25 x 25 Plan for Energy Independence

City of Ashland

October 2018

Center for Rural Communities
NORTHLAND COLLEGE

Acknowledgments

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Authors[1]

Brandon Hofstedt, Faculty Director of the Center for Rural Communities, Associate Professor of Sustainable Community Development

Scott Grinnell, Professor of Physics, Director of Sustainability Initiatives, and Faculty Research Associate at the Center for Rural Communities

Laura Loucks, Research Assistant at the Center for Rural Communities, Sustainability Intern at the City of Ashland

Report prepared by:

Center for Rural Communities

NORTHLAND COLLEGE

1All authors contributed equally to the development and completion of this report.

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Executive Summary

The Center for Rural Communities (CRC) at Northland College worked with the City of Ashland to assess its energy usage and update the City's 2009 25 x 25 Plan for Energy Independence. The following report summarizes the energy usage of its buildings (electricity and natural gas) and fuel usage (gasoline and diesel) by the City's vehicle fleet, and provides recommendations for achieving twenty-five percent of the City's total energy usage through renewable sources by 2025.

Key findings

- Since the early 2000s, the City of Ashland has demonstrated an interest and commitment to environmental sustainability and stewardship in a variety of ways: adopting a resolution to become an Eco-Municipality; committing to become a Green Tier Legacy Community, SolSmart Advisor Host Community, and an Energy Independent Community; and adopting a comprehensive plan that clearly embraces the values associated with sustainability.

The City could achieve its goal of acquiring 25 percent of its total energy from renewable sources by installing or purchasing subscriptions to 1,140 kilowatts of solar modules.

Key findings

- Over the last two years, overall electricity and fleet fuel usage remained flat seeing no noticeable increase in consumption. Over the same period, natural gas usage increased slightly continuing an upward trend in consumption since 2011.

- City facilities staff who oversee the maintenance and operation of city-owned buildings are generally well-informed, and actively pursuing basic energy-saving strategies (e.g., replacing lights, upgrading HVAC systems, and installing motion sensors) when they are able and as older products or systems need replacing. Biggest hurdles to the timely replacement of these older systems or products are staff time to implement changes and money required to purchase new products.

- Over the last year, the City of Ashland used 1,831,462 kilowatt hours (kWh) of electricity, 82,180 therms of natural gas (which is equivalent to 2,408,531 kWh), and 44,624 gallons of gasoline and diesel for the City's vehicle fleet (which equals roughly 1,558,875 kWh)[2]. The sum of these three forms of energy is approximately equal to 5,800,000 kWh per year. Without additional conservation measures (e.g., increased building insulation, improved energy efficiency practices and equipment, and occupant education), the City of Ashland would require 1,450,000 kWh of electricity through renewable sources (such as solar) to reach its goal of achieving 25 percent of its overall energy usage from renewables.

- The City could achieve its goal of acquiring 25 percent of its total energy (including electricity, natural gas, gasoline, and diesel) from renewable sources by installing or purchasing subscriptions to 1,140 kilowatts of solar modules. If accomplished solely through subscriptions, such as the Xcel Solar*Community Connect program, it would cost approximately $1.8 million; if through city-owned solar modules, it would cost approximately $2.9 million, (using a bulk-rate installation cost of $2.50/watt). It should be noted that the needs of the City (1.14 MW) exceeds Xcel's current offering through the Solar*Community Connect program (a total of 1.0 MW).

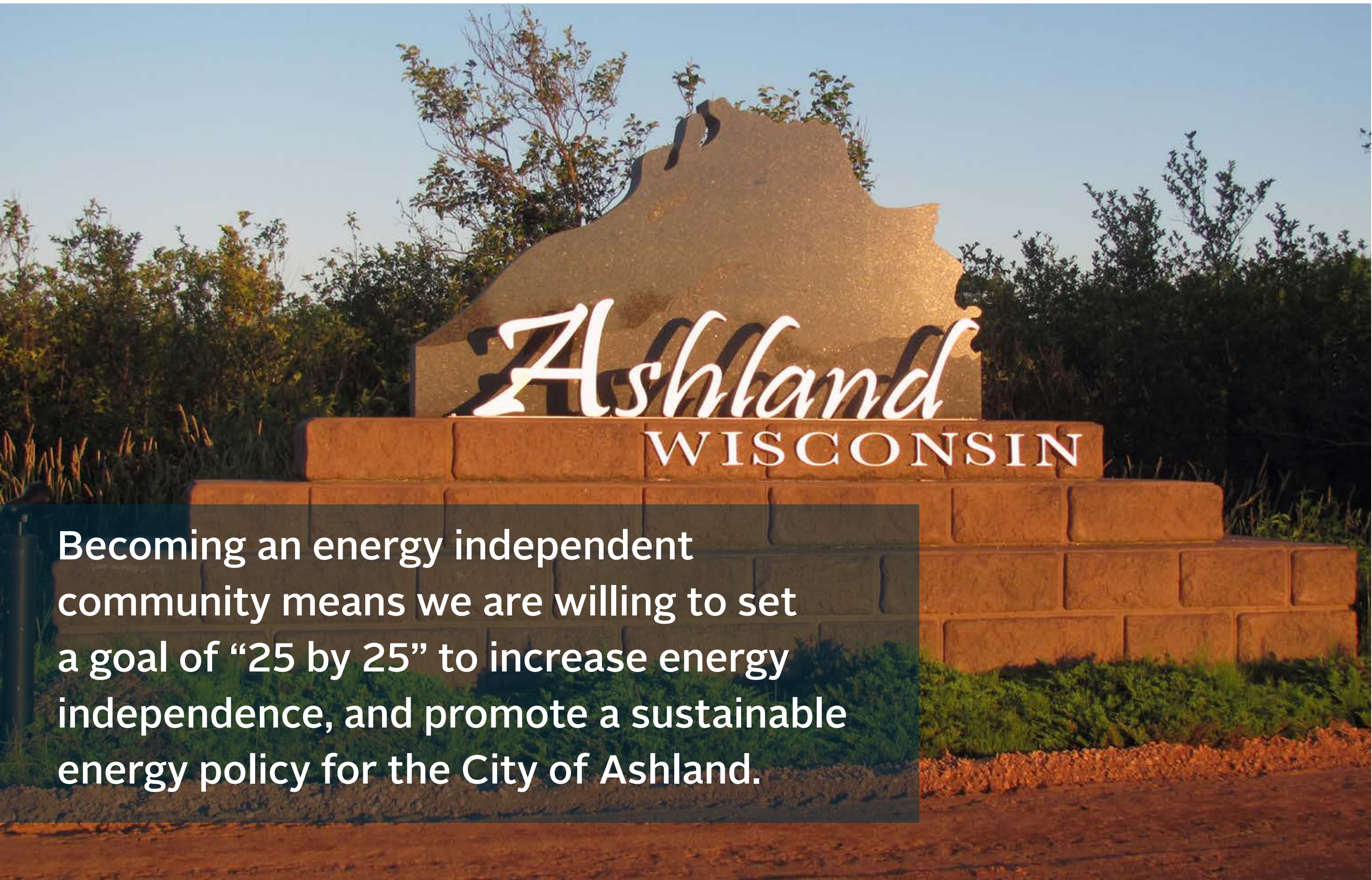
- The City should consider additional energy efficiency improvements of its buildings including additional insulation, better windows, high-efficiency HVAC systems, lower-energy lighting systems, energy efficient office equipment and appliances, and other energy saving measures and policies to help lower its overall energy usage. For example, if the City were to achieve 10 percent reduction in energy consumption through these measures, it would save over $50,000 on an annual basis, and reduce the expense associated with attaining its renewable energy goal by up to $200,000.

[2]We converted therms to kWh by multiplying the number of therms by 29.308. We converted fleet fuel to kWh by estimating the proportion of overall gallons used for gasoline and diesel. Our estimates assume that roughly two-thirds of the total gallons of fuel were from gasoline and the remaining one-third for diesel. We then converted these proportions to kWh through the following formula – 2/3 x 44,624 gal x 29.308kWh/0.877gal = 994,177 kWh; 1/3 x 44,624 gal x 29.308kWh/0.772gal = 564,698 kWh; Total = 1,558,875 kWh.

Introduction

In 2005, the City of Ashland became one of the first communities in the country to pass a resolution to become an Eco-municipality. Later, Ashland became a Green Tier Legacy Community, SolSmart Advisor Host Community, and an Energy Independent Community. The values and principles associated with each label are part of the City's image and demonstrate its commitment to protecting and respecting the natural environment of the Chequamegon Bay region. Most recently, the City's updated comprehensive plan, Authentic Ashland: A Comprehensive Plan for the City of Ashland 2015-2035, clearly embraces the values environmental sustainability and stewardship.

Similarly, these same values show up in this report, which is an energy independence assessment of the City of Ashland's electricity, natural gas, and vehicle fuel usage. In this report, we examine energy usage trends and provide recommendations for how the City of Ashland can move closer to becoming an energy independent community. Specifically, we explore ways the City can obtain twenty-five percent of its energy usage through investing in alternative energy sources (e.g., solar photovoltaic), reducing energy usage and increasing energy efficiency of high consuming building, and upgrading part of its fleet to electric or hybrid vehicles.



Becoming an energy independent community means we are willing to set a goal of "25 by 25" to increase energy independence, and promote a sustainable energy policy for the City of Ashland.

Methodology

This report relies on a variety of sources to assess energy usage and to provide recommendations for becoming an energy independent community. First, we utilize available records for electricity consumption (kWh, dollars) and natural gas (therms, dollars) provided by Xcel Energy for 36 properties from April 2011 to March 2018. For the seven highest consuming properties, we conducted walk through energy audits to supplement energy usage data. We also consulted knowledgeable City and Xcel employees regarding questions of energy usage patterns, buildings, and policies.

Finally, as part of the 2009 energy assessment report completed for the Chequamegon Bay area communities, one of the main suggestions was to improve tracking and monitoring systems for City-owned fleet data. The City of Ashland has been tracking fleet fuel (gallons) and cost (dollars) for thirteen departments and divisions since 2011. We utilize this information for assessment of City fleet data.

Table 1. Department Tracking Fleet Fuel Usage

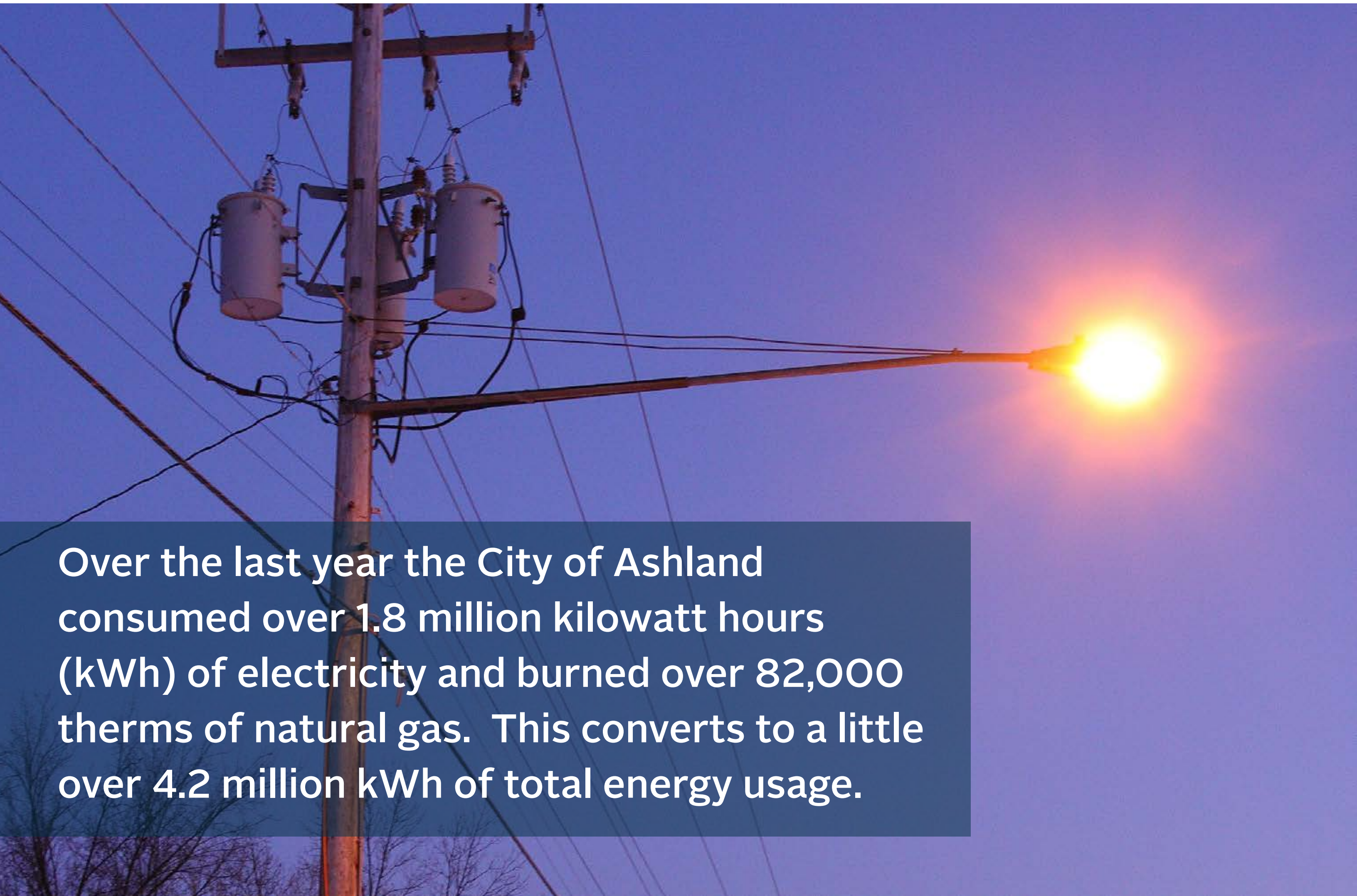
DEPARTMENT OR DIVISION
Ashland Housing Authority
Ashland County Aging Unit
Bay Area Rural Transit
Bay Area Rural Transit
Ashland Ambulance
Ashland Police Department
Department of Public Works
Engineering Division
Parks Department
Animal Warden
Facilities Maintenance
City Hall and Library
Water and Wastewater Utilities

Table 2. City Owned Properties

ID	NAME	ADDRESS
303417099	Sm Gen Svc	211 6th St W
302190096	Airport Maintenance Building	50511 St Hwy 112
302335868	Kreher Park Restroom	310 Prentice Ave N
302347645	Hodgkin's Park South	1222 7th St E
302449200	Prentice Park Camp	515 Turner Rd
302552596	Little League Park	700 14th Ave W
302562103	Sm Gen Svc	423 6th St W
302562242	East End Skate Rink	1612 5th St E
302644433	Hangar	50511 St Hwy 112
302982746	Bandshell	131 Lake Shore Dr W
302984816	Vaughn Library	502 Main St W
302991848	Terminal Building	50511 St Hwy 112
303093843	Penn Park	901 7th Ave E
303105193	Cold Storage Building	2020 6th St E
303112466	Bretting Rec Center	400 4th Ave W
303197007	Maslowski Beach Restroom	3215 Lake Shore Dr W
303307401	Hodgkin's Park Lights	1200 7th St E
303335742	Prentice Park Restrooms	517 Turner Road
303389302	Kreher RV Park	310 Prentice Ave N
303494786	Maslowski Beach Pavilion	3225 Lake Shore Dr W
303518678	Penn Park Restrooms	922 Willis Ave
303580956	Public Works Building	2020 6th St E
303590846	City Hall	601 Main St W
303603030	Bayview Park Restroom	1809 Lake Shore Dr E
303705559	Marina	300 Ellis Ave N
303820841	Hodgkin Park Equipment Rm	1120 7th Street E
303825973	West End Rink	601 Main St W
303963830	Airport	50511 St Hwy 112 Gate
304178140	St Lt Svc	825 Main Street W
304500475	Fire Station	215 6th Street E
304520171	Sm Gen Svc	323 Stuntz Ave N
302154453	Wastewater Utility	1901 Knight Rd
302152769	Wastewater Utility	314 11th Ave E
302152769	Wastewater Utility	523 Lake Shore Dr
303562018	Wastewater Utility	2614 Lake Shore Dr
303648977	Wastewater Utility	524 Turner Rd

Electricity and Natural Gas

In this section, we discuss electricity and natural gas usage trends for all City of Ashland properties. We do so for overall electricity and natural gas usage as well as usage by select properties (i.e., the highest energy consuming buildings). For the highest energy consuming buildings, we supplement the energy usage data with insights from field visits where we conducted an informal energy audit for each of these properties. We include specific recommendations for increasing energy efficiencies and reducing energy consumption for these high energy consuming properties.



Over the last year the City of Ashland consumed over 1.8 million kilowatt hours (kWh) of electricity and burned over 82,000 therms of natural gas. This converts to a little over 4.2 million kWh of total energy usage.

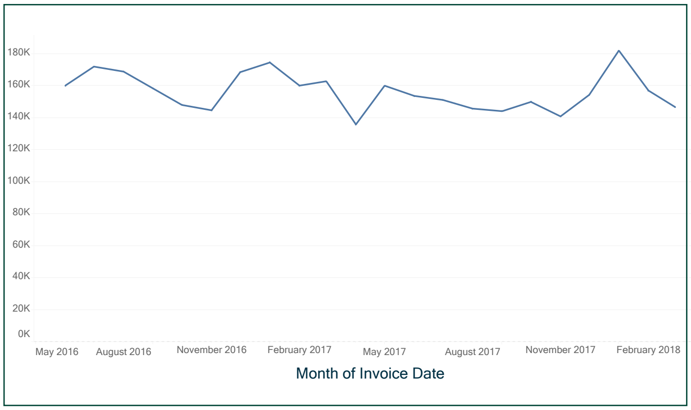
Overview

Over the last year and across all City owned properties, the City of Ashland consumed over 1.8 million kilowatt hours (kWh) of electricity. Similarly, the City burned over 82,000 therms of natural gas. When converted into kWh, we estimate that the total energy used by City properties and buildings from April 2017 to March 2018 is a little over 4.2 million kWh of energy. The total cost to the City over this period of time was approximately $234,960 (or about $20,000 per month).

