The University of Wisconsin Oshkosh

Creating a Solar Future in the City of Oshkosh

Proposal for the City of Oshkosh Sustainability Advisory Board

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Environmental Studies 490: Senior Seminar
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Executive Summary

Fossil fuel emissions have been on the rise since the industrial revolution in the 19th century and are contributing to the climate change crisis. Because the majority of energy worldwide is produced through the burning of coal, a major contributor to the current 401 parts per million of carbon dioxide in our atmosphere, it has never been more important to find alternative renewable energy sources.

This report illustrates how the implementation of solar photovoltaic technology on publicly owned buildings in the City of Oshkosh can reduce the city's ecological footprint, increase monthly savings on electric utility costs, contribute to Wisconsin's green economy, and advance the goals of the city's sustainability plan. Furthermore, the initial proposal investigated the implementation of solar panels on City of Oshkosh owned buildings. While the following report is still discussing this, our findings indicate that the implementation of solar panels on city-owned buildings is a long term goal, and further collaboration and research is needed for a successful transition into solar energy.

This report outlines stakeholders, identified in Oshkosh and surrounding areas, as people and businesses that affect the successful implementation of a City of Oshkosh solar project. Collaborative efforts that engage all stakeholders and the City of Oshkosh departments are critical in advancing solar technology to city buildings. Most critically, establishing a proper site selection process for potential solar should be targeted at energy-intensive buildings, which will create the most productive solar panel projects. Using criteria based on average yearly solar exposure, roof type, and electric utility usage and price, estimations regarding initial cost and return on investment can be established. This report outlines Oshkosh North High School as a prime example of solar installation in the City of Oshkosh.

Benchmarking is an opportunity to see how solar infrastructure is being incorporated into other cities and to evaluate the success of other projects in comparison to a potential solar plan for the City of Oshkosh. This report evaluates potential financial models to subsidize the initial cost of implementation and reduce the timeline for return on investment. While some barriers were identified, that may limit financial options, and there are several opportunities and models that increase financial resources for municipalities like the City of Oshkosh.

The benefits of solar go far beyond the ecological and economic analysis but aims to build stronger communities and encourage citizens to engage and take pride in their city. While additional research and collaboration is needed before solar is a feasible option for the City of Oshkosh, the research presented in this report illustrates the benefits and ways for the City of Oshkosh to move forward with solar projects in the future.

Background

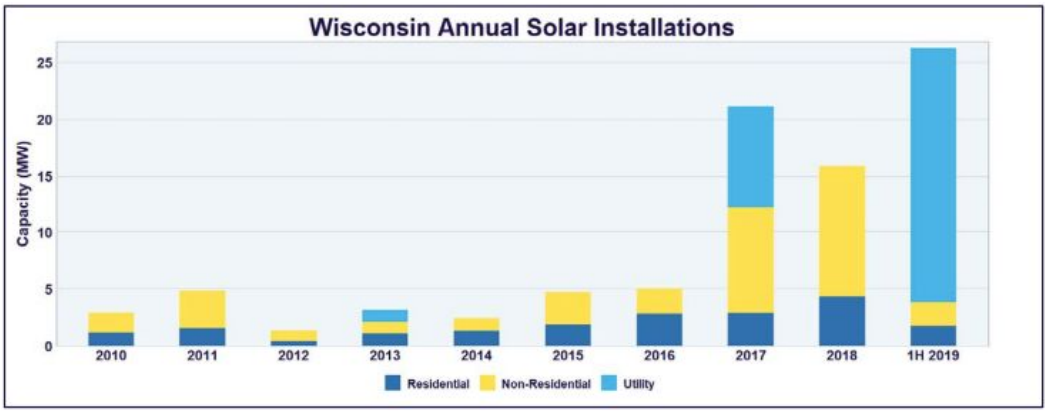
Building Wisconsin's Green Economy

The renewable energy market is growing in Wisconsin. The Bureau of Labor Statistics places solar photovoltaic installation as the fastest growing profession in the state, with a 63.3% change from 2018 - 2028 (Fastest Growing Occupations). With an estimated 92.79 MW of solar installed in the state as of June 2019, the growth rate projection ranks Wisconsin at 21st in the nation with over 981 MW of solar production over the next five years (Wisconsin Solar). See figure 1. Solar prices continue to fall due to improved technology and learned proficiency in manufacturing nationwide (Hamilton). As a result, it is predicted that over the next five years, the overall cost of solar in Wisconsin will fall by 32% (Wisconsin Solar). Clean energy, predominantly solar energy, is projected to be a key component in growing Wisconsin's green economy and allows the state to match neighboring states' efforts in solar energy production. See figure 2.

In addition to the exponential projected growth in the solar industry throughout Wisconsin, Governor Tony Evers signed 2019 Executive Order #38 Relating to Clean Energy in Wisconsin (Executive Order). Referencing the threat that climate change has on the state of Wisconsin, Section 2a of the order declares that, by 2050, all electricity consumed in the state of Wisconsin must be carbon-free (Executive Order). In the state of Wisconsin, La Crosse, Eau Claire, Madison, Middleton, and Monona have committed to 100% renewable energy by 2050, and have made additional strides in achieving this goal through the implementation of solar energy.

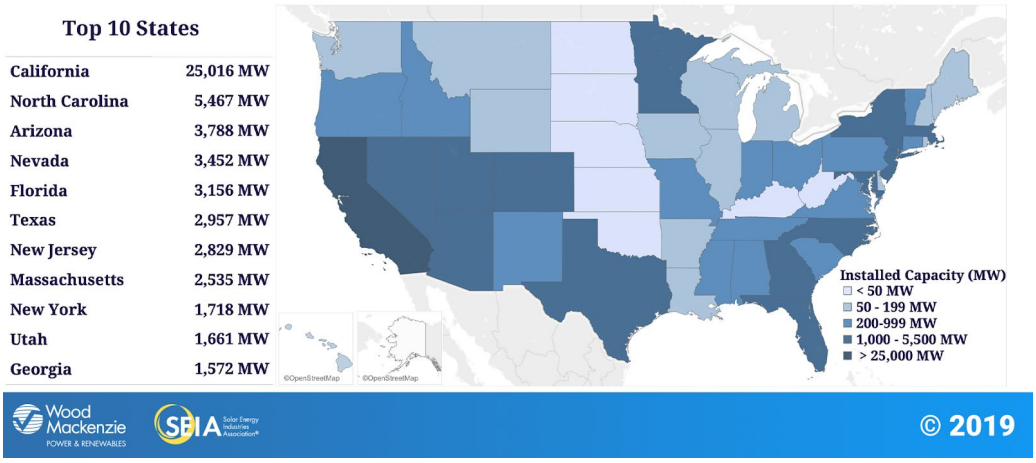
Two years ago, the City of Green Bay, WI, pledged to incorporate solar on select city buildings. After the Wisconsin Department of Revenue delegated nearly $18 million of excess Lambeau Field sales tax back to the municipalities of Brown County, the City of Green Bay put out a request for proposals on how to utilize the funds (Bollier). Eland Electric, a company that has expertise in solar infrastructure and installation throughout Northeast Wisconsin, submitted a proposal and was awarded $60,000 to start a solar project in Green Bay (Michalski). While still in the infancy stage, the City of Green Bay is a key example of the expansion in solar energy in Wisconsin municipalities. This further supports the data on the exponential growth of the solar industry. As Northeast Wisconsin continues to expand solar utility and infrastructure, it will not only be contributing to the environmental sustainability associated with establishing sources of clean energy but also contribute to growing the green economy throughout the State of Wisconsin.

