost of recommended Fitchburg PV arrays

Site Name	Total cost	Focus on Energy rebate	Net cost
Community Building	$72,575	$10,886	$61,689
Fire Station	$127,005	$19,051	$107,954
Well #5	$45,359	$6,804	$38,555
Well #10	$130,634	$19,595	$111,039
Well #11	$60,479	$9,072	$51,407
Total	**$436,052**	**$65,408**	**$370,644**

Table 14 provides a summary description of the array at each site as well as an aerial view of the arrays. The red outlines represent where the arrays would sit.

Table 14: Fitchburg description of potential PV arrays

Description of site	Aerial views with potential PV mounting
The **Community Building** offers four areas that may be able to house solar panels. The array is oriented based on the layout of the roof and avoids existing roof penetrations and oriented roof segments that are less desirable for solar gain. The analysis assumes flush-mounted racking for all four sections. City staff noted that the design of the solar array at the neighboring City Hall was impacted by design restrictions for the area. Fitchburg may review zoning and other requirements in order to determine what restrictions may exist on the design of the array.	

Description of site	Aerial views with potential PV mounting
The **Fire Station** has a flat roof, with minimal penetrations and equipment. An array could be configured in five segments. Panel efficiency can be enhanced by racking the panels with a south-facing 20-degree tilt in order to maximize insolation potential and available space. Panel rows may be spaced to allow for a 0.3 ground coverage ratio (GCR).	
Well #5 is a high user of electricity, representing approximately 11 percent of the City's total consumption. The well is housed in a small building that has a roof with few penetrations and there is minimal open space surrounding the building. The size of the roof and lack of space for a ground mounted system prevent installation of an array that would provide the majority of the facility's energy consumption. A modest array could be configured in three segments. Panel efficiency can be enhanced by racking the panels with a south-facing 20-degree tilt in order to maximize insolation potential and available space. Panel rows may be spaced to allow for a 0.3 GCR.	
The building that houses **Well #10** is too small to support a solar array that would generate a meaningful amount of electricity for the facility. However, the property where the well is located features considerable unobstructed open space that could be used for a ground-mounted solar array.	

Description of site	Aerial views with potential PV mounting
Well #11 is a high user of electricity, representing approximately nine percent of the City's total consumption. There is open space to the north of the building, where a PV array could be sited. The size of the roof and limitations on space for a ground mounted system prevent installation of an array that would provide the majority of the facility's energy consumption; however, a PV system at this location can support the City's progress toward its municipal renewable energy goals.