Table 3. Electricity and Natural Usage, April 2017-March 2018

KILOWATT HOURS	ELECTRICITY INVOICE ($)	THERMS	GAS INVOICE ($)	TOTAL ($)
1,831,462	180,236	82,180	54,724	234,960

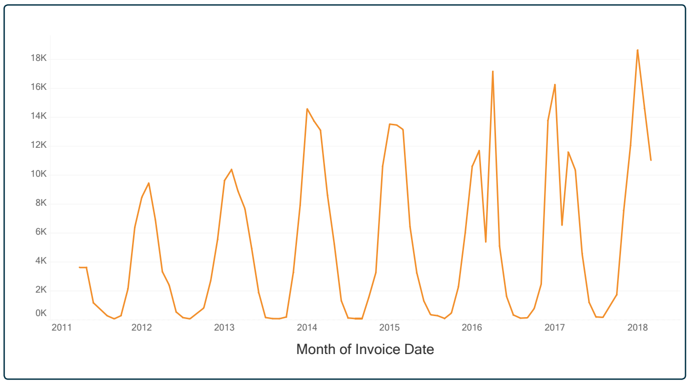
Figure 1. Total Electricity Usage (kWh) by Month, June 2016-March 2018[3]



Between June 2016-March 2018, electricity usage within the City remained flat with no evidence of an upward or downward trend.

The City of Ashland saw an increase in natural gas usage from its 2011 baseline. Although the overall use of natural gas for City owned properties as a whole remained flat between 2014 and 2017 (figure 2).

Figure 2. Total Natural Gas Usage (Therms) by Month, January 2011-March 2018



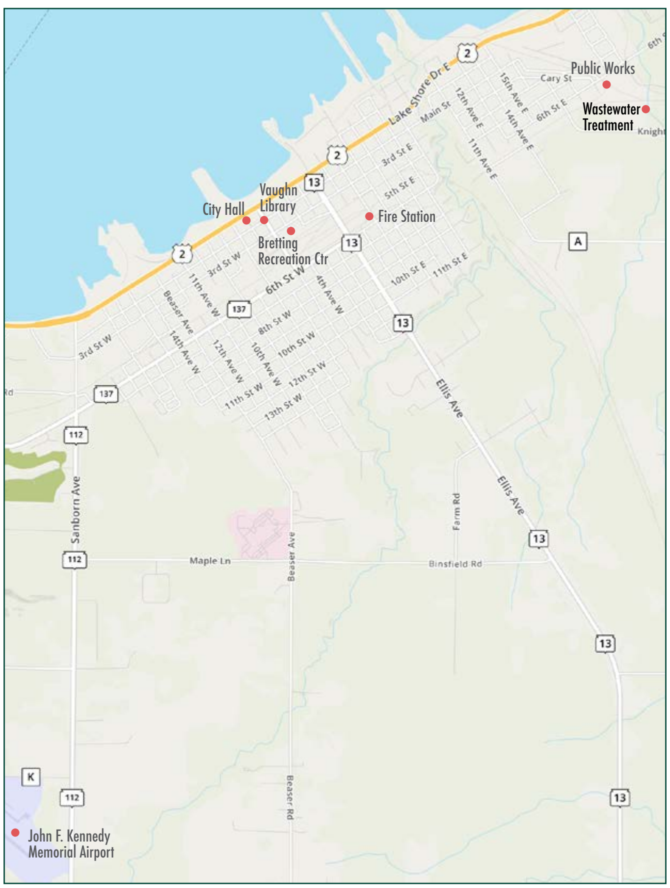
[3] We show trends for overall usage from June 2016 to March 2018 due to having complete data for all properties back to this date. We were not able to get data for the wastewater treatment plant farther back than this date. We have data for all other properties dating back to January 2011.

Top Consuming Buildings

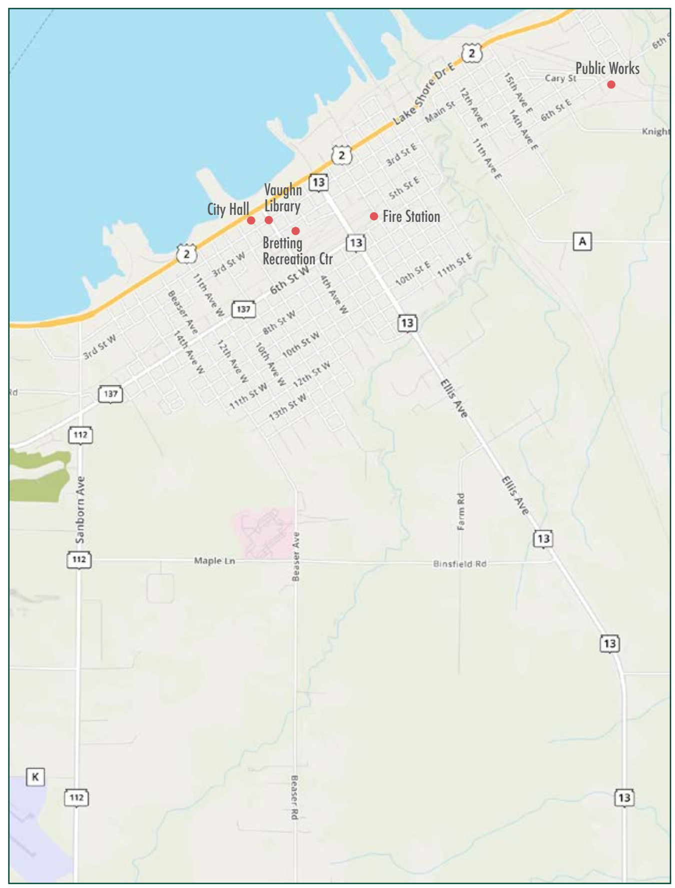
The top electricity consuming properties are wastewater treatment facilities (including several lift stations at various locations around Ashland), the fire station, city hall, the public works building, Bretting Recreation Center, airport facilities, and Vaughn Public Library (map 1).

The same buildings, with the exception of the wastewater treatment buildings and JFK Memorial Airport are the top natural gas consuming properties (map 2).

Map 1. Top Electricity Consuming Buildings



Map 2. Top Natural Gas Consuming Buildings



We estimate that the top seven electricity consuming locations and the top five natural gas consuming locations account for nearly all of the City's usage – approximately 99.5 percent of the electricity (kWh) and 98.1 percent of the natural gas (therms). In figure 3, we add electricity (kWh) and natural gas (therms converted into kWh) to identify the seven highest consuming buildings. To better understand energy consumption patterns and provide more specific recommendations, the CRC conducted informal energy audits of all of these buildings with qualified individuals who were able to describe the projects already implemented and some of the reasons for the high energy usage. From these tours, we observed that the facility staff who oversee the maintenance and operation of the City's buildings appear to be aware and well-informed of basic energy-saving strategies, with the following already in progress:

1. Replacing incandescent and fluorescent bulbs with more efficient and longer lasting LED bulbs. These are generally done as time and funding allows, particularly when existing bulbs burn out.

2. Upgrading old HVAC systems with more efficient variable air volume (VAV) systems. In some instances, however, problems exist between where the conditioned air is delivered and the location of the thermostat. To optimize comfort and energy efficiency, separate controls and additional ductwork may be required.

3. Replacing fixed-on lights (e.g. in restrooms) with motion sensors that automatically turn off lights when the room is unoccupied.

4. Covering single-pane windows with storm windows or interior plastic to reduce air infiltration and uncomfortable drafts.

Figure 3. Total Energy (kWh and Therms) by Top Consuming, April 2017-March 2018

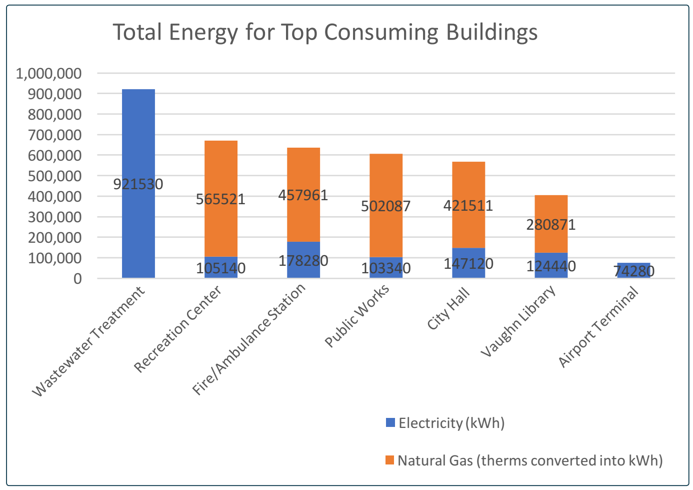
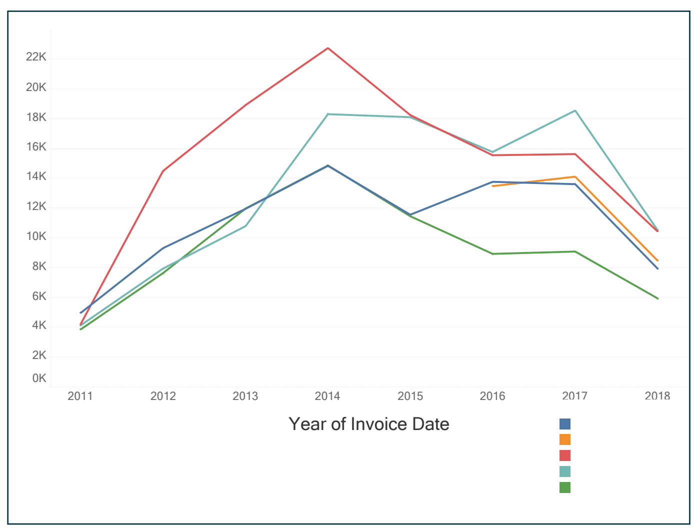


Figure 4. Natural Gas Usage (therms) by Top Consuming Buildings, January 2011-March 2018



Wastewater Treatment Plant
1901 Knight Road

The highest consumer of electricity for the City of Ashland is the wastewater treatment facility. Accounting for nearly 50 to 60 percent of the City's overall electricity consumption, the treatment plant operates pumps, aeration units, and an ultra-violet sterilization system that runs 24/7, day and night. The City has already invested in significant energy efficiency measures, including:

1. The majority of the pumps have been upgraded with variable frequency drives (VFD) to minimize their energy usage. The facility uses a variety of pumps of differing capacities to allow for efficient control under varying demands.

2. The facility employs a Supervisory Control and Data Acquisition (SCADA) software system that networks computers and graphical interfaces to improve the efficiency of monitoring and operational control.

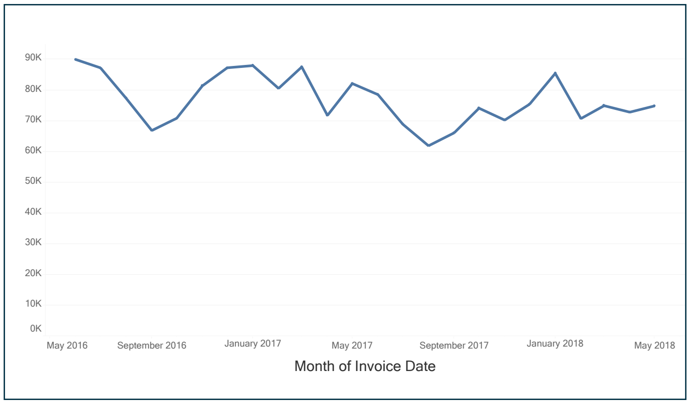
3. The aeration units for the oxidation tanks have been upgraded from large bubble jets to smaller, more energy-efficient fine-bubble diffusers.

4. Submerged ultraviolet (UV) bulbs sterilize the outflow without the use of chemical additives.

5. Upgrades to the HVAC system are in progress.

6. Some fluorescent have been converted to LED.

Figure 5. Waste Water Treatment Plant Electricity Usage (kWh) by Month, June 2016-May 2018



Recommendations

The wastewater treatment facility could further advance its energy efficiency by investing in these improvements:

1. Reduce the amount of water entering the plant by promoting water conservation from residential and commercial customers.

2. Separate the City's storm water system from its septic system so that storm water does not arrive at the treatment facility. The facility director indicated that at present they do not have the staff or resources to investigate where storm water is entering the sewer system.

3. Better educate City residents against flushing problem items (e.g. "disposable wipes") into the sewer system. These items can clog pumps and require time-consuming labor to remove.

4. The water treatment plant backflushes its filtration system on a daily basis to remove silt carried in from Chequamegon Bay. Currently, this backflushing fluid, which remains uncontaminated, is sent to the wastewater treatment plant, where it mixes with sewage. We recommend assessing whether this backflushing fluid can be safely returned directly to Chequamegon Bay, thereby reducing demands on the wastewater treatment facility.

5. Conduct a feasibility study for the implementation of anaerobic digestion to create combined heat and power (CHP) for the facility. The digested sludge could also be sold as compost or animal bedding to provide revenue for the City.

Fire Station
215 6th Street East

The fire and ambulance station is the newest building owned by the City of Ashland. Built in 2015 with modern energy efficient systems, the building accounts for less than ten percent of the City's annual electricity usage and just under twenty percent of its annual natural gas usage.

The fire station employs in-floor hydronic heat loops for the entire footprint of the vehicle bays and along the perimeter of the administration building. High efficiency natural gas boilers and energy efficient pumps circulate the heated fluid.

For the vehicle bays (including equipment storage), heat is supplied only by the in-floor system, which works well in winter to melt snow and keep the floor dry. The HVAC system serving the administration building does not extend to the vehicle bays, which have no cooling system for summer months. A separate ventilation system circulates fresh air through the vehicle bays and heats the air (using hot water from the boiler) if the outside temperature is below 45°F. The intake for this ventilation air is on the roof of the administration building, which consists of black rubber membrane (EPDM) and can get quite hot in the summer. Hence, during the summer months the fresh air for the vehicle bays can become uncomfortably warm. The vehicle bays are equipped with an exhaust system that attaches flexible ducts to the tailpipes of vehicles. Automatic fans draw the exhaust fumes outside. However, the system does not include make up air, resulting in negative pressure within the vehicle bays when this system is in use. Furthermore, the bays are not equipped with heat exchangers to extract energy from either the stale air of the bays themselves or from the vehicle exhaust ducts.

The HVAC system serving the administration building includes electric heating elements within the ductwork to supplement the primary system supplied by natural gas. These electric heating elements allow individuals to adjust the temperature of particular offices separate from the set point of the main system, thereby minimizing frequent adjustments and improving efficiency. The HVAC system utilizes seven variable air volume (VAV) thermostats in different areas of the building, another feature that improves overall efficiency.

Figure 6. Fire Station Electricity Usage (kWh) by Month, October 2015-March 2018

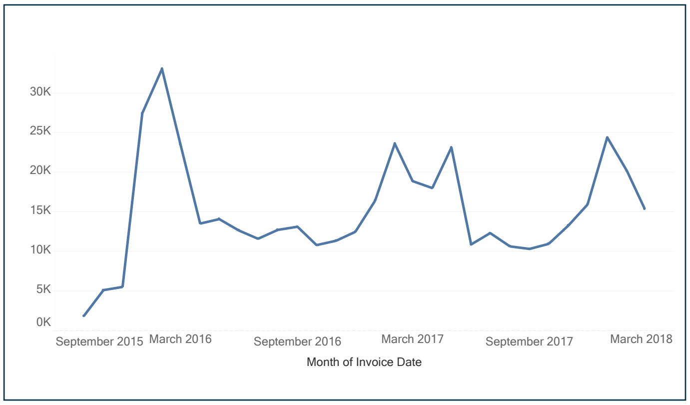
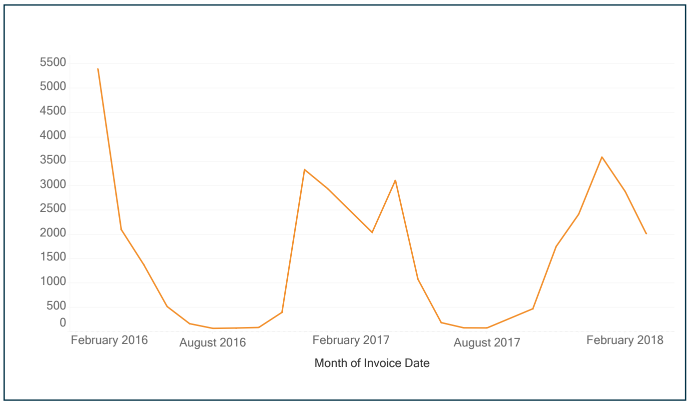


Figure 7. Fire Station Natural Gas Usage (therms) by Month, March 2016-March 2018



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Recommendations

1. Consider installing a heat exchanger to extract and save energy from the vehicle bays.
2. Assess the possibility of including make-up air for the vehicle exhaust system to prevent negative pressure. This system should also include heat exchanging properties (or be incorporated into a larger system).
3. Paint the EPDM roof of the administrative building white to reduce summer heating of the vehicle bay ventilation air. Alternatively, assess the possibility of creating a living roof to assist with cooling.
4. Insulate the aluminum frames of the windows in the administrative building, which currently get quite cold in the winter.
5. Convert existing fluorescent bulbs with LED bulbs as opportunities arise.

City Hall
601 Main Street West

City hall is a historic building constructed of brownstone blocks, which offer poor insulation. We estimate that city hall consumes about seven percent of the City's total electricity and nearly 20 percent of its natural gas. Since natural gas boilers are used to circulate heated water through wall-mounted radiators, the large seasonal use of natural gas suggests that the building suffers from inadequate insulation. Furthermore, the high ceilings and the absence of any form of destratification results in excessive heating to maintain comfort.

The City has already invested in some energy efficiency measures by:

1. Replacing single pane windows with triple-pane windows in the council chamber and covering the windows with cellular (honeycomb) shades.

2. Replacing some of the old lights with LEDs.

Recommendations

1. Assess the feasibility of insulating exterior walls. This may require significant interior renovation.

2. Replace single-pane windows with insulating windows, prioritizing as resources permit.

3. Consider more efficient (perhaps centralized) air conditioning systems.

4. Investigate large sources of electricity use. Monthly electricity usage has a baseline of nearly 10,000 kWh, plus higher seasonal variations. Consider hiring a company to install real-time energy monitoring devices to track down usage.

5. Add insulation to the roof. The roof appears to be insulated with R-19 fiberglass batts with no vapor barrier. Buildings in this climate benefit from two to three times as much insulation. However, the high levels of air-infiltration from leaky windows may limit the effectiveness of adding ceiling insulation without first correcting the worst of the windows.