Figure 1



Solar Spotlight - Wisconsin . 2019, *Solar Spotlight - Wisconsin* www.seia.org/sites/default/files/2019-09/Factsheet_Wisconsin.pdf.

Figure 2



"Solar Industry Research Data." *SEIA*, www.seia.org/solar-industry-research-data.

Problem Identification

Climate change is the defining issue of our time, and it is a consensus among the scientific community that its effects will compromise humanity's health and prosperity (Climate Change). The fifth assessment report released by the Intergovernmental Panel on Climate Change states that climate change is real and human activities are the leading cause (Climate Change). As societies advance and as the world population continues to grow exponentially, energy demands have also increased.

One of the major impacts of climate change we are already seeing in the City of Oshkosh and surrounding areas are the increased algal blooms evident in the Great Lakes and the lake system in the Fox/ Wolf Watershed. These algal blooms can be attributed to the increased rainfall and storm frequency as a direct result of climate change. These storms increase runoff into our riverways and lakes, affecting water quality and the integrity of the vulnerable ecosystems (What Climate Change Means for Wisconsin).

Greenhouse gas emissions result from the burning of fossil fuels with the most abundant, accounting for two-thirds of greenhouse gas emissions, which is carbon dioxide (Climate Change). According to scientists, the safe level of carbon dioxide in the air is 350 parts per million (ppm). However, since the industrial revolution in the 19th century, the amount has grown exponentially from about 208ppm to 401ppm in 2016 (Setiawan). The state of Wisconsin currently relies on the burning of fossil fuels as over 50% of Wisconsin's electricity is generated from coal. A transition to renewable energy sources, such as solar photovoltaic technology, is necessary to reduce not only the ecological footprint of the City of Oshkosh and the entire state but will allow the city to become more economically self-sufficient (U.S. Energy Information Administration).

While current renewable energy use data in the City of Oshkosh is limited, the sustainability plan is striving towards more renewable energy use in the future. Within the Oshkosh Sustainability Plan, the city wants to ensure that building codes allow for the development of more renewable energy sources. Also, residents and businesses are encouraged to look into more sustainable energy imports offered by Wisconsin Public Services (City of Oshkosh). More cities and states nationwide are committing to more sustainable futures, Oshkosh is looking to follow a similar path. Currently, there are a few renewable energy sources within the UW Oshkosh campus, including Sage Hall and the Career and Education Resource Center. These are a few of the more well-known examples around the city. Other buildings, like the Oshkosh Senior Center, have been evaluated for solar feasibility, and the data can be used for future proposals.

The company Sunvest in May of this year surveyed the Oshkosh Senior Center in collaboration with the City Planning department. They did a comprehensive evaluation of the building and created a detailed proposal; this can be found in the appendix. Their preliminary findings showed where they would put the panels, the upfront cost, and benefits, the return on investment timeline, and how much energy and cost savings would result in implementation.

They propose 80 of the 72 cell tier 1 330W solar modules, and this system would produce an estimated 32750 kWh after one year of production. They show that the solar panels will offset 33% of the energy demands of the building. This is a decent offset, and when they attach this cost, this has more meaning. They determined that if solar was to be installed on the Senior Center Building, that over $115,000 would be saved in energy utility costs over a 30-year period. This payback period may seem long, but this is in line with many other solar payback programs currently. This proposal is an example of solar panel viability in the City of Oshkosh that can be used as a model for future research. It lays out precisely what is needed for initial plans, and lays the ground for more individualized focus according to specific projects. This proposal is the future for other proposals like this, and action must be taken to further these project plans. Individuals, organizations, and city departments outlined later in the report are encouraged to be collaborated with in order to achieve proper solar feasibility in Oshkosh.

Social opinion can definitely be a barrier when pursuing projects with renewable energies. These new technologies require access to natural resources and the environment, leading to them being placed in highly visible areas. There is a strong movement that pushes the "not in my backyard" slogan. This group voices concern over the aesthetics and the unknowns of these technologies. Many feel as well that the large systems ruin the landscape. This can be a hurdle for many programs wishing to move forward with projects of this type. However, out of all renewables solar, depending on application type can be hidden in urban settings effectively. Solar energy is also the least controversial of renewable energy technologies. The current social climate is such that projects like this can breakthrough and succeed. A lot can be done to counteract these fears, such as education, through community outreach. By working through the concerns of a community in a learning environment, it is easier to foster new options and growth.

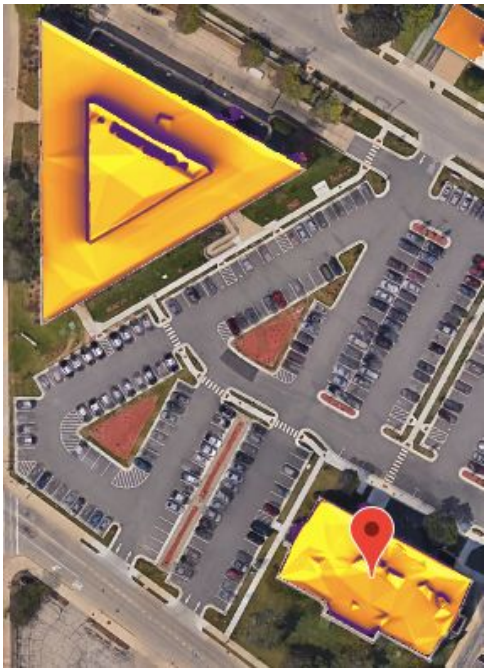
Proposed Action

Taking into account all of the data provided throughout the remainder of this report, we strongly suggest that the City of Oshkosh seriously consider implementing solar panel systems on select city-owned buildings. This action will put Oshkosh at the forefront of solar infrastructure and renewable energy production within Northeast Wisconsin. If Oshkosh is successful at implementing a solar program, it can act as a model for other cities in the state. Because this technology has not been implemented at the city level in many Wisconsin cities, further collaboration with city departments, educational institutions, and regional solar companies is needed for a successful solar project outcome. Additional research and collaborative action allows for the further development of Wisconsin's green economy.

Google: Project Sunroof

Google: Project Sunroof is a program that uses Google aerial and thermal imaging software. In addition, it provides estimated calculations on upfront costs, average monthly savings, and estimated total savings over a 20 year period after the solar purchase (Project Sunroof). The interactive data explorer utilizes Google's mapping and computing resources to evaluate the total solar potential for the region. While this tool is targeted at individual homeowners and calculates in the 30% federal tax credit provided for solar installation, the data is still useful in determining solar exposure, viability, and potential impact. According to Project Sunroof for the City of Oshkosh, in the 54901 area code, 75% of buildings have solar-viability (Project Sunroof). In addition, while this report is not recommending any specific building in which to implement solar panel systems, utilizing criteria provided by solar contractors and Project Sunroof methodology, the City of Oshkosh water treatment Plant, police department, and city hall prove to be viable options. See figure 7.