Figure 8. City Hall Electricity Usage (kWh) by Month, April 2011-March 2018

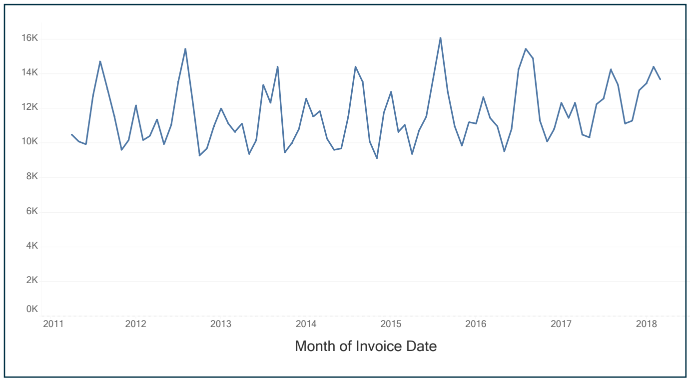
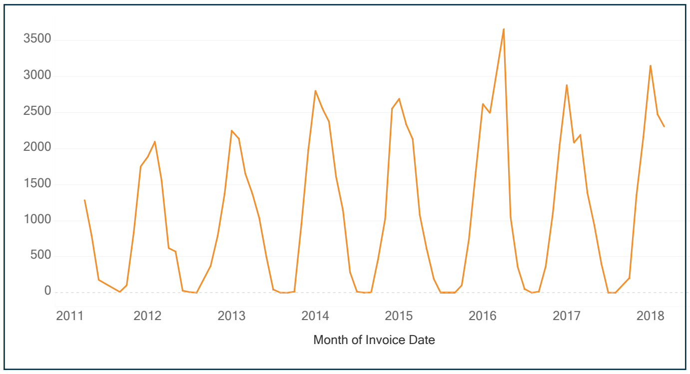


Figure 9. City Hall Natural Gas Usage (therms) by Month, April 2011-March 2018



Vaughn Public Library
502 Main Street West

The Vaughn Public Library is a 138-year old building occupying 20,400 square feet and accounts for 7 percent of the City's overall electricity usage, and 12.9 percent of its natural gas consumption.

The building was remodeled in 1983, moving the entrance from Main Street to Vaughn Avenue. The main library utilizes the first floor and basement, while the second floor provides meeting rooms, computers, and a children's room. The third floor is rented office space. Recent improvements include two new boilers, some LED lighting on the third floor, and the replacement of several windows. The basement and first two stories are heated by two high-efficiency natural gas boilers using wall-mounted radiators. The first floor (but not second floor) benefit from central air conditioning. The third floor offices have their own HVAC system.

Figure 10. Vaughn Library Electricity Usage (kWh) by Month, April 2011-March 2018

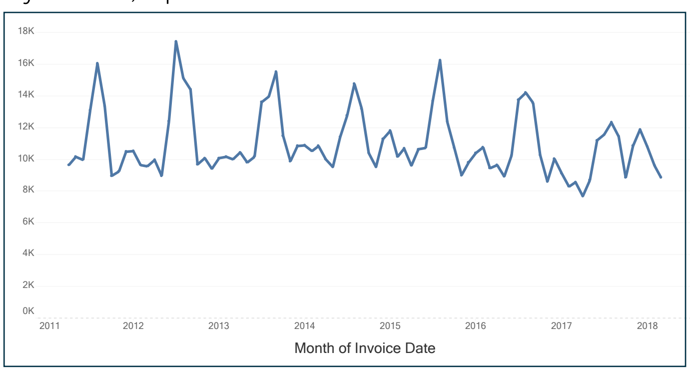
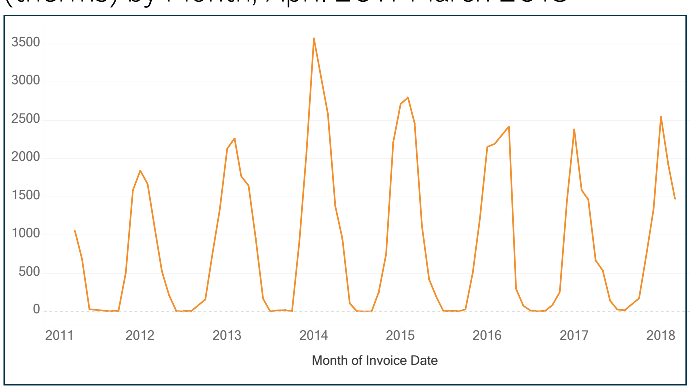


Figure 11. Vaughn Library Natural Gas Usage (therms) by Month, April 2011-March 2018



Long-term occupants of the library indicate that the building is rarely comfortable. Poor insulation (some of which results from the brownstone construction), air infiltration (including leaking windows), inadequate HVAC systems, and the relative isolation of the second floor—all contribute to high energy consumption and compromised comfort.

Energy efficiency measures in progress:

1. A new high-efficiency natural gas boiler was installed three years ago.
2. Central air conditioning for the first floor eliminates the use of less efficient alternatives.
3. Some of the third-floor fixtures have been switched to LED lighting.
4. Main entrance opens into a foyer, rather than directly into the library, reducing heat loss.

Recommendations

1. Consider replacing existing lighting fixtures with LED alternatives where appropriate.
2. Upgrade the HVAC system to provide air conditioning for the second floor, eliminating the need for less-efficient window-mounted units.
3. Replace windows where most needed, such as on the second floor.
4. During interior renovations, add insulation to walls and ceiling and improve windows.
5. Ensure that unnecessary electronics are shut down when not in use (e.g. when closed), including second floor computer room.
6. Ceiling fans to reduce air conditioning needs.

Bretting Recreation Center
400 4th Avenue West

The Bretting Recreation and Community Center is a large building (17,600 square feet) that houses the Parks and Recreation Department, and includes a large open gym with basketball and volleyball courts, a gymnastics room, and a youth recreation area. We estimate that the recreation center consumes about five percent of the City's overall electricity usage but over 23 percent of its natural gas usage--the largest proportion of any City property. This may indicate insufficient insulation, inefficient heat exchangers, excessive heating due to poor circulation, or a combination of issues. The gym, a large multipurpose space, utilizes its own heating and ventilation system that does not include air conditioning. As a result, the gym can become hot and humid in the summer, limiting its seasonal usefulness. The gymnastic room, recreation area, and offices include a full HVAC system. However, the ductwork delivering conditioned air appears to be inappropriately sized for the various spaces. Office workers report that they regularly have to turn on electric space heaters during the summer to keep from being overly cooled by the AC system, a highly inefficient situation. One problem may be that the thermostat controlling the system is located in the recreation area, a room that undergoes larger temperature fluctuations than the more centralized offices due to many large windows unprotected from summer sunshine.

Energy efficiency measures in progress:

1. Some older light fixtures have been replaced with LED bulbs.

2. LED fixtures have been purchased for the gym, though they have not yet been installed. Since the gym lights are kept on all day during the "open gym" period, replacing these lights should offer significant savings in electricity costs.

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Figure 12. Bretting Recreation Center Electricity Usage (kWh) by Month, April 2011-March 2018

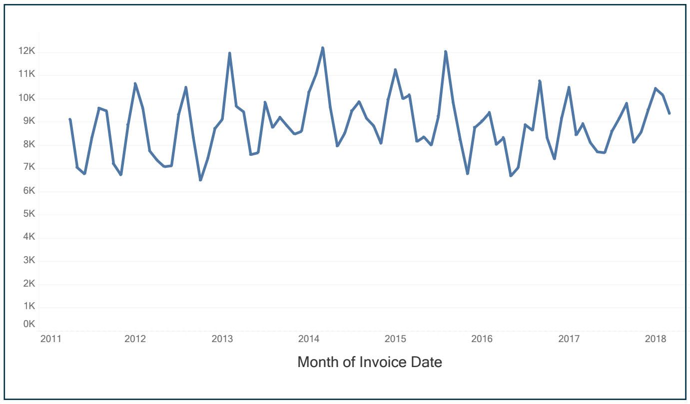
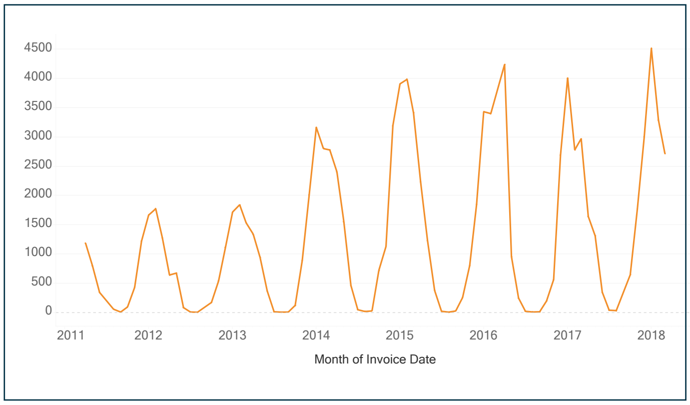


Figure 13. Bretting Recreation Center Natural Gas Usage (therms) by Month, April 2011-March 2018



Bretting Recreation Center (continued)
400 4th Avenue West

Recommendations

1. Consider installing dampers on the conditioned air ducts into the office so that office workers can better regulate temperature. Adjust the HVAC system so that space heaters are not used.

2. Evaluate heat loss throughout the center. Consider using thermal imaging to find areas of insufficient insulation (which may include the entire roof/wall system). Insulate as necessary.

3. Assess the operation and efficiency of the existing heat exchangers on the HVAC systems.

4. Consider the feasibility of installing high windows or roof-mounted daylighting to allow indirect natural light into the gym and gymnastics room. This could significantly reduce the need for artificial lighting during daylight.

5. Consider installing large ceiling fans in the gym and gymnastics room. These could provide low-energy cooling for the summer and reduced heating requirements in the winter by destratifying warm air near the ceiling.

Public Works
2020 6th Street East

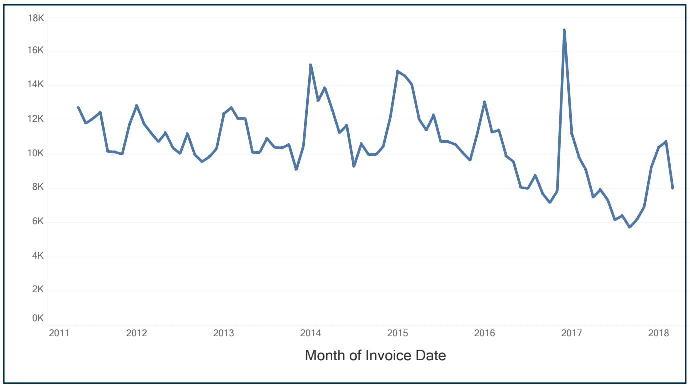
The public works building occupies 40,172 square feet and accounts for about five percent of the overall electricity consumption and 21 percent of the natural gas consumption of City owned properties. Over the last two years for which data is available (2016 and 2017), the Public Works building has seen roughly a 34 percent decrease[4] in electricity usage from its historical high in 2015.

At the heart of the public works building are the large garages, workshops, and vehicle washrooms. Not surprisingly, the garage doors are neither well insulated nor well sealed against drafts. As a result, overhead natural gas radiant heaters are frequently running during the winter months. Doors into administrative spaces open directly onto work spaces and garages, allowing unimpeded transfer of air (and possibly contaminants). Single-paned windows, set in concrete walls, provide inadequate insulation. Some of the larger administrative windows are covered with Plexiglas to improve comfort levels.

Energy efficiency measures already in progress:

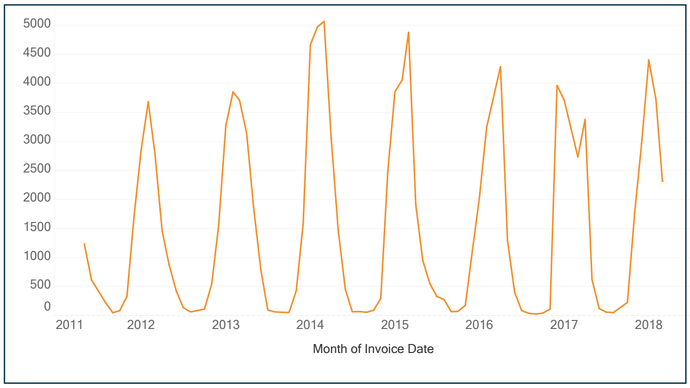
1. Some of the lights have been replaced with LED bulbs, and some are on motion sensors.

Figure 14. Public Works Electricity Usage (kWh) by Month, April 2011-March 2018



[4]The decrease is measured by 2017 meter read date of 93,400 kWh versus the invoice date of 84,160 kWh reflected in public works electricity usage figure.

Figure 15. Public Works Natural Gas Usage (therms) by Month, May 2011-March 2018



2. Office equipment that is not essential tends to be turned off during the night.
3. The old HVAC system is slated to be replaced.
4. The thermostat controller has been updated.
5. Garage doors are left open as briefly as necessary during the winter months.

Recommendations

1. Continue to reduce lighting costs through replacement of older bulbs with LEDs, particularly in the garages that require extensive lighting.
2. Insulate or replace single-paned windows.
3. Consider upgrading HVAC controls to allow temperature adjustability between office spaces. Some employees report that the air conditioner makes the spaces too cold during the summer.
4. Assess feasibility of improving insulation in the roof and exterior walls.
5. Replace doors separating garages and administrative spaces with better sealing models.

JFK Memorial Airport
50511 State Highway 112

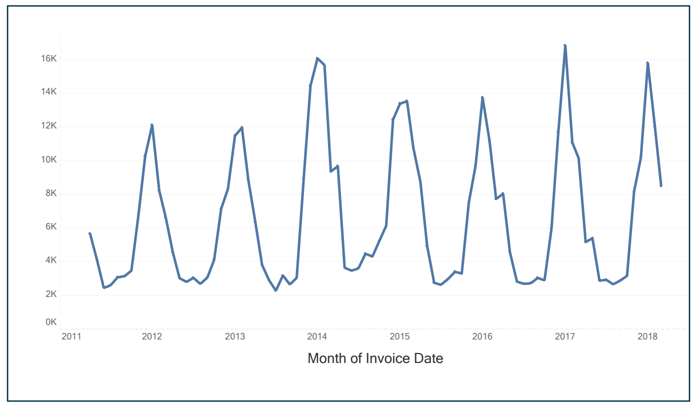
The airport is one of the most energy intensive locations because of the hundreds of incandescent runway lights, which are required by aviation law to be operational from sunset to sunrise. Each of the 104 bulbs currently use 30 watts.

The replacement of incandescent light bulbs with LED bulbs could be economically installed when the runway is redone (proposed to take place in 2020). However, the airport director pointed out that FAA regulations currently require that if incandescent bulbs are replaced with LED bulbs then each LED bulb, which generates too little heat to adequately melt off snow and ice, must be equipped with a supplemental 40-watt heater. Although LED bulbs with 40-watt heaters might still save electricity over the current 30-watt incandescent bulbs—because the heaters would only need to be used during freezing conditions—the FAA requirement significantly limits the economics of their installation. The taxi lights are already LED and are off until the pilot turns them on prior to landing. The terminal building itself, an aesthetic design, is made out of logs without supplemental insulation. The building is heated using an inefficient electric in-floor system. Due to the poor insulation of the building, the floor frequently becomes uncomfortably warm before the building itself warms to a comfortable temperature.

Energy efficiency measures in progress:

1. The taxi lights already use 5-watt LED bulbs rather than incandescent bulbs.
2. Storm windows have been added to the existing single-pane windows to reduce drafts and improve insulation.
3. Light sensors automatically turn off lights to the beacon and wind cone during daylight hours.
4. Equipment storage hanger is reportedly kept at a cool 40-45°F during the winter except when work is being done (at which point the temperature is increased to 60 °F).

Figure 16. JFK Airport[5] Electricity Usage (kWh) by Month, April 2011 – March 2018



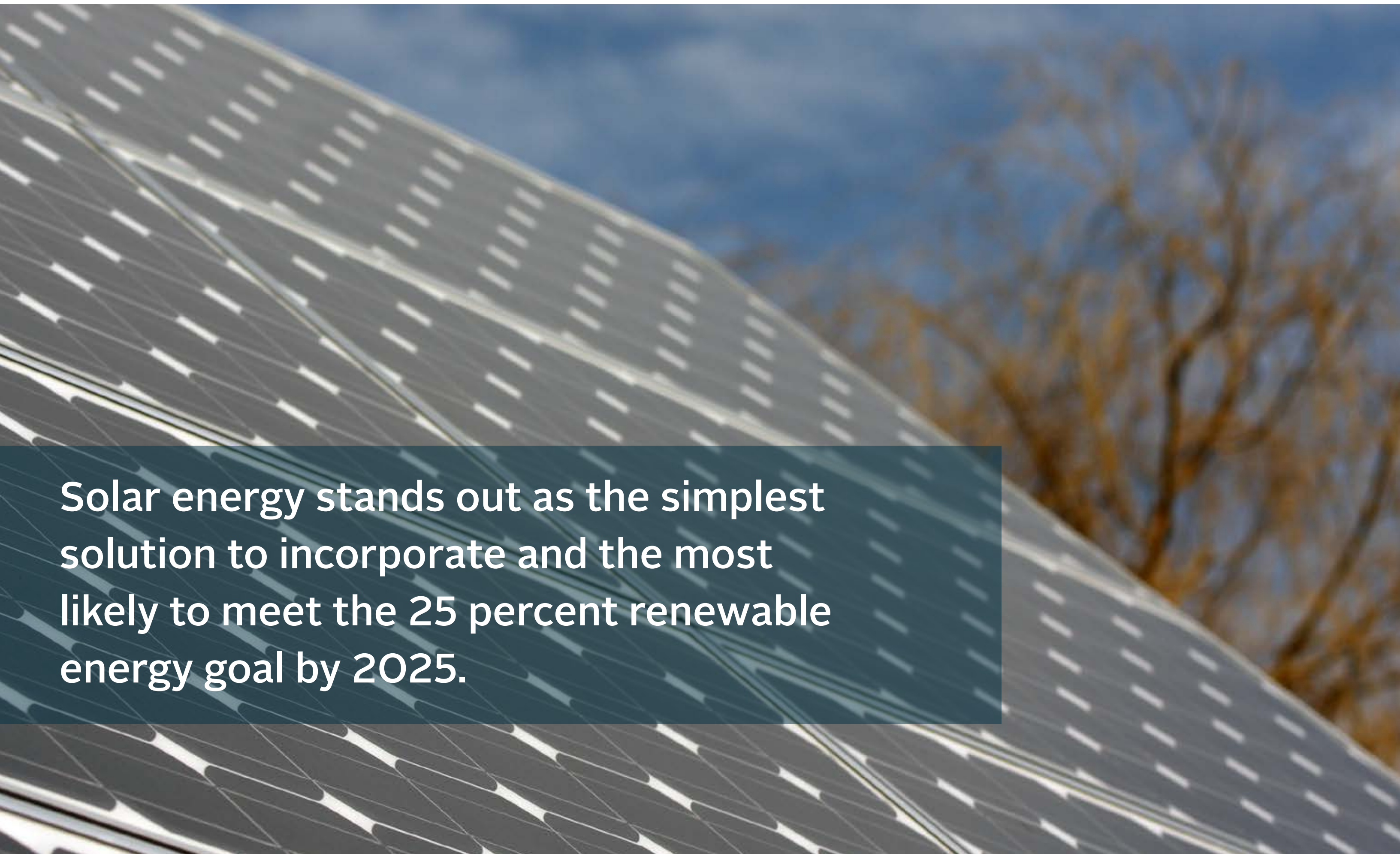
Recommendations

1. Investigate the possibility of installing LED bulbs for the airport runway lights. Research snow/ice sensors to reduce the need to operate the FAA-required 40-watt heating coils during clear conditions. Consider alternate solutions to keeping runway lights clear without energy-intensive heating.
2. Consider improvements to the electric in-floor system, possibly supplementing with a natural gas system to improve occupant comfort and reduce demands on the in-floor system.
3. Consider upgrades to the old and inefficient boiler in the equipment storage hanger.
4. Look into aesthetic methods of better insulating the log cabin construction.

[5]Airport includes Airport (303963830), Airport Maintenance Building (302190096), Hangar (302644433), and the Terminal Building (302991848).

Renewable Energy Options

The three most promising options for harnessing renewable energy in the Chequamegon Bay region are: solar, wind, and biomass. Of these, solar energy stands out as the simplest solution to incorporate and the most likely to meet the 25 percent renewable energy goal by 2025. Numerous studies of wind potential (e.g. see reports from the Northern Great Lakes Visitor Center, Bad River Reservation, and Madeline Island) indicate that this region lacks a consistent, adequate-strength, turbulence-free wind resource to make large-scale wind power economical. The final option, biomass—either from the anaerobic digestion of sewage or the combustion or gasification of wood chips—promises abundant resources but also entails greater start-up costs, more expensive maintenance and operation requirements, and may be difficult to complete by the hopeful 2025 date. For these reasons, this report focuses on solar photovoltaic energy, describing two available options. These two options are: (1) subscribing to Xcel Solar*Connect Community and (2) installing City-owned solar modules.



Solar energy stands out as the simplest solution to incorporate and the most likely to meet the 25 percent renewable energy goal by 2025.

OPTION 1: Xcel Solar*Connect Community Program

Xcel Energy announced at the beginning of May 2018 that they received enough subscriber interest to move forward with plans to construct a one-megawatt community solar garden in Ashland. This solar garden would include a field of solar arrays located on land Xcel owns on Highway 13 south of town. Residents and businesses of Ashland have the opportunity to buy portions of this garden in 200-watt shares and will receive credit on their energy bills each month proportional to their number of shares. This is not a direct purchase of solar modules – a company contracted by Xcel Energy owns, operates, and maintains the array. The purchase is valid for 25 years, after which customers must buy a new subscription. Because the modules are not bought outright, subscribers bear no responsibility for the operation or maintenance of the array. In other words, after the initial purchase, the only impact on customers would be a monthly reduction on their energy bills for 25 years. As soon as Xcel receives full payment, subscribers begin receiving credits. If electricity costs remain constant in the years to come, the simple pay-back time for the investment is estimated to be 15.2 years. However, assuming a more realistic 2 percent escalation in electricity costs, the payback time would decrease to less than 12 years, after which the customer increasingly benefits from the investment. Participation in this program would demonstrate the City's commitment to sustainability and move it forward toward its goal of procuring 25 percent of its electricity from renewable sources as required by the City's 25x25 energy plan.

Table 4. Xcel Solar*Connect Community Program Estimates (4/17-3/18)[6]

Cost ($)	kWh	% Offset	Subscription Size (kWh)	Deposit ($)	Balance ($)	Total ($)	Annual Credit ($)	Credit/ 25 Yrs	Credit/25 (yrs) 2 % escalation	Payback (yrs)	Payback (yrs) 2 % escalation
233,066	2,151,141	25	384	32,888	580,932	613,820	40,282	1,007,048	1,290,230	15.2	11.9
		15	230	19,733	348,559	368,292	24,169	604,229	774,138	15.2	11.9
		5	76.8	6,578	116,186	122,764	8,056	201,410	258,046	15.2	11.9
		200 kW	200	40,000	280,000	320,000	21,000	525,000	672,630	15.2	11.9
		400 kW	400	80,000	560,000	640,000	42,000	1,050,000	1,345,260	15.2	11.9

[6] See appendix for cost breakdown per property and overall. Note, although the upper limit per customer is 400 kW, there is currently (as of June 21) only 200 kW available for subscription. That means the City Of Ashland would only be able to purchase around 13 percent of total electricity usage.

Table 5. Xcel Solar*Connect Community Program Estimates per Property (2/16-3/18)

Name Address	Avg $/yr	Avg kWh/yr	% Offset	Subscription Size (kWh)	Deposit ($)	Balance ($)	Total ($)	Annual Credit ($)	Credit/ 25 Yrs	Credit/25 (yrs) 2 % escalation
Wastewater Utility 1901 Knight Rd	77,279	91 21,530	100	658.2	131,647	921,530	1,053,177	63,586	1,589,639	2,036,646
			75	493.7	987,35	691,148	789,883	47,690	1,192,229	1,527,484
			50	329.1	658,24	460,765	526,589	31,793	794,820	1,018,323
			25	164.6	329,12	230,383	263,294	15,896	397,410	509,162
Wastewater Utility 314 11th Ave E	47,207	261,058	100	186.5	37,294	261,058	298,351	18,013	450,324.	576,955
			75	139.9	27,970	195,793.	223,764	13,510	337,743	432,717
			50	93.2	18,647	130,529	149,176	9,006	225,162	288,478
			25	46.6	9,323	65,264	74,588	4,503	112,581	144,239
Fire Station 215 6th St E	17,150	178,280	100	127.3	25,469	178280	203,749	13,193	329,818	422,563
			75	95.5	19,1019	133710	152,811	9,895	247,364	316,922
			50	63.7	12,7349	89,140	101,874	6,596	164,909	211,281
			25	31.8	6,3679	44570	50,937	3,298	82,455	105,641
City Hall 601 Main St W	14,909	147,120	100	105.1	21,017	147,120	16,8137	10,887	272,172	348,707
			75	78.8	15,763	110,340	12,6103	8,165	204,129	261,530
			50	52.5	10,509	73,560	8,4069	5,443	136,086	174,353
			25	26.3	5,254	36,780	4,2034	2,722	68,043	87,177
Vaughn Library 502 Main St W	14,014	124,440	100	88.9	17,777	124,440	142,217	9,209	230,214	294,950
			75	66.7	13,333	93,330	106,663	6,906	172,661	221,213
			50	44.4	8,889	62,220	71,109	4,604	115,107	147,475
			25	22.2	4,444	31,110	35,554	2,302	57,554	73,738
Rec Center 400 4th Ave W	11,102	105,140	100	75.1	15,020	105,140	120,160	7,780	194,509	249,205
			75	56.3	11,265	78,855	90,120	5,835	145,882	186,904
			50	37.6	7,510	52,570	60,080	3,890	97,255	124,603
			25	18.8	3,755	26,285	30,040	1,945	48,627	62,301
Public Works 2020 6th St E	9,233	103,340	100	73.8	14,763	103,340	118,103	7,647	191,179	244,939
			75	55.4	11,072	77,505	88,577	5,735	143,384	83,704
			50	36.9	7,381	51,670	59,051	3,824	95,590	122,469
			25	18.5	3,691	25,835	29,526	1,912	47,795	61,235
Airport 50511 State Hwy 112	7,348	74,280	100	53.1	10,611	7,4280	84,891	5,497	137,418	17,6060
			75	39.8	7,959	5,5710	63,669	4,123	103,064	13,2045
			50	26.5	5,306	3,7140	42,446	2,748	68,709	8,8030
			25	13.3	2,653	1,8570	21,223	1,374	34,355	4,4015

Solar*Connect Per Building

If the City chose to buy subscriptions for the Xcel Solar*Connect program, they would be purchasing credits per building, not overall energy usage. However, assuming the City could purchase up to 25 percent of its electricity usage or its total overall energy usage in a given year through this program, we estimate an upfront investment of just under $614,000 to cover electricity and just over $1.6 million for its overall energy usage with a 25 year payback of approximately $1.3 million and $3.5 million respectively.

Figure 17. Xcel Solar*Connect Program Estimates for Overall Electricity Usage

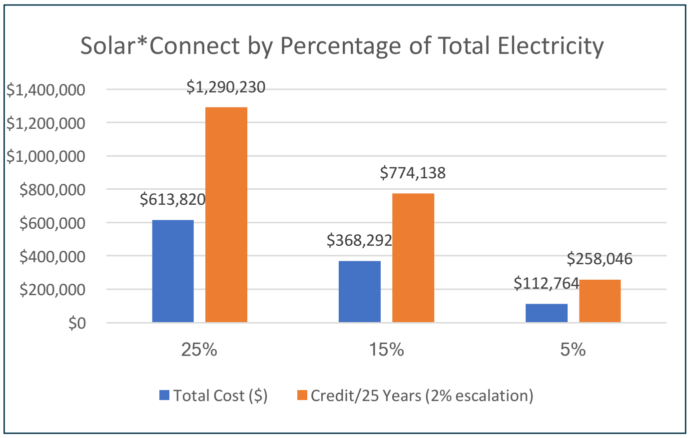
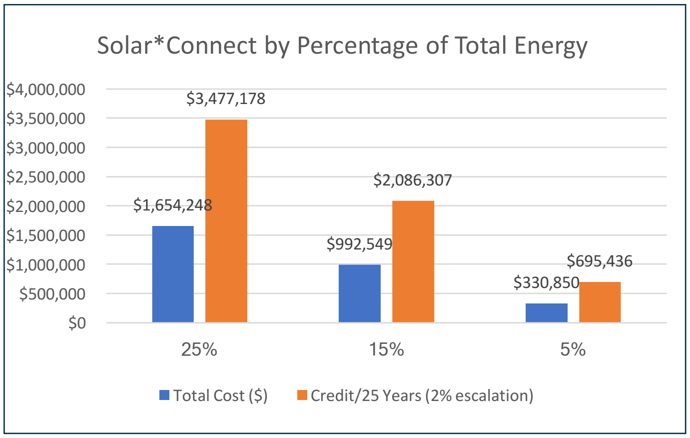


Figure 18. Xcel Solar*Connect Program Estimates for Overall Energy Usage



Solar*Connect by Building

Wastewater Treatment Plant
(1901 Knight Rd)

The top energy consumer is the wastewater treatment plant with an annual usage of 921,530 kWh (an annual cost of $77,279.30). A 100 percent offset for electricity would require a subscription through Solar*Connect equal to 658.2 kW and cost a total of $1,053,177. With an annual bill credit of $64,000, the payback time would be 12.9 years including a 2 percent energy cost inflation. At the end of 25 years, the City would have saved a total of $2,037,000 in energy payments. If the City chose 75 percent, 50 percent, and 25 percent energy offset subscriptions, the overall savings would be $1,527,000, $1,018,000, and $509,000 respectively, all with a simple pay-back of 12.9 years. Because this building uses so much electricity, the credit rate with Xcel is $0.069 instead of the standard $0.074, making the annual credit less and payback time longer than other City buildings.

Main Lift Station
(314 11th Ave E)

The second highest energy consumer is the main lift station with an annual usage of 261,057 kWh and annual electrical invoice of $47,207. Due to the annual usage, this building also qualifies for a lower $0.069 credit, making the payback time 12.9 years. To offset 100 percent of the annual electricity consumption, a subscription of 187 kW is needed, which would cost a total of $298,000 and offer an annual bill credit of $18,000. After the 25-year contract expires, the City would have saved a total of $577,000 (adjusted for a 2 percent energy cost inflation). Offsets at 75 percent, 50 percent, and 25 percent would save the City a total of $433,000, $288,000, and $144,000 respectively, over the 25 years.

Fire Station
(215 6th St E)

The City's new fire and ambulance station uses 178,280 kWh of electricity annually, amounting to $17,150 in annual invoices. If this building were to offset 100 percent of the electricity needs, it would cost $203,748. This investment would produce an annual credit of $13,000, saving the City a total of $330,000 over the lifetime of the contract. Since the fire station would be credited at the standard $0.074 rate, its payback time is slightly faster than the wastewater treatment facilities at 12.1 years.

City Hall
(601 Main St)

City Hall uses an average of 147,120 kWh annually, with a bill of $14,909. Purchasing a Solar*Connect subscription to cover 100 percent of the electricity needs would cost a total of $168,137, with an annual credit of $11,000, and would save the City $349,000 over the lifetime of the contract (payoff after 12.1 using the $0.074 credit rate). Purchasing 75 percent, 50 percent, and 25 percent coverage would save the City $262,000, $174,000, and $87,000 respectively at the end of 25 years.

Vaughn Publi Library
(502 Main St)

Vaughn Library uses 124,440 kWh annually with an annual electric invoice of $14,014. At 100 percent offset of annual electricity usage, the City would require a subscription size of 89 kW, which would cost a total of $142,217. The payback period is 12.1 years with the annual credit of $9,000, saving the City a total of $295,000 over the lifetime of the contract. Purchasing 75 percent, 50 percent, and 25 percent coverage would save the City $221,000, $147,000, or $74,000 respectively.

Solar*Connect by Building

Bretting Recreation Center
(400 $th Ave W)

Bretting Recreation Center uses 105,140 kWh of electricity per year and has an annual energy bill of $11,102. Covering 100 percent of the electricity needs for this location would cost $120,160, offer an annual credit of $8,000, and save the City $249,000 over the 25 years. Purchasing a 75 percent offset would save $187,000, a 50 percent offset would save $125,000, and 25 percent would save $62,000 over the lifetime of the contract.

Public Works
(2020 6th St E)

Ashland Public Works uses an average of 103,340 kWh for its electricity needs and pays $9,233 in electricity costs per year. Covering 100 percent of this buildings electricity usage needs would cost $118,103 upfront, with an annual credit of $8,000. This would produce a payback rate of 12.1 years, saving the City $245,000 over the life of the contract.

JFK Memorial Airport
(50511 State Highway 112)

Lastly, the City's airport uses an average of 74,280 kWh per year costing $7,348. Offsetting 100 percent of this electricity consumption with Solar*Connect would cost $84,891 and generate an annual credit of $5,000. The payback time for this, like the other buildings rated at $0.074 credit, would be 12.1 years. A total offset of energy would save the City $176,000. With 75 percent, 50 percent, and 25 percent, the City would save $132,000, $88,000, and $44,000 over the lifetime of the contracts, respectfully.

OPTION 2: City Owned Solar Installation

Another option for the City to consider is to install solar modules itself on City owned buildings and property. The cost of purchasing and installing its own solar arrays, as well as the economic benefits, are summarized in the appendix. Owning its own solar arrays would probably require larger upfront costs[7] but may provide greater long-term economic returns. Rather than receiving credits on electricity bills as would be the case with subscribing to Xcel's solar garden, the electricity created by City-owned arrays would be used on site and net metered, with any surplus sold to Xcel at a negotiated rate.

Three important differences between City-owned arrays and a subscription to the Xcel solar garden include:

1. ongoing maintenance costs must be borne by the City
2. a longer duration of benefit
3. a greater rate of return

Although maintenance requirements for solar arrays tend to be the smallest of any form of electricity generation, annual maintenance and operation costs may amount to between 0.5 percent and 1.5 percent of total system cost. Despite this added expense, the lifespan of solar modules is conservatively estimated at 40 years, considerably longer than the 25-year subscription offered by Xcel, and solar arrays generally outlive this conservative estimate. As a result, the savings from City-owned arrays could accumulate over the years to become substantially more than the benefits achieved through the Solar*Connect program. In addition, City-owned arrays directly offset electricity that would otherwise need to be purchased at the full retail rate (currently $0.12/kWh). Hence, the City would effectively be paying itself $0.12/kWh rather than receiving a $0.074/kWh credit as offered through the Solar*Connect program.

Xcel's current energy policy does not allow a customer to "overproduce" in any one location. This policy limits the benefits that the City might realize by creating a single large solar field, since electricity from this installation could not offset the combined electricity consumption of multiple City-owned premises. At best, the energy would be sold back at a much lower commercial rate (currently 3-4 cents per kWh) for any installation over 100 kW. In order for Xcel to offer net-metering, each solar array must be located on the premise it serves. Hence, building-specific arrays that reduce the net electricity requirements of the building appear to be the most favorable option. These arrays may be roof mounted or located adjacent the building. As noted earlier, most of the City's energy is used by only a few buildings. Integrating solar into these select sites may offer the most economical benefits. These installations could be done in stages, employing the savings from one installation to help fund the next, creating ongoing economic returns. Buildings that offer poor solar options, such as City Hall, would do better to reduce energy demands of the building and/or buy into a solar garden program.