Figure 7



City Hall: 215 Church Ave Police Department: 420 Jackson	Water Treatment Plant: 233 N Campbell Rd

"Project Sunroof - Data Explorer | 54901." *Google Project Sunroof*, Google, Nov. 2018, www.google.com/get/sunroof/data-explorer/place/ChIJnZEMbEHqA4gRfdRx1lJxo-A/#?overlay=flux.

Public Opinions on Solar energy

There are growing concerns about the longevity of our fossil fuel sources and the negative economic, environmental, and social impacts of fossil fuels. The world is beginning to see the effects these unrenewable fuel sources are having on the integrity of the planet. Alternatives to these fuel sources have been developed and are being continuously improved upon, increasing in popularity over time. This increasing popularity can be seen not only in media and social movements but also in government policies. The shift in thinking and social norms has helped the renewable energy sector grow tremendously. To analyze these changes in opinions, surveys, and data are presented that show an overall increase in approval and acceptance of solar and other renewable energy sources.

The first study categorized demographic differences based on political opinion, age, the prioritization level of implementing new technologies, etc. On average, this poll found that "Two-thirds of Americans give priority to developing alternative energy over fossil fuels" (Kennedy). This survey was conducted by the Pew Research Center from 2011 through 2017. The first study shows that, on average, Americans favor prioritizing and development of alternative energy sources over the expansion of the fossil fuel industry. The graph trend provided shows the increasing percentage from 2011 growing through 2017. The trend is increasing over the seven years, and future predictions assume that the trend will continue to increase positively. Currently, 65% of U.S. adults are in favor of alternative energies, while 27% are in favor of the expansion of fossil fuels (Kennedy). See figure 3.

Next, the divide between Republicans and Democrats and their energy priorities are represented. Democrats and Republicans, both on average, have a majority of support for the expansion of wind and solar energy. While Democratic voters tend to prioritize the development of these technologies, their counterparts hold a close majority as well. Republicans overall state that developing these alternative sources is a priority, but the majority still wish to continue to expand the production of fossil fuels (Kennedy). See figure 4. However, there continues to be majority support for the development of alternative energy technologies between both parties.

The last graph focuses on how age influences opinions on alternative energies and fossil fuels. Younger people (18-29) tend to favor prioritizing alternative energy sources at 75% over the expansion of fossil fuels, while the older generations still prioritize it at 50%. The poll overall shows that the population wants to see more development of these renewable technologies, and it is across the board supported. The divided views are becoming less, and this shows that this is a critical time to move forward with solar projects. See figure 5.

The overall state of public opinion on solar is very high currently, as illustrated in the previous surveys. However, there is still debate on alternative energies, and public opinion is subject to many influences. Looking closer at this idea, we used the Public acceptance of renewable energy technologies from an abstract versus concrete perspective and the positive imagery of solar power study. This poll gathered opinion data on solar focusing on public perceptions. Still, more specifically, it looks at how they propose the questions and whether the

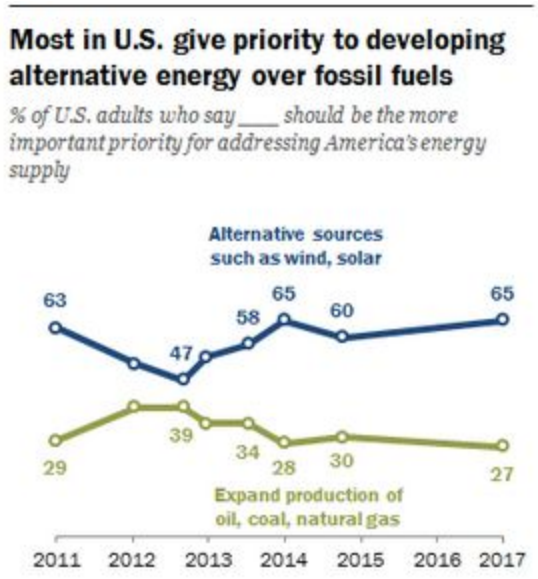
ideas proposed are abstract or concrete. The study focused on how people think about renewable energy topics and how language can influence perception. They concentrate on presentation and language because they want to use their findings to develop effective communication strategies in policymaking to positively impact public perception of energy systems. See figure 6.

As for the implications of this study on policy making, it seems to have an encouraging effect on how language will be used to address this topic moving forward. The researchers also decided that if people are allowed to develop a deeper understanding of the system and the trade-offs, this could mitigate the negative reactions among people who were conscious of moving forward with these projects. By doing this, they create an accurate picture of solar power, and this imagery will be linked with an overall acceptance of renewables. This is all achieved by making sure to ask the right types of questions, discussing ways to judge the level of acceptance, and how to present the topic in a way that connects on a concrete level. That will be the predictor of public acceptance.

The public perception of renewables is at an all-time high; however, solar power is further illustrated in a positive light as having additional symbolic qualities. Solar panels are tied to a positive community outlook that is valuable for attracting interested people to the city. These associations can make or break a project, so positive connections and examples must be successfully implemented before, during, and after a project to ensure its continued success.

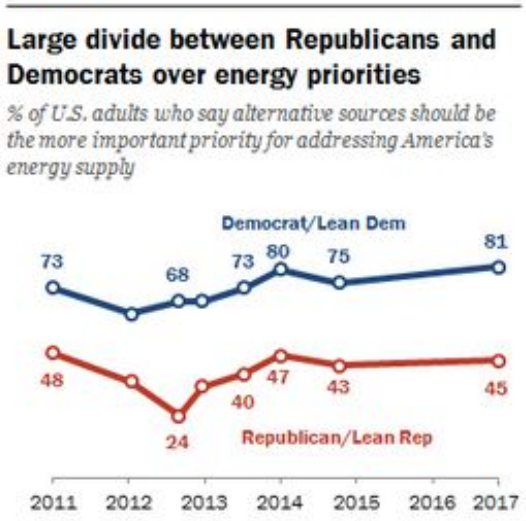
In summary, these public opinion polls looked at different aspects of the solar power debate. Collectively, the surveys illustrated the growing trend towards the acceptance of renewable energy sources across the board. The first study was divided into demographic categories, while the other ignored individual backgrounds and analyzed the overall acceptance of the technological change. The studies showed not only an overall positive trend of renewable energy acceptance but showed that solar energy was the frontrunner for social acceptance. Solar is seen as the least invasive and least controversial of the vast renewable energies available. In conclusion, solar projects and initiatives are vastly accepted by the public and are likely to be supported by the Oshkosh community. This support helps give validity to the timing of our project. We see that now is the time to propose these projects.

Figure 3



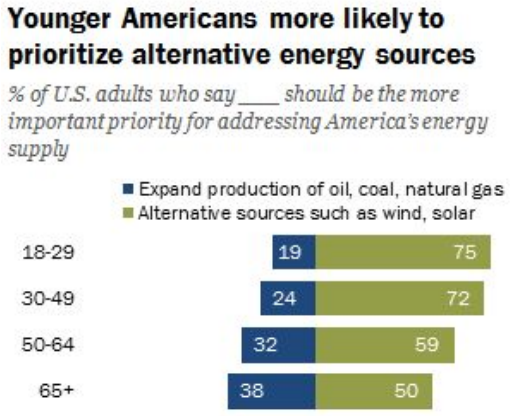
Kennedy, Brian. "Most in US Say Alternative Energy Takes Priority over Fossil Fuels." Pew Research Center, Pew Research Center, 23 Jan. 2017

Figure 4



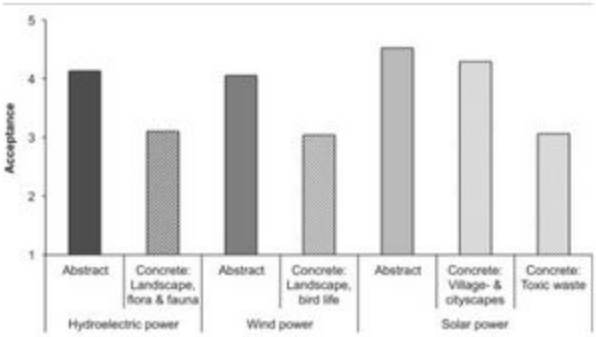
Kennedy, Brian. "Most in US Say Alternative Energy Takes Priority over Fossil Fuels." Pew Research Center, Pew Research Center, 23 Jan. 2017

Figure 5



Kennedy, Brian. "Most in US Say Alternative Energy Takes Priority over Fossil Fuels." Pew Research Center, Pew Research Center, 23 Jan. 2017

Figure 6



The acceptance rate for hydroelectric, wind and solar power, and the abstract or concept way presenting the topic.

Sütterlin, Bernadette, and Michael Siegrist. Public Acceptance of Renewable Energy Technologies from an Abstract Versus Concrete Perspective and the Positive Imagery of Solar Power. vol. 106, , 2017

Stakeholders

Sunvest Solar. Inc

Chris Collins: Project Manager

Chris Collins is a lead project manager for Sunvest Solar and has been working with solar projects since 2005. Sunvest Solar is committed to producing a more sustainable future for the coming American generations. For our project, Chris is a key stakeholder because of his interest in solar communities, his prior work with solar within our area, and his company potentially could carry out this project. Being in the solar industry for so long, Chris understands the keys to success and how to maximize the efficiency of solar power. Chris was very in favor of this solar infrastructure project because he thinks it is essential for communities to start making a switch to more sustainable ways of producing energy before it is too late. During the interview, he explained what type of roofs were the most effective, buildings that use the most energy are the most efficient, and community involvement are all very important. He mentioned being able to get specific statistics for installation costs and return investments on city buildings within Oshkosh to push our project forward. Not only did he mention how important it is to switch to renewables, but Sunvest also wants its customers and communities to be informed on how to become more sustainable and in what ways solar can fulfill some of these sustainability needs.

City of Oshkosh

Jon Urben: General Services Manager

Jon Urben is the general services manager for the city of Oshkosh. He is keen on sustainability and the switch to a greener community. Having the role of the City of Oshkosh General Services Manager, Jon has the ability to review any projects run through the city and evaluate the effects of these projects. His role and the department would be the leading group to oversee the development of a potential solar project and review the plans, specifications, and determine the contractor. In an interview with him, Jon stated that while solar undoubtedly has potential, he cautioned about immediate implementation as the city departments do not have enough background, research, or education on the topic. He suggested, prior to making an official recommendation, that we further promote education and community collaboration of relevant stakeholders. In this regard, an additional section was added to this report to establish relationships with educational institutions and foster roundtable discussions about solar feasibility in the City of Oshkosh. Efforts have been made in the past; however, the information provided throughout this report may lead to interesting future discussions.

City of Oshkosh

Steven Wiley: Assistant Planner with Planning Services and Community Development

Steven Wiley is the assistant planner with planning services and community development for the city of Oshkosh, and he also supports the sustainability board. Steven is important for this project because he bridges the divide between multiple groups within our project. As a part of the city staff, he interacts with numerous other city stakeholders and can inform us about their general opinions and concerns for our project. When asked about the general views of the staff and board members, he identified a few people in the community who had attempted these projects and replied with what went well and the setbacks they faced. He also shared some general opinions of the board; we used the concerns to make sure that we addressed those points of concern thoroughly. When asked about his personal opinion of the project and solar in general, he stated that he has a particular interest in solar and has studied it on and off. He believes that if the technology exists, why not harness this potential energy for the city's benefit. Steven thinks that the city could become self-sufficient, and that would be popular amongst many of the council and city staff.

Eland Electric Corp.

Jesse Michalski: Solar Specialist

Eland Electric Corporation is a team of electricians that work throughout the State of Wisconsin and has a growing presence in the Fox Valley region. Jesse Michalski is the solar specialist for the company that has spent the past 16 years as an electrician and has developed a specialty in solar as the company expanded its renewable energy efforts. Michalski's expertise in not only working with other municipalities to implement solar but on the specifications and codes that go along with successful solar energy production is vital to successfully harnessing solar as a sustainable energy source. Roof type, building age, average daily sun exposure, building's current energy usage, and utility prices, are a few key components to take into account when implementing a rooftop solar system. Recommendations made from Michalski reflected these factors as he stated that schools, fire departments, city garages, etc. typically have flat roofs, high utility rates, and usage and decent solar exposure, making these buildings excellent candidates for solar implementation. In addition to Michalski's recommendations on site selection, he was able to provide insight on initial costs and return on investment for implementing solar systems in the City of Oshkosh.

Greater Oshkosh Economic Development Corporation

Audra Hoy: Director of Business & Economic Development

Audra Hoy is an active community member serving on the Shapiro STEM Academy Board (President), Oshkosh Food Co-op Site Selection Committee (Team Lead), Alta Resources Center for Entrepreneurship & Innovation Advisory Board, Town of Algoma Planning Commission (Vice-Chair), Town of Algoma Economic Development Committee, and Northeast Wisconsin Modern Quilt Guild (President). Coupled with her role at Greater Oshkosh Economic Development Corporation, Audra is uniquely qualified to speak about the impacts of implementing solar panels on city owned buildings. She emphasizes that the financial timeline of the project is not a concern because if the return on investment exists, then the city will benefit from the cost savings in the long run. Audra advised, that if a solar project were implemented, in light of the recent conversations regarding water utility costs for residents, would recommend full transparency to City of Oshkosh residents on how the city is utilizing the energy savings. See appendix A.

Benchmarking

Madison

The city of Madison, WI, is taking strides towards becoming a renewable energy leader within the state and is making progress within its solar energy department specifically. Madison's goal is to create a state of balance between the natural and built environments wherein humans, plants, and animal communities live in harmony (City of Madison). One of the first steps is educating the community on the importance of renewables and why the transition is important for the future. The City of Madison's sustainability page offers a program called MadiSun, which provides lower costs to residents and businesses by buying together. There are also free community education sessions offered to teach how solar works and why renewables, in general, are greater than fossil fuels (City of Madison). There are two leading community solar examples found within Madison: the Alicia Ashman Library and the engineering service building. The library displays within its entrance an educational display of how photovoltaic energy systems work. It was installed in 2008 and generates 8,665kwh of energy equaling 6.9 tons of carbon savings annually (City of Madison). The engineering service building was installed in 2007 and generated 5,254kwh of energy-saving 4.2 tons of carbon annually (City of Madison). With solar energy on the rise, Madison intends on working towards a zero net energy standard by 2030 for new buildings and project developments (City of Madison). This is similar to Oshkosh's sustainability goals for 2020 and is something to look towards in the future.