[7] For this report we use $2.50 per watt, rather than the $1.60 per watt offered by Xcel Solar*Connect program

Table 6. City Owned Solar Modules[8] (4/17-3/18)

Cost ($)	kWh	% Offset	Installation Size (kWh)	Total Investment ($)	Annual Bill Credit Estimate ($)	Savings/25 Yrs	Savings/25 yrs (0.5% annual degradation)	Savings/25 yrs (2%escalation)	Savings/25 yrs (degradation & escalation)	Savings/40 yrs	Savings/40 yrs (0.5% annual degradation)	Savings/40 yrs (2% escalation)	Savings/40 yrs (degradation & escalation)	Payback(yrs)	Payback with degradation & escalation
233,066	2,151,141	100	1,537	3,842,796	233,066	5,826,639	5,140,379	7,607,337	7,569,300	10,201,826	7,622,419	12,109,342	14,274,008	16.5	12.7
		75	1,153	2,881,782	174,799	4,369,979	3,855,284	5,700,301	5,671,800	9,232,642	5,711,603	9,072,198	10,695,746	16.5	12.7
		50	768	1,920,776	116,533	2,913,320	2,570,190	3,796,249	3,777,268	18,262,592	3,803,777	6,040,680	7,123,083	16.5	12.7
		25	384	959,093	58,266	1,456,660	1,285,095	1,890,799	1,881,345	7,268,999	1,894,545	3,045,080	3,547,796	16.5	12.7

Table 7. City Owned Solar modules Estimates per Property (2/16-3/18)

Name Address	Avg $/yr	Avg kWh/yr	% Offset	Subscription Size (kWh)	Total ($)	Annual Savings ($)	Simple Savings/25 yrs	Complicated Savings/ 25 yrs	Simple Savings/40 yrs	Complicated Savings/40 yrs	Payback (yrs)	Payback 2% escalation (yrs)
Wastewater Utility	77,279	921,530	100	658.2	1,645,589	77,279	1,931,982	2,512,161	3,471,217	4,737,373	21.3	16.4
1901 Knight Rd			75	493.7	1,234,192	57,959	1,448,987	1,884,120	3,059,820	3,553,030	21.3	16.4
			50	329.1	822,795	38,640	965,991	1,256,080	2,648,423	2,368,687	21.3	16.4
			25	164.6	19,320	19,320	482,996	628,040	2,237,025	1,184,343	21.3	16.4
Main Lift Station	47,207	261,057.5	100	186.5	466,174	47,207	31,180,182	1,534,593	1,995,954	2,893,900	9.9	7.6
314 11th Ave E			75	139.9	349,631	35,405	885,1367	1,150,945	1,879,410	2,170,425	9.9	7.6
			50	93.2	1233,087	23,604	590,091	767,297	1,762,866	1,446,950	9.9	7.6
			25	46.6	116,544	11,802	295,046	383,648	1,646,323	723,475	9.9	7.6
Fire Station	17,150	178,280	100	127.3	318,357	17,150	428,761	557,519	759,542	1,051,356	18.6	14.3
215 6th St E			75	95.5	238,768	12,863	321,571	418,139	679,952	788,517	18.6	14.3
			50	63.7	159,179	8,575	12,734	278,759	600,363	525,678	18.6	14.3
			25	31.8	79,589	4,288	214,381	107,190	139,380	520,774	18.6	14.3
City Hall	14,909	147,120	100	105.1	262,714	14,909	372,731	484,663	657,043	913,965	17.6	13.6
601 Main St W			75	78.8	197,036	11,182	279,548	363,497	591,364	685,474	17.6	13.6
			50	52.5	131,357	7,455	186,365	242,331	525,685	456,983	17.6	13.6
			25	26.3	65,679	3,727	93,183	121,166	460,007	228,491	17.6	13.6
Vaughn Library	14,014	124,440	100	88.9	222,214	14,014	350,356	455,569	611,890	859,101	15.9	12.2
502 Main St W			75	66.7	166,661	10,511	262,767	341,676	556,336	644,325	15.9	12.2
			50	44.4	111,107	7,007	175,178	227,784	500,782	429,550	15.9	12.2
			25	22.2	55,554	3,504	87,589	113,892	445,229	214,775	15.9	12.2
Rec Center	11,102	105,140	100	75.1	187,750	11,102	277,552	360,902	487,444	680,580	16.9	13.0
400 4th Ave W			75	56.3	140,813	8,327	208,164	270,676	440,506	510,435	16.9	13.0
			50	37.6	93,875	5,551	138,776	180,451	9393,569	340,290	16.9	13.0
			25	18.8	46,938	1,945	69,388	90,225	346,631	170,145	16.9	13.0
Public Works	9,233	103,340	100	73.8	184,536	9,233	230,830	300,149	411,947	566,015	20.0	15.4
2020 6th St E			75	55.4	138,402	6,925	173,1223	225,112	365,813	424,511	20.0	15.4
			50	36.9	92,2678	4,617	115,415	150,075	319,679	283,007	20.0	15.4
			25	18.5	46,134	2,308	57,708	75,037	273,545	141,504	20.0	15.4
Airport	7,348	74,280	100	53.1	132,643	7,348	183,689	238,852	324,536	450,420	18.1	13.9
50511 State Hwy 112			75	39.8	99,483	5,511	137,767	79,139	291,376	1337,815	18.1	13.9
			50	26.5	66,322	3,674	91,845	119,426	258,215	225,210	18.1	13.9
			25	13.3	33,161	1,837	45,923	59,713	225,054	112,605	18.1	13.9

[8] See appendix for cost breakdown per property and overall. These estimates do not include cost of maintenance. Prices can vary greatly depending on decisions made about type of panel and related parts as well as placement and installation requirements.

Direct Solar Install Per Building

As with the Solar*Connect program, the City of Ashland may choose to install solar modules on or near selected building. Assuming the City were to cover 25 percent of its electricity needs on an annual basis, we estimate an upfront cost of approximately $1 million and a payback of $1.8 million over 25 years. Similarly, if the City were to install enough solar energy to cover 25 percent of its total energy needs, we estimate an investment of approximately $2.6 million and a 25-year payback of $4.8 million.

Based on energy usage and roof design, property location, or land availability we suggest beginning discussions and further investigation for direct install at the properties shown below. Beginning with the largest energy users like the wastewater treatment plant will allow the City of Ashland to progress more quickly toward the overall goal of 25 percent renewable energy by 2025. Assuming no outside financial assistance, the solar resource of the Chequamegon Bay region offers a simple pay-back of approximately 17 years for City-owned installations.

Figure 19. Direct Solar Installation Estimates for Overall Electricity Usage

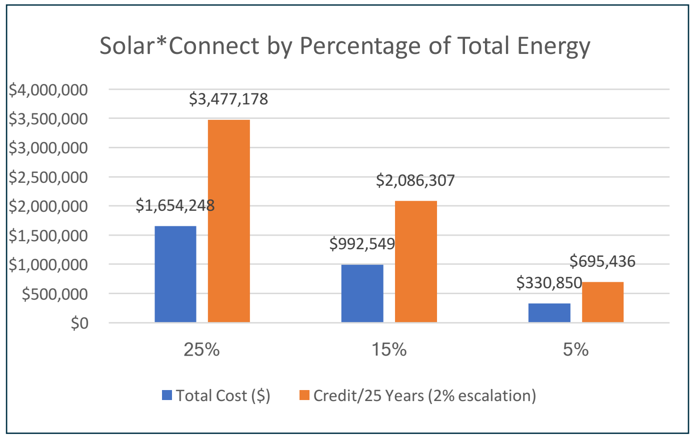


Figure 20. Direct Solar Installation Estimates for Overall Energy Usage

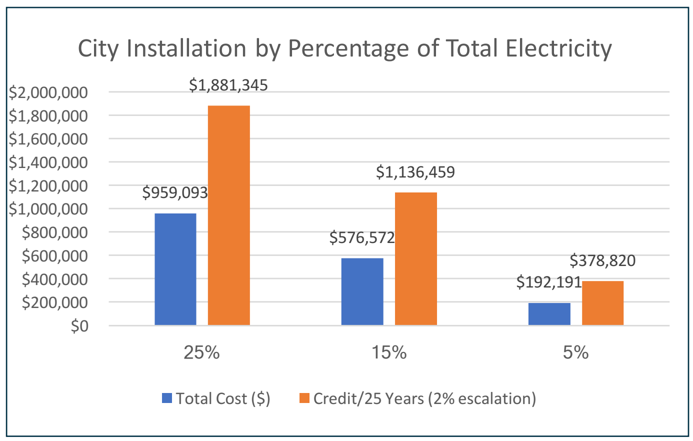
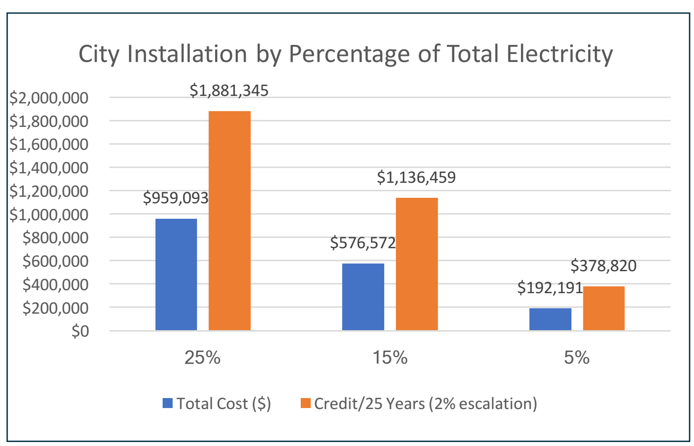


Figure 21. City Owned and Installed Solar Modules by Top Electricity Consuming Building



Direct Solar by Building

Wastewater Treatment Plant

The wastewater treatment plant is the City's largest user of electricity, consuming 921,530 kWh annually and costing the City $77,279 per year. Offsetting 100 percent of this location's electricity needs would cost approximately $1,600,000. The City would save roughly $3.1 million in avoided electricity bills over the 40-year anticipated life of the system. Covering 75 percent, 50 percent, or 25 percent of energy usage would save $2.3 million, $1.5 million, or $770,000 over the 40 years. Because this location makes up such a large proportion of the City's overall electricity needs, we estimate that by offsetting even 60 percent of the wastewater treatment plant's electricity requirements through solar modules would cover 25 percent of the entire City's electricity. To also account for other forms of energy (natural gas, gasoline, and diesel fuel, as well as electricity), then offsetting all of the wastewater treatment plant's electrical consumption as well as an additional 536,491 kWh would be required to provide 25 percent of the City's total energy through solar electricity alone.

Fire Station

The new fire and ambulance station consumes an estimated 178,000 kWh of electricity annually, costing the City $17,000. If the City were to install solar modules to cover 100 percent of the energy needs, it would cost approximately $318,357 and provide an annual savings of $17,000. After the investment is paid off, the City would save $17,000 per year for a total profit of $732,998 after the 40-year life of the system. Installing a system to offset 75 percent, 50 percent, or 25 percent of the usage would result in a total profit of $550,000, $366,000, and $183,000 respectively.

Bretting Recreation Center

Installing sufficient solar modules on the Bretting Recreation Center to offset 100 percent of its net electricity demands would require the installation of a 75 kW array and cost the City roughly $188,000 up front. A 75 kW array can be expected to generate the 106,000 kWh hours that are annually needed. The electrical generation of this array would save the City an estimated $11,000 every year, the cost of their current electricity invoice, and would break even with the investment after the 13th year (adjusted with a 2 percent energy inflation and 0.5 percent panel degradation per year). Over the 40 year estimated lifespan of the panels, the energy generated would save the City a total of $681,000 for a total profit of $492,000. Installing solar panels to cover roughly 75 percent, 50 percent, or 25 percent of total energy usage would result in a total profit of $370,000, $246,000, and $123,000 respectively over the 40-year life.

Public Works

The City of Ashland Public Works department uses roughly 103,000 kWh per year, costing the City $9,000 in electricity annually. Offsetting 100 percent of the usage with solar modules would cost a total of $184,000, with an estimated payback period of about 15 years. During the 40-year life of the modules, the City would save $381,000. Similarly, offsetting 75 percent, 50 percent, and 25 percent of the electricity usage would generate a net profit of $286,000, $110,000, and $95,000 respectively over the 40-year life.

Recommendations for Solar

Even though the Solar*Connect program offers stability with its guaranteed rates and no hidden costs (e.g. for maintenance), the 25-year contract limits the duration of the benefits and the City loses out on an additional 15 years or more of possible savings that could be achieved through installing its own solar arrays.

Installing photovoltaic modules on City-owned property would provide a better "credit" rate, as the credit would be the full retail value of the electricity (currently $0.12/kWh) rather than the lesser rate offered by Xcel ($0.074/kWh).

Both options (subscribing to Xcel's Solar*Connect program versus City-owned and maintained systems) require significant upfront capital. For the Solar*Connect program, no grants are available for purchasing solar production. However, grants may be available for installing solar on municipal buildings that could significantly help offset the costs (e.g., the Wisconsin Public Service Commission recently began a $5 million dollar grant pool to be used in energy innovation projects).

Other potential opportunities for grants include Focus on Energy and sustainability-focused loans such as the PACE (Property Assessed Clean Energy) administered by WECC (Wisconsin Energy Conservation Corporation). Power Purchase Agreements, or PPAs, are becoming more popular with solar installation, where a third party agrees to pay for the installation of the arrays, and the City would pay them through the savings the arrays produce. After an agreed-upon amount of time, the payments would cover the cost of the installation and the ownership would be transferred directly to the municipality.

Figure 22. Estimated Breakeven and Accumulated Payback for Wastewater Treatment

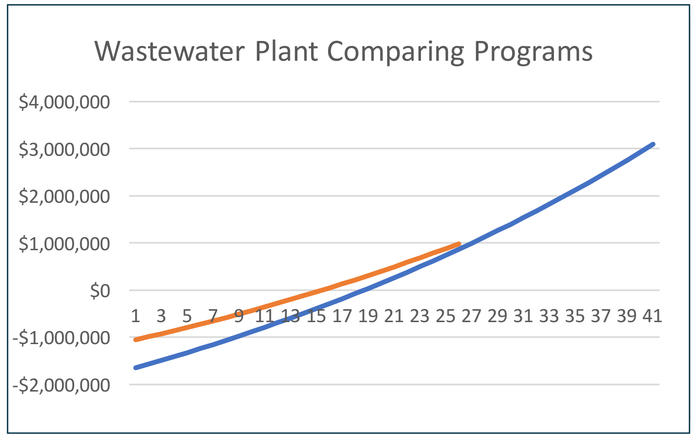


Figure 23. Estimated Breakeven and Accumulated Payback for the Fire Station

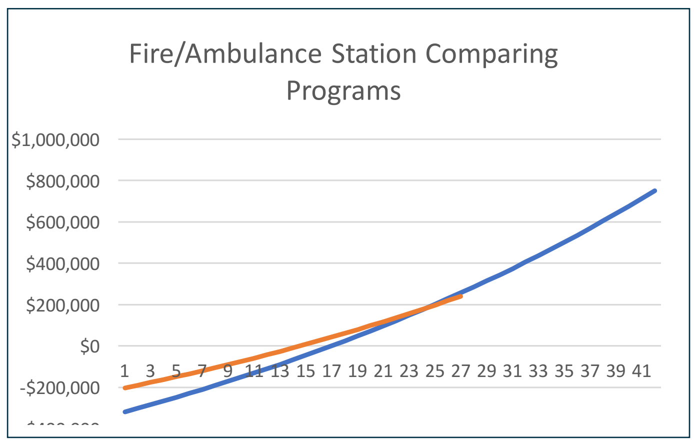


Figure 24. Estimated Breakeven and Accumulated Payback for City Hall

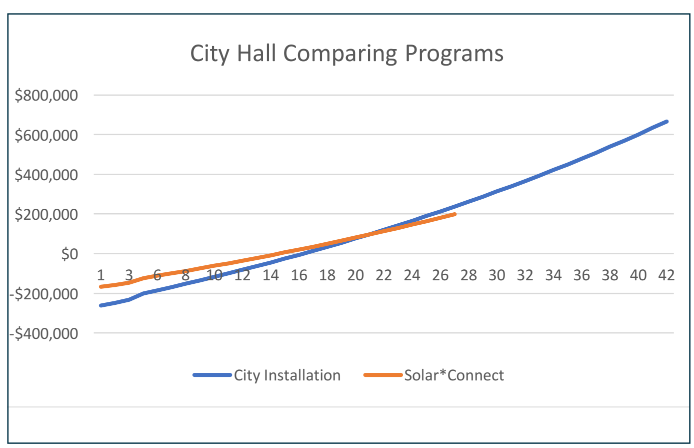


Figure 25. Estimated Breakeven and Accumulated Payback for Wastewater Treatment

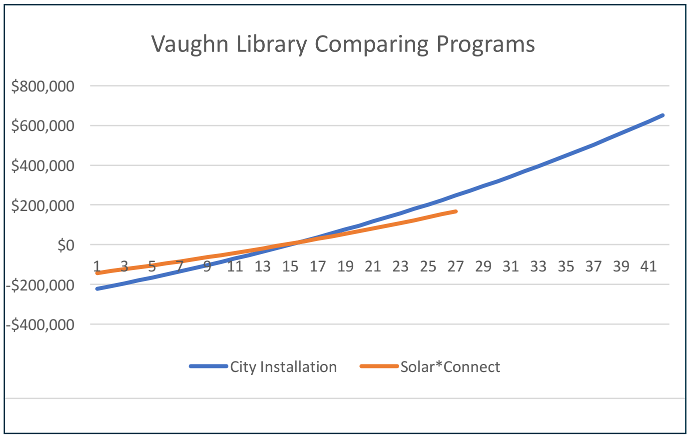


Figure 26. Estimated Breakeven and Accumulated Payback for the Bretting Center

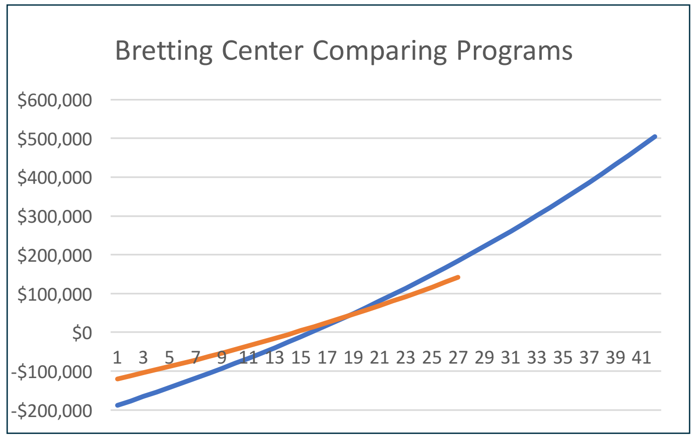


Figure 27. Estimated Breakeven and Accumulated Payback for Public Works

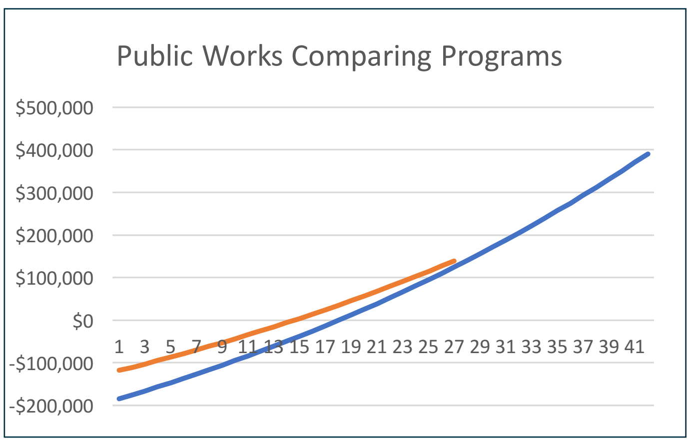
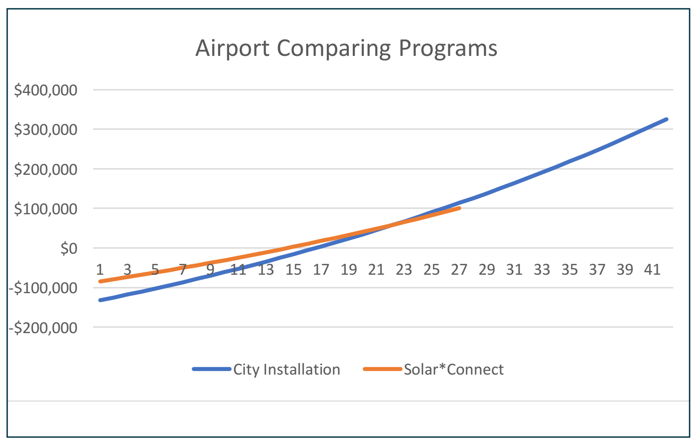


Figure 28. Estimated Breakeven and Accumulated Payback for the Airport



Fleet

In this section, we discuss the City of Ashland's fleet usage data. The City has been tracking fuel usage since 2011 using thirteen codes to categorize expenditures and quantity. Most but not all categories are complete. For example, the code "UTILITY" refers to water and wastewater utilities, and the data for these vehicles is only tracked when fuel is used or purchased from certain locations. Therefore, the data for this department is not completely accurate. However, to the best of our knowledge, most of the other department categories reflect correct fuel usages. We begin this section with an overview summary of fuel usage for the City since 2011. Next, we examine trends in the largest fuel consuming departments or divisions within the City. Finally, we end with recommendations for reducing fuel usage and improving fuel consumption.