La Crosse and Eau Claire

The cities of La Crosse and Eau Claire WI, have been taking steps in the right direction with solar power. They have made room for solar energy to grow in their communities by collecting research regarding solar energy as it relates to planning, permitting, and education ("Getting Started With Solar"). They are doing this to help become recognized as SolSmart cities. SolSmart is an organization funded by the U.S Department of Energy Solar Energy Technologies Office ("Nationally Distinguished. Locally Powered"). Their goal is to make it faster, easier, and more affordable to go solar. SolSmart helps local governments and organizations by providing no-cost technical assistance to help the communities become "open for solar business." Individually, La Crosse is hoping to earn recognition from SolSmart, through their tiered program.

There are three tiers; the first is bronze, silver, and the highest tier is gold. Since they had launched this program in 2016, the organization had more than 300 cities, counties, or regional organizations that have achieved one of their designations ("Nationally Distinguished. Locally Powered"). La Crosse is also being advised by the Midwest Renewable Energy Association (MREA) to assist in professional training with solar PV and thermal systems. This technical training helps the city with its objectives towards the SolSmart designation and helping to increase the efficiency of all local processes related to solar development. The city has now created a solar permitting checklist for citizens to follow when they are installing solar; they also have finance and incentive resources along with solar mapping and production value resources available. These are here to help citizens figure out initial cost and planning tools to help them implement solar on their homes and buildings.

Eau Claire is furthering its initiatives to create a solar-friendly community by awarding businesses, organizations, and individuals with environmentally sustainable awards targeted at renewables and solar energy. Furthermore, their designated "Green Team" is promoting and educating the community on how to appropriately incorporate solar energy. They also provide additional resources on how to find a solar contractor, financial incentives, and the social, economic, and environmental benefits (City of Eau Claire).

Currently, La Crosse and Eau Claire are supporting solar advancements and are educating their communities on solar. Both cities recognize that sustainability is a collaborative effort, and to further the creation of city-wide solar projects; they must also support citizens, businesses, and organizations in their efforts to adopt sustainable practices themselves.

Fayetteville, Arkansas

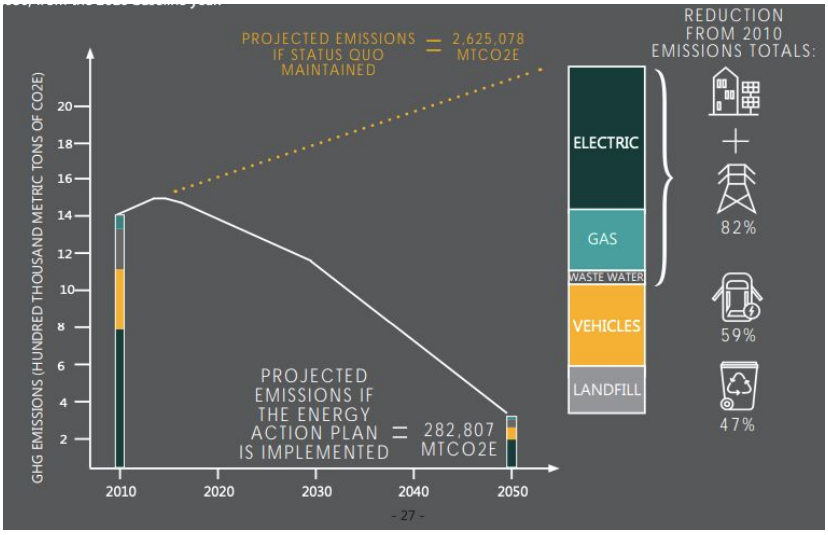
In January 2018, the City of Fayetteville adopted an Energy Action Plan that outlines the methods by which the city can reach its goal of converting all city facilities to 100% clean energy by 2030 (Solar Array Project). This plan was a collaborative effort among experts in energy efficiency, green building design, renewable energy design, and installation, electric and gas utilities, facilities management, and elected officials. Similar to the City of Oshkosh Sustainability Plan for 2020, Fayetteville's Energy Action Plan is a purposeful and proactive response to climate change that addresses social stability, economic security, and environmental purity in line with their city's values and culture (Arkansans Can Take Steps).

In November 2018, the City Council of Fayetteville approved a third party financing agreement with two electric and solar companies, Ozarks Electric Cooperative and Today's Power Inc. The purpose of this agreement was to construct solar power arrays on city-owned land while fostering innovation and competition. The agreement states the city will lease eighty-seven acres of public land to Today's Power Inc., where they will build and install solar panels to power the surrounding wastewater treatment plants and other nearby city facilities. In turn, the cost and responsibility of operating and maintaining the facility will fall to Today's Power Inc., and the City of Fayetteville will purchase electricity generated by the arrays at a set rate for the next 20 years. The initial investment on behalf of the city was to make electrical system improvements to the sites totaling $716,946, paid through their Water/Sewer Reserve Fund, and the calculated return on investment is 4.4 years. See Appendix B.

Because of their ambitious renewable energy goals, taking advantage of solar power was a logical step. Analysis of current city utilities in early 2018 stated that 16% of the city's total energy usage was produced by renewable energy. They also determined that 67% of the city's total energy consumption was coming from the city's two wastewater treatment plants. The new solar array is being constructed to transfer the wastewater treatment plants to 100% renewable energy. Projections indicate that the solar array project will offset the energy usage of the two wastewater treatment plants by 103% (Solar Array Project). Because a high energy consumptive facility utilizes the energy produced by the solar array, the cost-benefit was higher. This increased the city's total electric utility usage from 16% renewable energy to 72% renewable. See figure 8.

Even though this example depicts a large scale ground-mounted solar photovoltaic array, the City of Fayetteville is a prime example of how community collaboration and creative third party financial modeling can successfully implement solar infrastructure to power city-owned buildings. The Solar Array Project also shows a significantly quick return on investment time due to there third party financing model. Environmental Director, Peter Nierengarten at the City of Fayetteville stated that this financing agreement was by far the most viable option for the city as all the city had to do was provide the land and pay their utility bill (Nierengarten).

Figure 8



Nierengarten, Peter, et al. *Energy Action Plan* . 2018, pp. 27, *Energy Action Plan* .

Duluth, Minnesota

Duluth, Minnesota, is always updating and reevaluating energy use within the city to become more sustainable and ready for future energy implications. Their latest energy agenda, in 2017, lays out a plan of action to reduce carbon emissions by 80% citywide by 2050 (City of Duluth). This plan of action is in accordance with international carbon emissions goals set out by the UN (City of Duluth). Fifteen thousand tons of greenhouse gases are planned to be reduced every four years, which can be translated into real-world changes when it comes to emissions. Not only does this increase sustainability within the city, but it also reaches the sustainability plan for Duluth, which is similar to Oshkosh's 2020 goals to achieve an overall "greener" city with respect to social, environmental, and economic ties.

With this 2017 energy plan, Duluth plans on continuing its expansion towards a greener community. In doing so, they have partnered with three major organizations to promote this idea: US Climate Mayors, America's Pledge on Climate Change, and Great Lakes Climate Adaptation Network. Duluth mayor Emily Larson joined these organizations in 2017 in accordance with the White House's withdrawal from the Paris Accords (City of Duluth). Through these organizations, the mayor would like to develop more relationships with non-governmental agencies to work towards a more resilient future (City of Duluth).

Three main projects have been developed in Duluth that revolve around solar power. Canal Park, Wrenshall Array, and Rice Lake Road are the three most developed and established solar power systems in Duluth. Canal Park was developed on June 6, 2017, and is a solar infrastructure canopy that hosts electric car charging stations. Also, excess energy from the canopy is used to power nearby light fixtures within the park and other energy needs throughout the park (City of Duluth). The initial project cost approximately 378,000 to install, funded through donors (City of Duluth). In its lifetime, the project has saved an estimated energy amount of 135MWh (Also

Energy). This translates out to 2,400 trees planted, 69,000 gallons of water collected, and 10,700 gallons of gasoline not used (Also Energy). No return on investment was calculated for this project, but based on the environmental lifetime savings, it has proven very useful for the city.

Currently, around 33% of all energy in Duluth is supplied through renewable energy sources. This number is planned to increase to approximately 50% by 2030 and 80% by 2050 (City of Duluth). Duluth represents a similar population and city agenda as Oshkosh, which is why this example is so important. Not only does this project show the potential environmental savings from these solar projects, but it also shows how other cities are starting to transition to renewable energy sources that benefit not only the city but sets examples for future projects in other cities.

Barriers

Defining a Public Utility

The majority of marketing and existing information for solar energy is targeted at residential homes and property owners. This is primarily because they are subject to the 30% federal tax credit, and there are fewer barriers associated with implementing solar on private property as opposed to city-owned buildings. This is true for both of the solar companies we spoke to Eland Electric Corporation and Sunvest.

When speaking with Jesse Michalski from Eland Electric, he stated that financing was the main barrier, particularly for municipalities. In this regard, he spoke further on the benefits of third party financing, but also raised a critical factor in moving forward with this financing model in the State of Wisconsin. The language in the Wisconsin State Legislature and statutes, outlined in Wisconsin Legislative Council Information Memorandum: Overview of Wisconsin's Public Utility Regulatory System, are extremely broad. This unclear language regarding public utilities make cities efforts' to obtain third party financing for solar installation and infrastructure disorganized as this financial model is legally ambiguous.

In Milwaukee, Wisconsin, we see the language put to the test. Similarly to the Green Bay model, Milwaukee put out a request for proposal to solar contractors to finance, design, and install solar systems on a variety of municipal buildings in the City of Milwaukee (Michalski). Eagle Point Solar was the LLC. awarded the project and was prepared to lease six solar systems to the municipal site owners. However, WE Energies challenged the financing model. They claimed that because Eagle Point Solar would own the majority of the solar arrays at the beginning of the project, and was not a regulated utility provider, the agreement should be deemed illegal (Boulton).

In an effort to combat WE Energy's reluctance to cooperate with the solar project, Eagle Point Solar has asked the Public Service Commission to order WE Energies to move forward with the project (Boulton). Eagle Point Solar faced opposition in Dubuque, Iowa, on an almost identical case and fought it all the way through the Iowa Supreme Court. The company won in

2011, and they are hoping to do the same in Wisconsin (Uhlenhuth). Eagle Point Solar is confident in its ability to fight Wisconsin utility companies in advocacy of third party financing throughout the state. However, the language still stands, and current utility providers are expected to fight against this model of solar implementation. Currently, leadership on the Milwaukee City Council is motivated and ready to fight the utility company, as they want to install as much solar as possible on city-owned buildings (Michalski). The outcome of this case will set a precedent for the entire state of Wisconsin to see if all other cities, school districts, counties, and other nonprofit entities have an additional way of paying for solar.

Social

The social barriers surrounding solar energy are essential to address as it may inhibit future solar growth in the City of Oshkosh. However, it is also important to take the concerns expressed in this section and incorporate them into education and outreach efforts to promote a solar future. Many factors make solar seem like an impractical choice. However, this vision is often influenced by current governmental regulations and numerous fossil fuel lobbyists. Many of these regulations effectively control the social norms associated with renewable technologies. They also influence and regulate the market, subsidies, and federal grants available for advancing community and city solar projects.

Another widespread barrier is in regards to social and cultural influences that affect individuals unwillingness to adopt renewable energy practices. The fear of solar being unreliable or a general disinterest in solar developments lead to the disengagement of the community. That disengagement is one of the main issues that hinder the renewable energy sector from developing consistently everywhere. If the community loses interest and withdraws its support, the project may fail. Keeping the community interested and engaged is important because developing a more in-depth knowledge of the subject helps solar projects prosper.

The data collected in the surveys presented above showed that effective imagery and public attitudes of solar are predominantly positive. They also concluded that by providing descriptions of solar power infrastructure and how the process works is beneficial in evoking a positive response from community members. Negative responses are typically expressed with perceived disadvantages associated with change and switching current energy systems. However, negative attitudes do not dominate public perception. Further education on the positive impacts of solar panels may assist in addressing and concerns and foster a more positive atmosphere.

Lack of education on this particular subject is another significant social barrier many projects need to overcome. The need for more education on these subjects is urgent. Without this background knowledge, communities lose this awareness for renewable energy technologies and the associated opportunities. Taking this into account, it is important to create a positive atmosphere on the city level to change public opinion by creating a solar-friendly community. Social barriers have a significant influence on the development of renewable energies and can be

challenging to navigate. However, with proper education and city action towards developing a positive solar atmosphere in the community, the City of Oshkosh can establish successful solar projects.

Education

The Wisconsin Department of Workforce Development has issued funding to help hundreds of businesses and nonprofits to train workers and provide workforce development assistance to their communities (Wisconsin Fast Forward Annual Report). Solar energy implementation is on the rise in the State of Wisconsin, and this necessitates having adequately trained professionals to install, operate, and maintain these systems. Assembly Bill 237 was brought to the floor in 2019 and directed the Wisconsin Department of Workforce Development to allocate funding to train and certify individuals in the solar installations and wind technician trades. If approved, this bill would designate funding to educational institutions such as Fox Valley Technical College to increase the specialized workforce needed to advance and achieve renewable energy goals for the State of Wisconsin.

Furthermore, the University of Wisconsin Oshkosh is a leader in sustainable initiatives and home to Sage Hall, which is ranked highly for its solar energy production. Understanding how solar has already been implemented in the City of Oshkosh can foster new developments on the city level. If educational institutions such as Fox Valley Technical College and the University of Wisconsin Oshkosh come together to educate and discuss the potential benefits of solar in the City of Oshkosh, city departments, organizations, businesses, and residents can all come together and develop a positive solar climate.

Cost

According to public opinion surveys, financing is the primary concern when implementing solar panels. According to Jesse Michalski, a solar specialist at Eland Electric, communicating the impact and benefits of solar often lead to misconceptions about cost and financing. However, there are several solutions that help alleviate the financial burden to municipalities regarding installing solar systems on city-owned buildings.

Grants

Grants are one way to subsidize the initial cost of solar installation to municipalities, and many can be found through the federal government hosted under the U.S. Department of Energy. More specifically, the Office of Solar Technologies is the host of many initiatives and programs that work to reduce the overall cost of installation, maintenance, and repairs to solar infrastructure.

In 2011 Initiative SunShot was launched as a way to reduce the total costs associated with solar energy with a target reduction rate of 75% by 2020 (U.S. Department of Energy).