Between 2011 and 2017, fuel usage by the City of Ashland remained relatively flat with between 40,014 and 47,641 gallons of fuel consumed per year.

Table 8. City of Ashland Departments and Codes for Tracking Fuel Usage

DEPARTMENT OR DIVISION	CODE
Ashland Housing Authority	AH
Ashland County Aging Unit	ACAU
Bay Area Rural Transit	BART
Bay Area Rural Transit	AFD
Ashland Ambulance	AMBL
Ashland Police Department	APD
Department of Public Works	DPW
Engineering Division	ENG
Parks Department	PARKS
Animal Warden	AW
Facilities Maintenance	FM
City Hall and Library	STAFF
Water and Wastewater Utilities	UTILTY

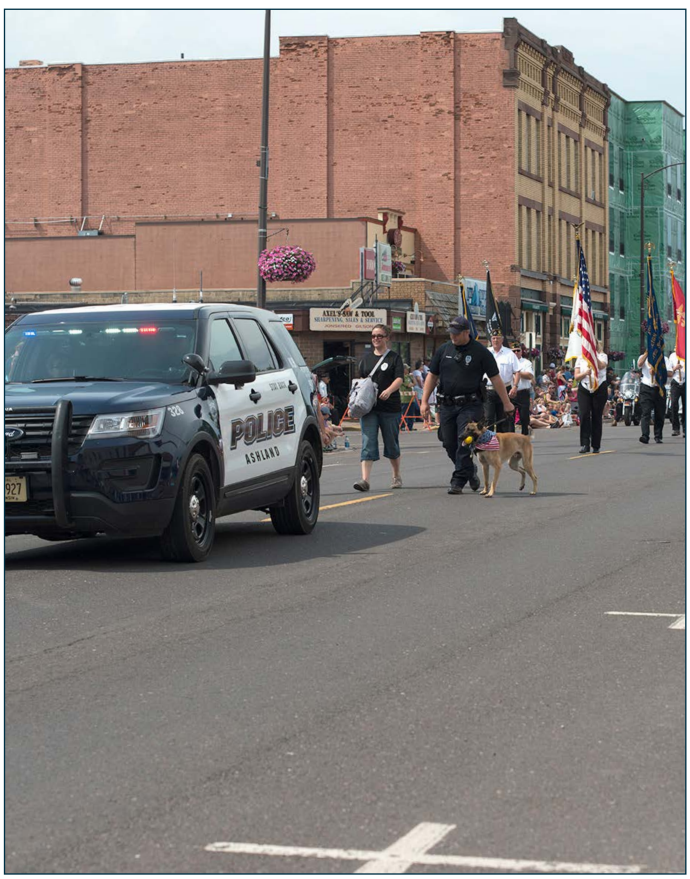
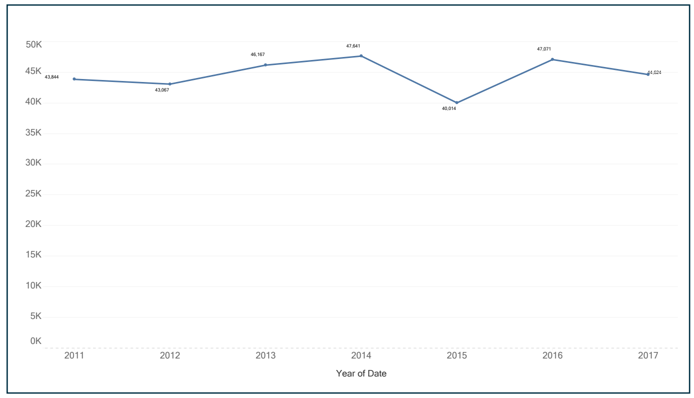
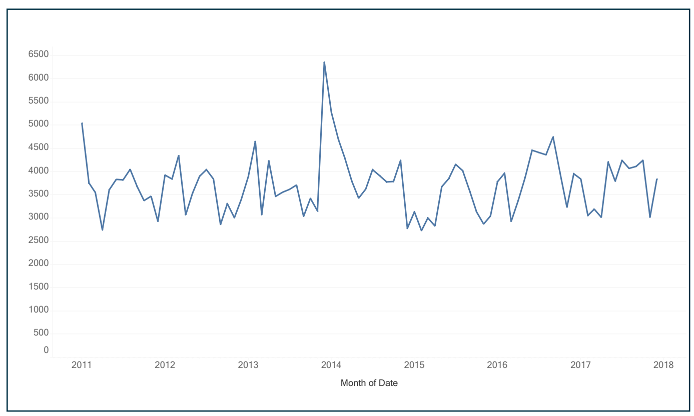


Figure 29. Total Fuel Usage (Gallons) by Year, January 2011- December 2017



Between 2011 and 2017, fuel usage by the City of Ashland remained relatively flat with between 40,014 and 47,641 gallons of fuel consumed per year.

Figure 30. Total Fuel Usage (Gallons) by Month, January 2011- December 2017



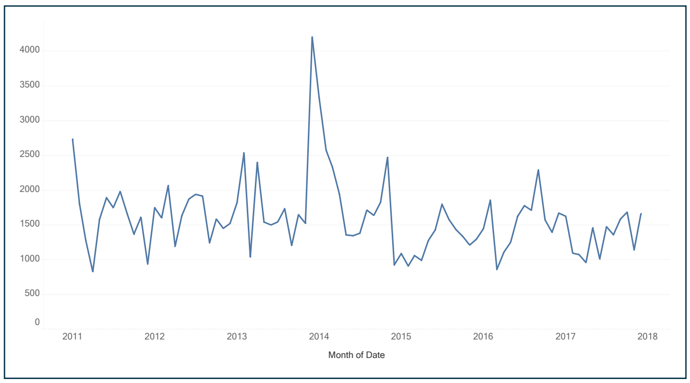
Monthly usage, again, remains consistent from 2011 to 2017 with annual highs typically occurring over the summer months. Occasionally, heavy snowfall months show a significant increase in fuel usage – e.g., the historical high in fuel consumption was December of 2013 with 6,357 gallons, which was the same month Ashland experienced snowfall in excess of thirty inches in a three-day period.

Top Consuming Departments

Isolating the top five largest users of fuel for vehicles, we discuss noticeable trends for each of these departments and provide recommendations for reducing fuel usage.

Public Works

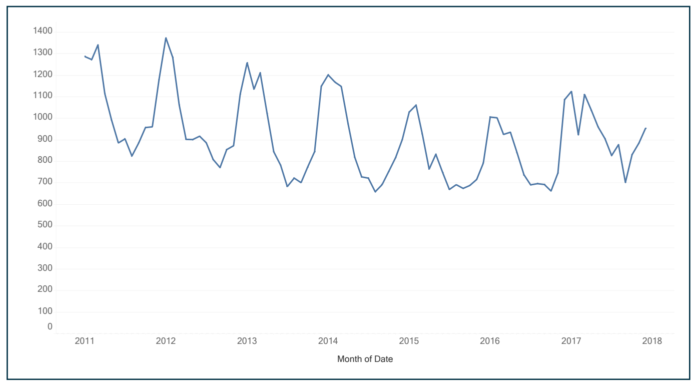
Figure 31. Total Fuel Usage (Gallons) for Public Works by Month, Jan 2011- Dec 2017



The Public Works Department has decreased its average fleet fuel use between 2011 and 2017. Other than the spike to over 3,000 gallons of use in January 2014, there is a decrease in usage from 2,700 gallons in January 2011 to 1,600 in January of 2017.

Ashland Police Department

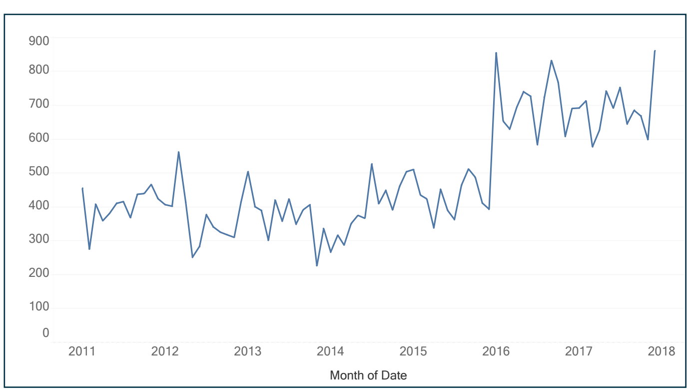
Figure 32. Total Fuel Usage (Gallons) for Ashland Police Department by Month, Jan 2011- Dec 2017



Ashland Police Department also has seen a decrease in overall fuel consumption between 2011 and 2017. The Department used 1,286 gallons in January 2011, whereas In January 2017 the department used 1,125 gallons. The lowest consuming months tend to be in August and September (e.g. in August 2014 only 658 gallons were used).

Ashland Police Department

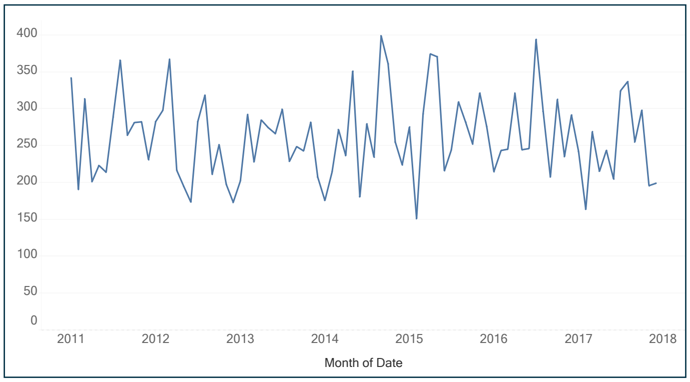
Figure 33. Total Fuel Usage (Gallons) for Ambulance Services by Month, Jan 2011- Dec 2017



Ambulance fuel usage in the City of Ashland has remained fairly consistent with the exception of the new ambulance station coming on-line in 2016 causing a jump in baseline from 393 gallons in December 2015 to 855 gallons in January of 2016. Before the ambulance station was completed, the department used an average of 4,726 every year (2011-2015); after the station was completed the facility used an average of 8,377 gallons a year (in 2016 and 2017).

Ashland Fire Department

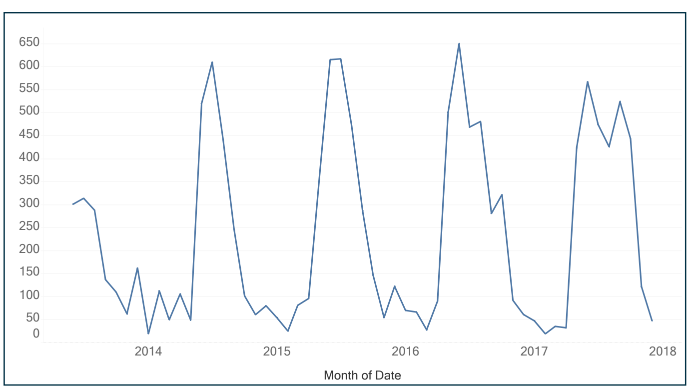
Figure 34. Total Fuel Usage (Gallons) for Ashland Fire Department by Month, Jan 2011- Dec 2017



The Ashland Fire Department has had extremely consistent usage of fleet gasoline between 2011 and 2017. Their lowest-consuming month was in February of 2015 when they used only 150 gallons, whereas their highest-consuming month in the 6 years studied was during July 2016 when the department used 393 gallons of fuel. On average, the Fire Department uses 263 gallons per month.

Parks and Recreation

Figure 35. Total Fuel Usage (Gallons) for Parks and Recreation by Month, Jun 2013- Dec 2017



Ashland Parks and Recreation department has wide annual fluctuations in fleet usage. The month with the lowest usage is consistently February, where in 2017 the department used 19 gallons of fuel, compared to June of 2016 when the usage topped 650 gallons. This trend conforms to the department's activities, most of which are during the summer.

Fleet Recommendations

To prevent unnecessary waste, City employees could undergo energy efficiency training that includes efficient management and deployment of vehicles, reduced idling times, proper and timely vehicle maintenance, prompt closing of doors in heated garages during cold weather, isolating garages from workshops and offices with well-sealing doors, and replacing inefficient vehicles when possible.

The possibility of incorporating electric vehicles into the City's fleet provides opportunities to save energy, as electric vehicles tend to be much more efficient than gasoline or diesel vehicles, requiring as little as one-third as much energy for the same output. City-owned electric vehicles could not only reduce fleet energy consumption, it could also demonstrate to the community the City's commitment to sustainability. However, it should be noted that the greater efficiency of electric vehicles means that they provide significantly less engine heat, an often essential benefit in the cold winter months. In order for vehicle occupants to remain comfortable during the winter, supplemental electric heat would likely be required, quickly eroding the benefits in energy efficiency. Hence, electric vehicles would most economically serve the City during the summer.

Another consideration is that rapid advances in electric vehicle technology promises to offer less expensive vehicles with greater travel ranges in the near future. Investing in electric vehicles now may be far more costly than in the near future and the vehicles may prove less functional and more problematic than continuing to use the City's existing fleet. Any investment in electric vehicles should be strategic and include consideration of seasonal constraints.

Appendix

Xcel Solar*Connect Community Estimates (2/16-3/18)

Name Address ID	Average Annual Electric Invoice ($)	Average Annual Usage (kWh)	% Offset	Solar Subscription Size (kW)	Deposit Amount ($)	Remaining Amount ($)	Total Investment ($)	Annual Bill Credit Estimate ($)	Credit/ 25 Yrs	Credit/25 (yrs) 2% escalation	Payback (yrs)	Payback with 2% escalation (yrs)
Sm Gen Svc	1,548	11622	100	8.3	1,660	11,622	13,282	872	21,790	27,918	15.2	11.9
211 6th St W			75	6.2	1,245	8,716	9,961	654	16,343	20,938	15.2	11.9
303417099			50	4.2	830	5,811	6,641	436	10,895	13,959	15.2	11.9
			25	2.1	415	2,905	3,320	218	5,448	6,979	15.2	11.9
Airp Mintc Bldg	863	5740	100	4.1	820	5,740	6,560	425	10,619	13,605	15.4	12.1
50511 State			75	3.1	615	4,305	4,920	319	7,964	10,204	15.4	12.1
Hwy 112			50	2.1	410	2,870	3,280	212	5,3010	6,803	15.4	12.1
302190096			25	1.0	205	1,435	1,640	106	2,655	3,401	15.4	12.1
Krhr Pk Rstrm	2,512	19752	100	14.1	2,822	19,752	22,574	1,462	36,541	46,817	15.4	12.1
310 Prentice			75	10.6	2,116	14,814	16,930	1,096	27,406	35,112	15.4	12.1
Ave N			50	7.1	1,411	9,876	11,287	731	18,271	23,408	15.4	12.1
302335868			25	3.5	705	4,938	5,643	365	9,135	11,704	15.4	12.1
Hodkns Prk S.	427	2040	100	1.5	291	2,040	2,331	151	3,774	4,835	15.4	12.1
1222 7th St E			75	1.1	219	1,530	1,749	113	2,830	3,626	15.4	12.1
302347645			50	0.7	146	1,020	1,166	75	1,887	2,418	15.4	12.1
			25	0.4	73	510	583	38	944	1,209	15.4	12.1
Prntc Prk Camp	1,411	10180	100	7.3	1,454	10,180	11,634	753	18,833	24,129	15.4	12.1
515 Turner Road			75	5.5	1,091	7,635	8,726	565	14,125	18,097	15.4	12.1
302449200			50	3.6	727	5,090	5,817	377	9,417	12,064	15.4	12.1
			25	1.8	364	2,545	2,909	188	4,708	6,032	15.4	12.1
Lttle Lgu Prk	198	176	100	0.0	0	0	0	0	0	0	N/A	N/A
700 14th Ave W			75	0.0	0	0	0	0	0	0	N/A	N/A
302552596			50	0.0	0	0	0	0	0	0	N/A	N/A
			25	0.0	0	0	0	0	0	0	N/A	N/A
Sm Gen Svc	2,918	23260	100	16.6	3,323	23,260	26,583	1,721	43,031	55,131	15.4	12.1
423 6th St W			75	12.5	2,492	17,445	19,937	1,291	32,273	41,348	15.4	12.1
302562103			50	8.3	1,661	11,630	13,291	861	21,516	27,566	15.4	12.1
			25	4.2	831	5,815	6,646	430	10,758	13,783	15.4	12.1
E End Skt Rnk	366	1546	100	1.1	221	1,546	1,7667	114	2,860	3,664	15.4	12.1
1612 5th St E			75	0.8	166	1,160	1,325	86	2,145	2,748	15.4	12.1
302562242			50	0.6	110	773	883	57	1,430	1,832	15.4	12.1
			25	0.3	55	387	442	29	715	916	15.4	12.1
Hangar	212	235	100	0.2	34	235	269	18	441	565	15.2	11.9
50511 State			75	0.0	0	0	0	0	0	0	N/A	N/A
Hwy 112			50	0.0	0	0	0	0	0	0	N/A	N/A
302644433			25	0.0	0	0	0	0	0	0	N/A	N/A
Bandshell	479	2542	100	1.8	363	2,542	2,905	188	4,702	6,024	15.4	12.1
131 Lake Shore			75	1.4	272	1,906	2,178	141	3,526	4,518	15.4	12.1
Dr W			50	0.9	182	1,271	1,452	94	2,351	3,012	15.4	12.1
302982746			25	0.5	91	635	726	47	1,175	1,506	15.4	12.1
Vaughn Lbr	14,014	124440	100	88.9	17,777	124,440	142,217	9,209	230,214	294,950	15.4	12.1
502 Main St W			75	66.7	13,333	93,330	106,663	6,906	172,661	221,213	15.4	12.1
302984816			50	44.4	8,889	62,220	71,109	4,604	115,107	147,475	15.4	12.1
			25	22.2	4,444	31,110	35,554	2,302	57,554	73,738	15.4	12.1