With this initiative, the Solar Energy Technologies Office was developed and aimed to create a knowledge base and develop technologies to improve solar viability further and reduce costs further. It is expected that by the end of 2019, the SunShot Initiative alone will have funded over 80 solar projects totaling $130 million in awarded grant funding.
For example, in 2014, Eau Claire adopted solar-friendly city-wide practices and was awarded funding through the SunShot: Grow Solar partnership. This allowed their city to become a regional and national leader in solar city projects (City of Eau Claire). There are many opportunities for local governments like the City of Oshkosh to advance their solar knowledge and funding opportunities through grants and additional models.

Third Party Financing

The Federal Solar Tax Credit was established as an incentive for private home and land owners to install solar systems on their property. In return, they would be allowed to deduct 30% of the installation cost of the solar system from their federal taxes. Because cities, municipalities and other nonprofit entities do not pay federal taxes, they are not privy to the 30% tax credit. Because of this barrier in financial incentive, there are very few viable ways that cities are able to install solar technologies on city-owned buildings. Third party financing is a practical solution and a key factor in making a financial model work.

Third party financing allows for two types of solar financing through a non-profit company: solar leasing or power purchase agreements. In both models, a private solar installer builds, installs, and maintains the solar system with little to no upfront cost to the municipality. This in turn allows the for profit entity to take advantage of the 30% tax credit.

In the solar leasing model, the municipality may lease the solar system from the third party and benefit from the electricity it produces. Similarly, the power purchasing agreement models are set up where the third party owns the solar system and under contract agree to sell the city energy produced by the system at a fixed rate, typically below market value. In either scenario, the economic incentive to establish a relationship with a third party and implement solar energy on city owned buildings would greatly reduce the monthly cost of a standard energy utility bill.

At the end of the contract, the city and the third party may renegotiate the terms of the contract. Based on fluctuating market utility prices, the overall project success and benefits to both parties, the agreement may continue, an arrangement may be made to transfer ownership from the third party to the city or the third party may choose to remove the systems. In some cases, solar leasing agreements may be leased for ownership. However, a lease to own agreement would turn the responsibility of maintenance and upkeep onto the municipality rather than the third party.

These are only possible scenarios, however once the relationships with solar installers are established, and the longer the project is implemented, the higher the cost benefit on both sides.

As alluded to in the benchmarking section of this paper, the City of Fayetteville, AR built a relationship with a solar utility company to enact third party financing for their solar array farm. Based on all of their calculations and analysis of all financing options, they concluded that the return on investment was far faster and the initial cost to the city was significantly lower utilizing third party financing compared to other financing options.

Estimates and Return on Investment

Working with Jesse from Eland Electric, we were able to get property estimates on desired Oshkosh city-owned buildings. It was emphasized that buildings with high energy outputs and extended periods of solar exposure throughout the year would be good candidates for solar installation. Eland Electric has access to proper software and formulas that provide a return on investment timelines and the initial cost of installation. Using this information and technology, estimates are provided for Oshkosh North High School.

A summary of the Return on Investment timeline and the initial cost of installation is provided here. To see the full budget and production reports, please view Appendix C and D. The upfront cost to install the solar panel system is approximately $1,563,100 with a break-even point of 14.32 years. Further examining the budget number on pages 5 and 6 of the budget report in appendix D, it is currently displayed being slightly oversized, producing more energy than the school uses in the summer months. There are several ways to get the ROI a little quicker, and one of those may be to start with a smaller solar panel system, especially if the school is served by WE Energies (they offer net metering up to 300KW AC). Further information or clarification regarding this report may be directed to Jessie Michalski at Eland Electric Corporation, who prepared the reports.

Lifespan of Solar

In terms of overall maintenance and cost, solar panels need a minute amount of work on them post initial installation. Solar panel manufacturers design these panels to withstand different climate elements, including hot and cold cycles and high intense storms (Energy Informative). However, solar panels do degrade over time as they age further. Each panel has a general “degradation rate” per year, which overall lowers the efficiency of the panel, but the effect is minuscule. The average degradation rate is around 0.8% per year, so after 25 years, the solar panel should still be approximately 75% efficient (Sunpower). Solar technology is still a relatively new technology with most modern panels within the 10-15 year age range. Data is limited when it comes to the lifespan over 25 years, but the oldest solar panel in the U.S. is still working after 60 years (Energy Informative). Solar panel systems will continue to be upgraded in durability and performance, but a general guideline to follow as a user is checking panels annually for damage and cleaning them every so often to keep off debris for the best efficiency.

Keeping up to date on other city examples throughout the state on their solar panel lifespan and average maintenance will provide the best example on needed updates and maintenance. In addition, as current solar projects nationwide are developed, more information will present itself on when panels need to be replaced or updated. In general, not much maintenance is required in solar panels after initial installation because of how well they are manufactured

Significance to Sustainability

Oshkosh has the opportunity to be a leader in switching to renewable energy and promoting a greener community. Steps have already been taken to emphasis the importance of sustainability through goals, community projects, and organizations that help pave the way for the future. The next step for Oshkosh in transitioning to a "green" city to encourage the switch from fossil fuels to renewable energy sources. This can be done through the installation of solar panels onto city buildings to aid in the transition to a more sustainable future.

With fossil fuels becoming more scarce and climate change on the rise, establishing renewable energy plans for cities is vital for the future. One of the worries with converting to renewable energy is the loss of efficiency and production achieved from using fossil fuels. Currently, around 85% of the United States rely on fossil fuels as an energy source (U.S Energy Information System). Cities produce some of the highest amounts of greenhouse gas emissions. Not only do cities produce emissions, but many of the means to produce energy currently are very detrimental to the environment in ways in which we use the land improperly. The further use of fossil fuels will lead to more drastic climatic changes and a more challenging future for humans and other species on Earth. Encouraging cities to switch to renewable energies, especially solar power, will, in turn, promote a healthier sense of environment and include social and economic benefits along with it. Other cities have already seen positive effects from incorporating solar power energy into city planning on economic, environmental, and social bases.

The goal of Oshkosh in terms of sustainability is to improve the quality of life in Oshkosh by providing sustainability practices to meet the environmental, economic, and social needs of the present without compromising the needs of the future (City of Oshkosh). To achieve this goal, the city requires changes that are overall more sustainable and promote a greener future. Currently, Wisconsin has an average of around 90 million metric tons of carbon emissions per year (Statista Research Department). Transitioning to solar panels can reduce these emissions drastically by reducing the total amount of carbon produced. Based on other data samples, the size of the solar system can be generally converted to the amount of carbon emissions saved. The ratio is approximately 1:1, so for every 1Kfw of solar panels, it equivalates out to 1 metric ton of carbon emissions (Richardson). Applying these estimates to Oshkosh, in particular, city buildings, significant improvements to sustainability can be made through solar panel infrastructure. Solar panels also offer economic savings through the return investments received

from customers. When converting to solar power, the amount of energy being produced will cost less compared to that of current energy bills. This switch will be able to provide sufficient energy to users while also reducing energy bills along the way, which positively affects the community's economy while promoting more sustainable practices. If efforts are made to better communities using renewable energy, other sustainable living measures can be taken to make an area become greener.