Xcel Solar*Connect Community Estimates (2/16-3/18) *continued*

Name Address ID	Average Annual Electric Invoice ($)	Average Annual Usage (kWh)	% Offset	Solar Subscription Size (kW)	Deposit Amount ($)	Remaining Amount ($)	Total Investment ($)	Annual Bill Credit Estimate ($)	Credit/ 25 Yrs	Credit/25 (yrs) 2 % escalation	Payback (yrs)	Payback with 2 % escalation (yrs)
Trml Bldg	7,348	74280	100	53.1	10,611	74,280	84,891	5,497	137,418	176,060	15.4	12.1
50511 State Hwy 112			75	39.8	7,959	55,710	63,669	4,123	103,064	132,046	15.4	12.1
302991848			50	26.5	5,306	37,140	42,446	2,748	68,709	88,030	15.4	12.1
			25	13.3	2,653	18,570	21,223	1,374	34,355	44,015	15.4	12.1
Pn Prk Csns	242	462	100	0.3	66	462	527	35	865	1,109	15.2	11.9
901 7th Ave E			75	0.2	49	346	396	26	649	831	15.2	11.9
303093843			50	0.0	0	0	0	0	0	0	N/A	N/A
			25	0.0	0	0	0	0	0	0	N/A	N/A
Cld Stg Bldg	1,149	8153	100	5.8	1,165	8,153	9,317	603	15,082	19,323	15.4	12.1
2020 6th St E			75	4.4	873	6,114	6,988	452	11,312	14,492	15.4	12.1
303105193			50	2.9	582	4,076	4,659	302	7,541	9,662	15.4	12.1
			25	1.5	291	2,038	2,329	151	3,771	4,831	15.4	12.1
Rec Cntr	11,102	105140	100	75.1	15,020	105,140	120,160	7,780	194,509	249,205	15.4	12.1
400 4th Ave W			75	56.3	11,265	78,855	90,120	5,835	145,882	186,904	15.4	12.1
303112466			50	37.6	7,510	52,570	60,080	3,890	97,255	124,602	15.4	12.1
			25	18.8	3,755	26,285	30,040	1,945	48,627	62,301	15.4	12.1
Mas Bch Rstm	571	3201	100	2.3	457	3,201	3,658	240	6,001	7,688	15.2	11.9
3215 Lake Shore Dr W			75	1.7	343	2,400	2,743	180	4,501	5,766	15.2	11.9
303197007			50	1.1	229	1,600	1,829	120	3,000	3,844	15.2	11.9
			25	0.6	114	800	914	60	1,500	1,922	15.2	11.9
Hdk Pklgts	705	1645	100	1.2	235	1,645	1,880	123	3,084	3,952	15.2	11.9
1200 7th St E			75	0.9	176	1,234	1,410	93	2,313	2,964	15.2	11.9
303307401			50	0.6	118	823	940	62	1,542	1,976	15.2	11.9
			25	0.3	59	411	470	304	771	988	15.2	11.9
Prtc Prk Rst	544	2995	100	2.1	428	2,995	3,423	222	5,541	7,099	15.4	12.1
517 Turner Rd			75	1.6	321	2,246	2,567	166	4,156	5,324	15.4	12.1
303335742			50	1.1	214	1,498	1,711	1101	2,770	3,549	15.4	12.1
			25	0.5	107	749	856	55	1,385	1,775	15.4	12.1
Krhr Rv Prk	6,9712	54080	100	38.6	7,726	54,080	61,806	4,002	100,048	128,182	15.4	12.1
310 Prentice Ave N			75	29.0	5,794	40,560	46,354	3,001	75,036	96,136	15.4	12.1
303389302			50	19.3	3,863	27,040	30,903	2,001	50,024	64,091	15.4	12.1
			25	9.7	1,931	13,520	15,451	1,000	25,012	32,045	15.4	12.1
Mas Bch Pvl	296	940	100	0.7	134	940	1,074	70	1,738	2,227	15.4	12.1
3225 Lake Shore Dr W			75	0.5	1001	705	805	52	1,304	1,670	15.4	12.1
303494786			50	0.3	67	470	537	35	869	1,113	15.4	12.1
			25	0.0	0	0	0	0	0	0	N/A	N/A
Penn Prk Rst	312	1081	100	0.8	154	1,081	1,235	81	2,026	2,596	15.2	11.9
922 Willis Ave			75	0.6	116	810	926	61	1,519	1,947	15.2	11.9
303518678			50	0.4	77	540	617	41	1,013	1,298	15.2	11.9
			25	0.0	0	0	0	0	0	0	N/A	N/A
Pbl Wks Bld	9,233	103340	100	73.8	14,763	103,340	118,103	7,647	191,179	244,939	15.4	12.1
2020 6th St E			75	55.4	11,072	77,505	88,577	5,735	143,384	183,704	15.4	12.1
303580956			50	36.9	7,381	51,670	59,051	3,824	95,590	122,469	15.4	12.1
			25	18.5	3,691	25,835	29,526	1,9112	47,795	61,235	15.4	12.1

Name Address ID	Average Annual Electric Invoice ($)	Average Annual Usage (kWh)	% Offset	Solar Subscription Size (kW)	Deposit Amount ($)	Remaining Amount ($)	Total Investment ($)	Annual Bill Credit Estimate ($)	Credit/ 25 Yrs	Credit/25 (yrs) 2 % escalation	Payback (yrs)	Payback with 2 % escalation (yrs)
City Hall	14,909	147120	100	105.1	21,017	147,120	168,137	10,887	272,172	348,707	15.4	12.1
601 Main St W			75	78.8	15,763	110,340	126,103	8,165	204,129	261,530	15.4	12.1
303590846			50	52.5	10,509	73,560	84,069	5,443	136,086	174,353	15.4	12.1
			25	26.3	5,254	36,780	42,034	2,722	68,043	87,177	15.4	12.1
Bvw Prk Rst	876	5763	100	4.1	823	5,763	6,586	426	10,662	13,660	15.4	12.1
1809 Lake Shore Dr E			75	3.1	617	4,322	4,940	3120	7,996	10,245	15.4	12.1
			50	2.1	412	2,882	3,293	213	5,3301	6,830	15.4	12.1
303603030			25	1.0	206	1,441	1,647	107	2,665	3,415	15.4	12.1
Marina	4,495	22280	100	15.9	3,183	22,280	25,463	1,649	41,218	52,809	15.4	12.1
300 Ellis Ave N			75	11.9	2,387	16,710	19,097	1,237	30,914	39,606	15.4	12.1
303705559			50	8.0	1,591	11,140	12,731	824	20,609	26,404	15.4	12.1
			25	4.0	796	5,570	6,366	412	10,305	13,202	15.4	12.1
Hgn Pk Eq Rm	319	1125	100	0.8	161	1,125	1,285	84	2,108	2,701	15.2	11.9
1120 7th St E			75	0.6	120	843	964	63	1,581	2,026	15.2	11.9
303820841			50	0.4	80	562	643	42	1,054	1,351	15.2	11.9
			25	0.2	40	281	321	21	527	675	15.2	11.9
W End Rnk	402	1929	100	1.4	276	1,929	2,205	145	3,617	4,634	15.2	11.9
601 Main St W			75	1.0	207	1,447	1,653	108.9	2,713	3,475	15.2	11.9
303825973			50	0.7	138	965	1,102	72	1,808	2,317	15.2	11.9
			25	0.3	69	482	551	36	904	1,158	15.2	11.9
Airport	288	880	100	0.6	126	880	1,006	66	1,650	2,114	15.2	11.9
50511 State Hwy 112 Gate			75	0.5	94	660	754	450	1,238	1,585	15.2	11.9
			50	0.3	63	440	503	33	825	1,057	15.2	11.9
303963830			25	0.0	0	0	0	0	0	0	N/A	N/A
St Lt Svc	775	10404	100	7.4	1,486	10,404	11,890	770	19,247	24,660	15.4	12.1
825 Main St W			75	5.6	1,115	7,803	8,918	577	14,436	18,495	15.4	12.1
304178140			50	3.7	743	5,202	5,945	385	9,624	12,330	15.4	12.1
			25	1.9	372	2,601	2,973	192	4,812	6,165	15.4	12.1
Gen TOD Svc	17,150	178280	100	127.3	25,469	178,280	203,749	13,193	329,818	422,563	15.4	12.1
215 6th St E			75	95.5	19,101	133,710	152,811	9,895	247,364	316,922	15.4	12.1
304500475			50	63.7	12,734	89,140	101,874	6,596	164,909	211,281	15.4	12.1
			25	31.8	6,367	44,570	50,937	3,298	82,455	105,641	15.4	12.1
Sm Gen Svc			100	0.0	0	0	0	0	0	0	N/A	N/A
323 Stuntz Ave N			75	0.0	0	0	0	0	0	0	N/A	N/A
304520171			50	0.0	0	0	0	0	0	0	N/A	N/A
			25	0.0	0	0	0	0	0	0	N/A	N/A
Wstwtr Utility	77,279	921530	100	658.2	131,647	921,530	1,053,177	63,586	1,589,639	2,036,646	16.6	12.9
1901 Knight Rd			75	493.7	98,735	691,146	789,883	47,689	1,192,229	1,527,484	16.6	12.9
			50	329.1	65,824	460,765	526,589	31,793	794,820	1,018,323	16.6	12.9
302154453			25	164.6	32,912	230,383	263,294	15,896	397,410	509,161	16.6	12.9
Main Lftstn	47,207	261058	100	186.5	37,2934	261,058	298,351	18,013	450,324	576,955	16.6	12.9
314 11th Ave E			75	139.9	27,970	195,793	223,764	13,510	337,743	432,717	16.6	12.9
302152769			50	93.2	18,647	130,529	149,176	9,006	225,162	288,478	16.6	12.9
			25	46.6	9,323	65,264	74,588	4,503	112,581	144,239	16.6	12.9

Xcel Solar*Connect Community Estimates (2/16-3/18) *continued*

Name Address ID	Average Annual Electric Invoice ($)	Average Annual Usage (kWh)	% Offset	Solar Subscription Size (kW)	Deposit Amount ($)	Remaining Amount ($)	Total Investment ($)	Annual Bill Credit Estimate ($)	Credit/ 25 Yrs	Credit/25 (yrs) 2 % escalation	Payback (yrs)	Payback with 2 % escalation (yrs)
6th Ave Lftstn	4,080	33380	100	23.8	4,769	33,380	38,149	2,470	61,753	79,118	15.4	12.1
523 Lake Shore Dr			75	17.9	3,576	25,035	28,611	1,853	46,315	59,338	15.4	12.1
			50	11.9	2,384	16,690	19,074	1,235	30,877	39,559	15.4	12.1
302307545			25	6.0	1,192	8,345	9,537	618	15,438	19,779	15.4	12.1
27th Ave Lftstn	750	4354	100	3.1	622	4,354	4,976	322	8,055	10,320	15.4	12.1
2614 Lake Shore Dr			75	2.3	467	3,266	3,732	242	6,041	7,740	15.4	12.1
			50	1.6	311	2,177	2,488	161	4,027	5,160	15.4	12.1
303562018			25	0.8	1556	1,089	1,244	81	2,014	2,580	15.4	12.1
Trnr Rd Lftstn	1,111	7193	100	5.1	1,028	7,193	8,221	532	13,307	17,049	15.4	12.1
524 Turner Rd			75	3.9	771	5,395	6,165	399	9,980	12,787	15.4	12.1
303648977			50	2.6	514	3,597	4,110	266	6,654	8,525	15.4	12.1
			25	1.3	257	1,798	2,055	133	3,327	4,262	15.4	12.1
TOTAL	102,638	924627	**100**	1537.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			75	1152.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			50	768.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			25	383.6	32,888	580,932	613,820	40,282	1,007,048	1,290,230	15.2	11.9
			200KW Max	200.0	40,000	280,000	320,000	21,000	525,000	672,630	15.2	11.9

City Owned Solar Installation (2/16-3/18)

Name Address ID	Average Annual Electric Invoice ($)	Average Annual Usage (kWh)	% Offset	Solar Subscription Size (kW)	Total Investment ($)	Annual Bill Credit Estimate ($)	Savings/25 Yrs	Savings/25 yrs (0.5% annual degradation)	Savings/25 yrs (2%escalation)	Complicated Savings/ 25 yrs (degradation & escalation)	Simple Savings/40 yrs (conservative est. of life modules)	Savings/40 yrs (0.5% annual degradation)	Savings/40 yrs (2% escalation)	Complicated Savings/ 40 yrs (degradation & escalation)	Payback(yrs)	Payback with 2 % escalation (yrs)
Sm Gen Svc	1,548	11622	100	8.3	20,753	1,548	38,700	34,149	50,586	50,333	66,726	50,682	95,393	94,916	13.4	10.3
211 6th St W			75	6.2	15,565	1,161	29,031	25,612	37,939	37,750	61,538	38,011	71,545	71,187	13.4	10.3
303417099			50	4.2	10,376	774	19,354	17,075	25,293	25,166	56,350	25,341	47,697	47,458	13.4	10.3
			25	2.1	5,188	387	9,677	8,537	12,646	12,583	51,162	12,670	24,235	23,729	13.4	10.3
Airp Mintc Bldg	862.57	5740	100	4.1	10,250	862.57	21,564	19,024	28,181	28,040	36,870	28,234	53,143	52,877	11.9	9.1
50511 State Hwy 112			75	3.1	7,688	647	16,173	14,268	21,136	21,030	34,308	21,176	39,857	39,658	11.9	9.1
			50	2.1	5,125	431	10,782	9,512	14,090	14,020	31,745	14,117	26,571	26,439	11.9	9.1
302190096			25	1.0	2,563	216	5,391	4,756	7,045	7,010	29,183	7,059	13,501	13,219	11.9	9.1
Krhr Pk Rstrm	2,511.59	19752	100	14.1	35,271	2,512	62,790	55,394	82,056	81,646	108,609	82,211	154,739	153,965	14.0	10.8
310 Prentice Ave N			75	10.6	26,454	1,884	47,092	41,547	61,542	61,234	99,792	61,659	116,054	115,474	14.0	10.8
			50	7.1	17,636	1,256	31,395	27,697	41,028	40,823	90,974	41,106	77,370	76,983	14.0	10.8
302335868			25	3.5	8,818	628	15,697	13,849	20,5134	20,411	82,156	20,553	39,313	38,491	14.0	10.8
Hodkns Prk S.	427	2040	100	1.5	3,643	427	10,684	9,425	13,962	13,892	17,935	13,988	26,329	26,197	8.5	6.6
1222 7th St E			75	1.1	2,732	321	8,013	7,069	10,471	10,419	17,025	10,491	19,747	19,648	8.5	6.6
302347645			50	0.7	1,821	2134	5,342	4,713	6,981	6,946	16,114	6,994	13,165	13,090	8.5	6.6
			25	0.4	911	107	2,671	2,356	3,490	3,473	15,203	3,497	6,689	6,549	8.5	6.6
Prntc Prk Camp	1,411	10180	100	7.3	18,179	1,411	35,279	31,124	46,104	45,873	60,645	46,191	86,942	86,507	12.9	9.9
515 Turner Road			75	5.5	13,634	1,058	26,459	23,343	34,578	34,405	56,100	34,643	65,206	64,880	12.9	9.9
302449200			50	3.6	9,089	706	17,640	15,562	23,052	22,937	51,555	23,096	43,471	43,253	12.9	9.9
			25	1.8	4,545	353	8,820	7,781	11,526	11,468	47,011	11,548	22,088	21,627	12.9	9.9
Lttle Lgu Prk	198	176	00	0.0	0	0	0	0	0	0	0	0	0	0	NA	NA
700 14th Ave W			75	0.0	0	0	0	0	0	0	0	0	0	0	NA	NA
302552596			50	0.0	0	0	0	0	0	0	0	0	0	0	NA	NA
			25	0.0	0	0	0	0	0	0	0	0	0	0	NA	NA
Sm Gen Svc	2,918	23260	100	16.6	41,536	2,918	72,942	64,351	95,323	94,846	126,299	95,504	179,758	178,859	14.2	10.9
423 6th St W			75	12.5	31,152	2,188	54,706	48,263	71,492	71,135	115,915	71,628	134,818	134,144	14.2	10.9
302562103			50	8.3	20,768	1,459	36,471	32,175	47,661	47,423	105,532	47,752	89,879	89,429	14.2	10.9
			25	4.2	10,384	729	18,235	16,088	23,831	23,712	95,148	23,876	45,669	44,715	14.2	10.9
E End Skt Rnk	366	1546	100	1.1	2,761	366	9,154	8,075	11,962	11,902	15,283	11,985	22,558	22,445	7.5	5.8
1612 5th St E			75	0.8	2,071	275	6,865	6,057	8,972	8,927	14,593	8,989	16,918	16,834	7.5	5.8
302562242			50	0.6	1,380	183	4,577	4,038	5,981	5,951	13,903	5,992	11,279	11,223	7.5	5.8
			25	0.3	690	92	2,288	2,019	2,991	2,976	13,213	2,996	5,731	5,611	7.5	5.8

City Owned Solar Installation (2/16-3/18) *continued*

Name Address ID	Average Annual Electric Invoice ($)	Average Annual Usage (kWh)	% Offset	Solar Subscription Size (kW)	Total Investment ($)	Annual Bill Credit Estimate ($)	Savings/25 Yrs	Savings/25 yrs (0.5% annual degradation)	Savings/25 yrs (2%escalation)	Complicated Savings/ 25 yrs (degradation & escalation)	Simple Savings/40 yrs (conservative est. of life modules)	Savings/40 yrs (0.5% annual degradation)	Savings/40 yrs (2% escalation)	Complicated Savings/ 40 yrs (degradation & escalation)	Payback(yrs)	Payback with 2 % escalation (yrs)
Hangar	212	235	100	0.2	420	212	5,37	4,682	6,935	6,901	8,590	6,948	13,070	13,013	2.0	1.5
50511 State Hwy 112			75	0.0	0	0	0	0	0	0	0	0	0	0	NA	NA
302644433			50	0.0	0	0	0	0	0	0	0	0	0	0	NA	NA
			25	0.0	0	0	0	0	0	0	0	0	0	0	NA	NA
Bandshell	479	2542	100	1.8	4,538	479	11,986	10,575	15,664	15,586	20,226	15,694	29,539	29,391	9.5	7.3
131 Lake Shore Dr W			75	1.4	3,404	360	8,990	7,931	11,748	11,689	19,092	11,770	22,154	22,043	9.5	7.3
302982746			50	0.9	2,269	240	5,993	5,287	7,832	7,793	17,957	7,847	14,769	14,696	9.5	7.3
			25	0.5	1,135	120	2,997	2,644	3,916	3,896	16,822	3,923	7,505	7,348	9.5	7.3
Vaughn Lbr	14,014	124440	100	88.9	222,214	14,014	350,356	309,091	457,858	455,569	611,890	458,725	863,418	859,101	15.9	12.2
502 Main St W			75	66.7	166,661	10,511	262,767	231,818	343,393	341,676	556,336	344,044	647,563	644,325	15.9	12.2
302984816			50	44.4	111,107	7,007	175,178	154,546	228,929	227,784	500,782	229,363	431,709	429,550	15.9	12.2
			25	22.2	55,554	3,504	87,589	77,273	114,464	113,892	445,229	114,681	219,358	214,775	15.9	12.2
Trml Bldg	7,348	74280	100	53.1	132,643	7,348	183,689	162,054	240,051	238,851	324,536	240,506	452,683	450,420	18.1	13.9
50511 State Hwy 112			75	39.8	99,482	5,511	137,767	121,541	180,039	179,138	291,375	180,3806	339,513	337,815	18.1	13.9
302991848			50	26.5	66,321	3,674	91,844	81,027	120,026	119,426	258,214	120,253	226,342	225,210	18.1	13.9
			25	13.3	33,161	1,837	45,922	40,514	60,013	59,713	225,054	60,127	115,008	112,605	18.1	13.9
Pn Prk Csns	242	462	100	0.3	824	242	6,047	5,335	7,903	7,863	9,869	7,918	14,903	14,828	3.4	2.6
901 7th Ave E			75	0.2	618	181	4,535	4,001	5,927	5,897	9,663	5,938	11,177	11,121	3.4	2.6
303093843			50	0.0	0	0	0	0	0	0	0	0	0	0	NA	NA
			25	0.0	0	0	0	0	0	0	0	0	0	0	NA	NA
Cld Stg Bldg	1,149	8153	100	5.8	14,558	1,149	28,725	25,342	37,539	37,351	49,322	37,610	70,790	70,436	12.7	9.7
2020 6th St E			75	4.4	10,919	862	21,544	19,006	28,154	28,013	45,682	28,207	53,092	52,827	12.7	9.7
303105193			50	2.9	7,279	575	14,362	12,671	18,769	18,676	42,043	18,805	35,395	35,218	12.7	9.7
			25	1.5	3,640	287	7,181	6,335	9,385	9,338	38,403	9,402	17,985	17,609	12.7	9.7
Rec Cntr	11,102	105140	100	75.1	187,750	11,102	277,552	244,862	362,715	360,902	487,444	363,402	684,000	680,580	16.9	13.0
400 4th Ave W			75	56.3	140,813	8,327	208,164	183,647	272,037	270,676	440,506	272,552	513,000	510,435	16.9	13.0
303112466			50	37.6	93,875	5,551	138,776	122,431	181,358	180,451	393,569	181,701	342,000	340,290	16.9	13.0
			25	18.8	46,938	2,776	69,388	61,216	90,679	90,225	346,631	90,851	173,776	170,145	16.9	13.0
Mas Bch Rstm	571	3201	100	2.3	5,715	571	14,276	12,595	18,657	18,563	24,162	18,692	35,182	35,006	10.0	7.7
3215 Lake Shore Dr W			75	1.7	4,286	428	10,707	9,446	13,993	13,923	22,733	14,019	26,387	26,255	10.0	7.7
303197007			50	1.1	2,858	286	7,138	6,297	9,328	9,282	21,304	9,346	17,591	17,503	10.0	7.7
			25	0.6	1,429	143	3,569	3,149	4,664	4,641	19,876	4,673	8,938	8,752	10.0	7.7

City Owned Solar Installation (2/16-3/18) *continued*

Name Address ID	Average Annual Electric Invoice ($)	Average Annual Usage (kWh)	% Offset	Solar Subscription Size (kW)	Total Investment ($)	Annual Bill Credit Estimate ($)	Savings/25 Yrs	Savings/25 yrs (0.5% annual degradation)	Savings/25 yrs (2%escalation)	Complicated Savings/ 25 yrs (degradation & escalation)	Simple Savings/40 yrs (conservative est. of life modules)	Savings/40 yrs (0.5% annual degradation)	Savings/40 yrs (2% escalation)	Complicated Savings/ 40 yrs (degradation & escalation)	Payback (yrs)	Payback with 2 % escalation (yrs)
Hdk Pklgts	705	1645	100	1.2	2,938	705	17,615	15,540	23,020	22,905	28,862	23,063	43,410	43,193	4.2	3.2
1200 7th St E			75	0.9	2,203	528	13,211	11,655	17,265	17,178	28,128	17,297	32,557	32,395	4.2	3.2
303307401			50	0.6	1,469	352	8,807	7,770	11,510	11,452	27,393	11,532	21,705	21,596	4.2	3.2
			25	0.3	734	176	4,404	3,885	5,755	5,726	26,659	5,766	11,029	10,798	4.2	3.2
Prtc Prk Rst	544	2995	100	2.1	5,348	544	13,603	12,001	17,777	17,688	22,999	17,810	33,523	33,355	9.8	7.6
517 Turner Rd			75	1.6	4,011	408	10,202	9,000	13,332	13,266	21,662	13,358	25,142	25,016	9.8	7.6
303335742			50	1.1	2,674	272	6,801	6,000	8,888	8,844	20,325	8,905	16,761	16,678	9.8	7.6
			25	0.5	1,337	136	3,401	3,000	4,444	4,422	18,988	4,453	8,517	8,339	9.8	7.6
Krhr Rv Prk	6,972	54080	100	38.6	96,571	6,972	174,298	153,769	227,779	226,640	301,179	228,210	429,540	427,392	13.9	10.7
310 Prentice Ave N			75	29.0	72,429	5,229	130,723	115,327	170,834	169,980	277,037	171,158	322,155	320,544	13.9	10.7
303389302			50	19.3	48,286	3,486	87,149	76,885	113,889	113,320	252,894	114,105	214,770	213,696	13.9	10.7
			25	9.7	24,143	1,743	43,574	38,442	56,945	56,660	228,751	57,053	109,128	106,848	13.9	10.7
Mas Bch Pvl	296	940	100	0.7	1,678	296	7,412	6,539	9,672	9,622	12,245	9,705	18,237	18,145	5.7	4.4
3225 Lake Shore Dr W			75	0.5	1,258	222	5,559	4,904	7,253	7,217	11,826	7,279	13,677	13,609	5.7	4.4
303494786			50	0.3	839	148	3,706	3,270	4,835	4,811	11,406	4,852	9,118	9,073	5.7	4.4
			25	0.0	0	0	0	0	0	0	0	0	0	0	NA	NA
Penn Prk Rst	312	1081	100	0.8	1,929	312	7,812	6,892	10,209	10,158	12,945	10,229	19,253	19,156	6.2	4.7
922 Willis Ave			75	0.6	1,447	234	5,859	5,169	7,657	7,619	12,463	7,672	14,439	14,367	6.2	4.7
303518678			50	0.4	965	156	3,906	3,446	5,105	5,079	11,980	5,114	9,626	9,578	6.2	4.7
			25	0.0	0	0	0	0	0	0	0	0	0	0	NA	NA
Pbl Wks Bld	9,233	103340	100	73.8	184,536	9,233	230,830	203,643	301,658	300,149	411,947	302,229	568,859	566,015	20	15.4
2020 6th St E			75	55.4	138,402	6,925	173,123	152,732	226,243	225,112	365,813	226,672	426,644	424,511	20	15.4
303580956			50	36.9	92,268	4,617	115,415	101,822	150,829	150,075	319,679	151,115	284,429	283,007	20	15.4
			25	18.5	46,134	2,308	57,708	50,911	75,414	75,037	273,545	75,557	144,523	141,504	20	15.4
City Hall	14,909	147120	100	105.1	262,714	14,909	372,731	328,831	487,098	484,663	657,043	488,021	918,558	913,965	17.6	13.6
601 Main St W			75	78.8	197,036	11,182	279,548	246,623	365,324	363,497	591,364	366,016	688,919	685,474	17.6	13.6
303590846			50	52.5	131,357	7,455	186,365	164,415	243,549	242,331	525,685	244,010	459,279	456,983	17.6	13.6
			25	26.3	65,679	3,727	93,183	82,208	121,775	121,166	460,007	122,005	233,367	228,491	17.6	13.6
Bvw Prk Rst	876	5763	100	4.1	10,291	876	21,891	19,313	28,608	28,465	37,403	28,662	53,949	53,679	11.8	9.0
1809 Lake Shore Dr E			75	3.1	7,718	6567	16,418	14,485	21,456	21,349	34,830	21,497	40,462	40,259	11.8	9.0
303603030			50	2.1	5,146	438	10,946	9,656	14,304	14,233	32,257	14,331	26,974	26,840	11.8	9.0
			25	1.0	2,573	219	5,473	4,828	7,152	7,116	29,684	7,166	13,706	13,420	11.8	9.0

City Owned Solar Installation (2/16-3/18) *continued*

Name Address ID	Average Annual Electric Invoice ($)	Average Annual Usage (kWh)	% Offset	Solar Subscription Size (kW)	Total Investment ($)	Annual Bill Credit Estimate ($)	Savings/25 Yrs	Savings/25 yrs (0.5% annual degradation)	Savings/25 yrs (2%escalation)	Complicated Savings/ 25 yrs (degradation & escalation)	Simple Savings/40 yrs (conservative est. of life modules)	Savings/40 yrs (0.5% annual degradation)	Savings/40 yrs (2% escalation)	Complicated Savings/ 40 yrs (degradation & escalation)	Payback (yrs)	Payback with 2 % escalation (yrs)
Marina	4,495	22280	100	15.9	39,786	4,495	112,379	99,143	146,861	146,127	188,995	147,139	276,947	275,562	8.9	6.8
300 Ellis Ave N			75	11.9	29,839	3,371	84,284	74,357	110,146	109,595	179,048	110,354	207,710	206,672	8.9	6.8
303705559			50	8.0	19,893	2,248	56,189	49,571	73,430	73,063	169,102	73,570	138,473	137,781	8.9	6.8
			25	4.0	9,946	1,1234	28,095	24,786	36,715	36,532	159,155	36,785	70,361	68,891	8.9	6.8
Hgn Pk Eq Rm	319	1125	100	0.8	2,008	319	7,972	7,033	10,418	10,366	13,219	10,438	19,646	19,547	6.3	4.8
1120 7th St E			75	0.6	1,506	239	5,979	5,275	7,813	7,774	12,717	7,828	14,734	14,661	6.3	4.8
303820841			50	0.4	1,004	159	3,986	3,516	5,200	5,183	12,215	5,219	9,823	9,774	6.3	4.8
			25	0.2	502	80	1,993	1,758	2,604	2,591	11,713	2,609	4,991	4,887	6.3	4.8
W End Rnk	402	1929	100	1.4	3,445	402	10,054	8,870	13,139	13,074	16,882	13,164	24,778	24,654	8.6	6.6
601 Main St W			75	1.0	2,583	302	7,541	6,653	9,854	9,805	16,021	9,873	18,583	18,490	8.6	6.6
303825973			50	0.7	1,722	201	5,027	4,435	6,570	6,537	15,160	6,582	12,389	12,327	8.6	6.6
			25	0.3	861	101	2,514	2,218	3,285	3,268	14,299	3,291	6,295	6,163	8.6	6.6
Airport	288	880	100	0.6	1,571	288	7,210	6,3601	9,422	9,375	11,899	9,440	17,768	17,679	5.4	4.2
50511 State Hwy 112 Gate			75	0.5	1,179	216	5,407	4,771	7,067	7,031	11,506	7,080	13,326	13,260	5.4	4.2
303963830			50	0.3	786	144	3,605	3,180	4,711	4,688	11,113	4,720	8,884	8,840	5.4	4.2
			25	0.0	0	0	0	0	0	0	0	0	0	0	NA	NA
St Lt Svc	775	10404	100	7.4	18,579	775	19,383	17,100	24,677	24,553	34,925	25,378	46,535	46,302	24.0	18.9
825 Main St W			75	5.6	13,934	581	14,537	12,825	18,508	18,415	30,280	19,033	34,901	34,726	24.0	18.9
304178140			50	3.7	9,289	388	9,691	8,550	12,338	12,277	25,635	12,689	23,267	23,151	24.0	18.9
			25	1.9	4,645	194	4,846	4,275	6,169	6,138	20,991	6,344	11,822	11,576	24.0	18.9
Gen TOD Svc	17,150	178280	100	127.3	318,357	17,150	428,761	378,262	560,320	557,519	759,542	561,382	1,056,639	1,051,356	18.6	14.3
215 6th St E			75	95.5	238,768	12,863	321,571	283,696	420,240	418,139	679,952	421,037	792,479	788,517	18.6	14.3
304500475			50	63.7	159,179	8,575	214,381	189,131	280,160	278,759	600,363	280,691	528,320	525,678	18.6	14.3
			25	31.8	79,589	4,2878	107,190	94,565	140,080	139,380	520,774	140,346	268,447	262,839	18.6	14.3
Sm Gen Svc			100	0.0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
323 Stuntz Ave N			75	0.0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
304520171			50	0.0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
			25	0.0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Wstwtr Utility	77,279	921530	100	658.2	1,645,589	77,279	1,931,982	1,704,434	2,524,785	2,512,161	3,471,217	2,529,568	2,524,785	4,737,373	21.3	16.4
1901 Knight Rd			75	493.7	1,234,192	57,959	1,448,987	1,278,325	1,893,588	1,884,120	3,059,820	1,897,176	1,893,588	3,553,030	21.3	16.4
302154453			50	329.1	822,7945	38,640	965,991	852,217	1,262,392	1,256,080	2,648,423	1,264,784	1,262,392	2,368,687	21.3	16.4
			25	164.6	411,397	19,320	482,996	426,108	631,196	628,040	2,237,025	632,392	631,196	1,184,343	21.3	16.4

City Owned Solar Installation (2/16-3/18) *continued*

Name Address ID	Average Annual Electric Invoice ($)	Average Annual Usage (kWh)	% Offset	Solar Subscription Size (kW)	Total Investment ($)	Annual Bill Credit Estimate ($)	Savings/25 Yrs	Savings/25 yrs (0.5% annual degradation)	Savings/25 yrs (2%escalation)	Complicated Savings/ 25 yrs (degradation & escalation)	Simple Savings/40 yrs (conservative est. of life modules)	Savings/40 yrs (0.5% annual degradation)	Savings/40 yrs (2% escalation)	Complicated Savings/ 40 yrs (degradation & escalation)	Payback (yrs)	Payback with 2 % escalation (yrs)
Main Lftstn	47,207	261057.5	100	186.5	466,174	47,207	1,180,182	1,041,181	1,542,305	1,534,593	1,995,954	1,545,227	2,908,442	2,893,900	9.9	7.6
314 11th Ave E			75	139.9	349,631	35,405	885,137	780,886	1,156,729	1,150,945	1,879,410	1,158,920	2,181,332	2,170,425	9.9	7.6
302152769			50	93.2	233,087	23,604	590,091	520,590	771,152	767,297	1,762,866	772,614	1,454,221	1,446,950	9.9	7.6
			25	46.6	116,544	11,802	295,046	260,295	385,576	383,648	1,646,323	386,307	738,912	723,475	9.9	7.6
6th Ave Lftstn	4,080	33380	100	23.8	59,607	4,080	101,991	89,979	133,286	132,620	176,952	133,539	251,348	250,091	14.6	11.2
523 Lake Shore Dr			75	17.9	44,705	3,060	76,494	67,484	99,965	99,4645	162,051	100,154	188,511	187,568	14.6	11.2
302307545			50	11.9	29,804	2,040	50,996	44,989	66,643	66,310	147,149	66,769	125,674	125,045	14.6	11.2
			25	6.0	14,902	1,020	25,498	22,495	33,323	33,155	132,247	33,385	63,857	62,523	14.6	11.2
27th Ave Lftstn	750	4354	100	3.1	7,775	750	18,754	16,545	24,508	24,386	31,802	24,555	46,217	45,986	10.4	8.0
2614 Lake Shore Dr			75	2.3	5,831	563	14,066	12,400	18,381	18,289	29,858	18,416	34,663	34,480	10.4	8.0
303562018			50	1.6	3,888	375	9,377	8,273	12,254	12,193	27,915	12,277	23,109	22,993	10.4	8.0
			25	0.8	1,944	188	4,689	4,136	6,127	6,096	25,971	6,139	11,742	11,497	10.4	8.0
Trnr Rd Lftstn	1,111	7193	100	5.1	12,845	1,111	27,778	24,506	36,301	36,120	47,411	36,370	68,456	68,114	11.6	8.9
524 Turner Rd			75	3.9	9,633	833	20,834	18,380	27,226	27,090	44,200	27,278	51,342	51,085	11.6	8.9
303648977			50	2.6	6,422	556	13,889	12,253	18,151	18,060	40,989	18,185	34,228	34,057	11.6	8.9
			25	1.3	3,211	278	6,945	6,127	9,075	9,030	37,7778	9,093	17,392	17,028	11.6	8.9
TOTAL	233,066		100	1537.1	3,842,796	233,066	5,826,639	5,140,379	7,607,337	7,569,300	10,201,826	7,622,419	12,109,342	14,274,008	16.5	12.6
			75	1152.7	2,881,782	174,799	4,369,979	3,855,284	5,700,301	5,671,800	9,232,642	5,711,603	9,072,198	10,695,746	16.5	12.6
			50	768.3	1,920,776	116,533	2,913,3120	2,570,190	3,796,249	3,777,268	8,262,592	3,803,777	6,040,680	7,123,083	16.5	12.6
			25	383.6	959,093	58,266	1,456,660	1,285,095	1,890,799	1,881,345	7,268,999	1,894,545	3,045,080	3,547,796	16.5	12.6

Center for Rural Communities
NORTHLAND COLLEGE

The Northland College Center for Rural Communities applies research-based solutions to social and economic challenges, partners with community members to build on local knowledge, and promotes the long-term health and vitality of rural communities in the north woods region.
For more information, visit us at:
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CRC Staff

- **Brandon Hofstedt**, Faculty Director of the Center for Rural Communities, Associate Professor of Sustainable Community Development

- **Robin Kemkes**, Faculty Research Associate at the Center for Rural Communities

- **Sean Akerman**, Faculty Research Associate at the Center for Rural Communities

You can reach us at:

Center for Rural Communities
Northland College
1411 Ellis Avenue
Ashland, WI 54806
crc@northland.edu