Conclusion

The City of Oshkosh, hopefully, can find a way to implement solar panel systems within its upcoming sustainability plans and achieve a greener future. With the installation of solar panels on more buildings within the city, it will reduce overall greenhouse gas emissions put out by the city. Also, it will lower the cost of energy utilities for buildings by producing energy for a lower price than traditional methods. This plan motivates other surrounding cities and individuals to follow a more sustainable way of living for the future. If Oshkosh carries out a solar project in the future, the city will be on track with its current and future sustainability goals. Many of the global agendas to reduce the overall carbon footprint put out by cities and humans, in general, involves the transition to renewable energy sources. Solar panels have been proven to be effective in many areas like Fayetteville and Duluth with excellent results in terms of energy production and sustainability. This switch for Oshkosh is one of the first steps to a more sustainable future.

Appendix A

The City of Oshkosh switched to a monthly billing cycle in the spring of 2019 so residents could better track their water usage (Slattery). Beginning in 2018, the water utility price had increased by almost 8%, however after transferring to a monthly billing system, residents have experienced significant spikes in the price they pay for water. In some cases, residents have expressed water bills nearly 20 times their average monthly charge (Amundsen). The City of Oshkosh released several statements and held community meetings to discuss citizens concerns and advised that residents check for leaks in taps and toilets, which may account for the increased monthly charges (Slattery).

Appendix B

City of Fayetteville. "Solar Array Project." *Fayetteville, AR - Official Website*,

www.fayetteville-ar.gov/3536/Solar-Array-Project.

SAVINGS

Electricity Bill Savings:	$939,717
Battery, HVAC & Lighting Savings:	$2,500
Generator Fuel Cost Savings:	$60,000
Generator Management Payment:	$75,000
Battery Storage Loss Payment:	$1,152
TOTAL SAVINGS	**$1,078,369**

COSTS

Solar Maintenance Agreement	$20,116
Solar Electricity Cost	$874,348
Loss of Hay/Sludge Spreading Revenue	$22,000
TOTAL COSTS	**$916,464**
NET ANNUAL SAVINGS	**$161,905**
Capital cost: Site electrical improvements,to be paid through Water/Sewer Reserve Fund	**$716,946**

RETURN ON INVESTMENT: 4.4 years

Design 1 Oshkosh North High School, 1100 W Smith Ave

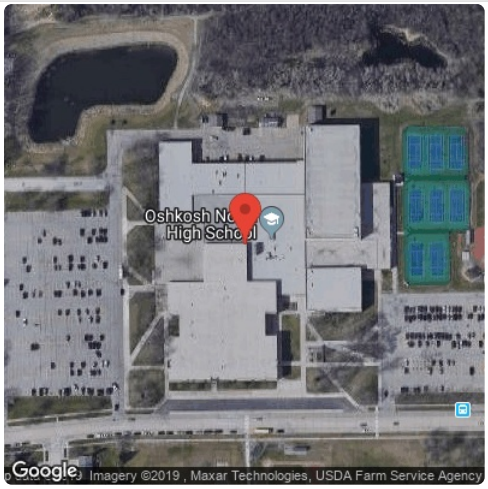
Report

Project Name	Oshkosh North High School
Project Address	1100 W Smith Ave
Prepared By	Jesse Michalski jessemi@elandelectric.com

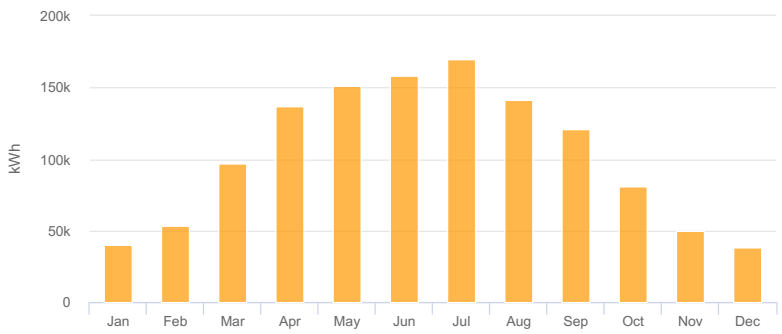
System Metrics

Design	Design 1
Module DC Nameplate	989.1 kW
Inverter AC Nameplate	800.0 kW Load Ratio: 1.24
Annual Production	1.237 GWh
Performance Ratio	84.3%
kWh/kWp	1,251.1
Weather Dataset	TMY, 10km grid (44.05,-88.55), NREL (prospector)
Simulator Version	0a85ecb1f7-666d51b86b-ae8fff61fa-cbebe908f0

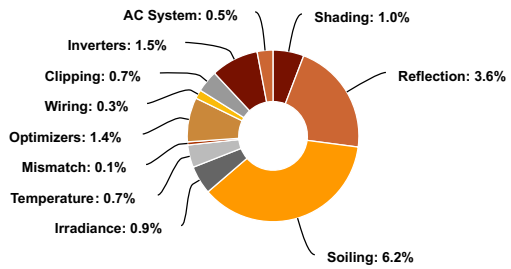
Project Location



Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,376.3	
	POA Irradiance	1,485.0	7.9%
	Shaded Irradiance	1,470.5	-1.0%
	Irradiance after Reflection	1,417.9	-3.6%
	Irradiance after Soiling	1,330.7	-6.2%
	Total Collector Irradiance	**1,330.7**	**0.0%**
Energy (kWh)	Nameplate	1,315,753.3	
	Output at Irradiance Levels	1,303,897.3	-0.9%
	Output at Cell Temperature Derate	1,294,602.1	-0.7%
	Output After Mismatch	1,293,313.9	-0.1%
	Optimizer Output	1,275,167.0	-1.4%
	Optimal DC Output	1,271,574.9	-0.3%
	Constrained DC Output	1,262,717.0	-0.7%
	Inverter Output	1,243,700.0	-1.5%
	Energy to Grid	**1,237,480.0**	**-0.5%**
Temperature Metrics			
	Avg. Operating Ambient Temp		10.6 °C
	Avg. Operating Cell Temp		17.0 °C
Simulation Metrics			
	Operating Hours		4694
	Solved Hours		4694

Condition Set

Description	Condition Set 1
Weather Dataset	TMY, 10km grid (44.05,-88.55), NREL (prospector)
Solar Angle Location	Meteo Lat/Lng
Transposition Model	Perez Model
Temperature Model	Sandia Model

Temperature Model Parameters

Rack Type	a	b	Temperature Delta
Fixed Tilt	-3.56	-0.075	3°C
Flush Mount	-2.81	-0.0455	0°C
East-West	-3.56	-0.075	3°C
Carport	-3.56	-0.075	3°C

Soiling (%)

J	F	M	A	M	J	J	A	S	O	N	D
20	20	15	10	2	2	2	2	2	2	10	15

Irradiation Variance	5%
Cell Temperature Spread	4° C
Module Binning Range	-2.5% to 2.5%
AC System Derate	0.50%

Module Characterizations

Module	Uploaded By	Characterization
Q.PEAK DUO L-G5.3 395 (Hanwha)	Folsom Labs	Spec Sheet Characterization, PAN

Component Characterizations

Device	Uploaded By	Characterization
SE100KUS (SolarEdge)	Folsom Labs	Spec Sheet
P860 (SolarEdge)	Folsom Labs	Sheet

Components

Component	Name	Count
Inverters	SE100KUS (SolarEdge)	8 (800.0 kW)
Strings	10 AWG (Copper)	66 (15,805.8 ft)
Optimizers	P860 (SolarEdge)	1,254 (1.08 MW)
Module	Hanwha, Q.PEAK DUO L-G5.3 395 (395W)	2,504 (989.1 kW)

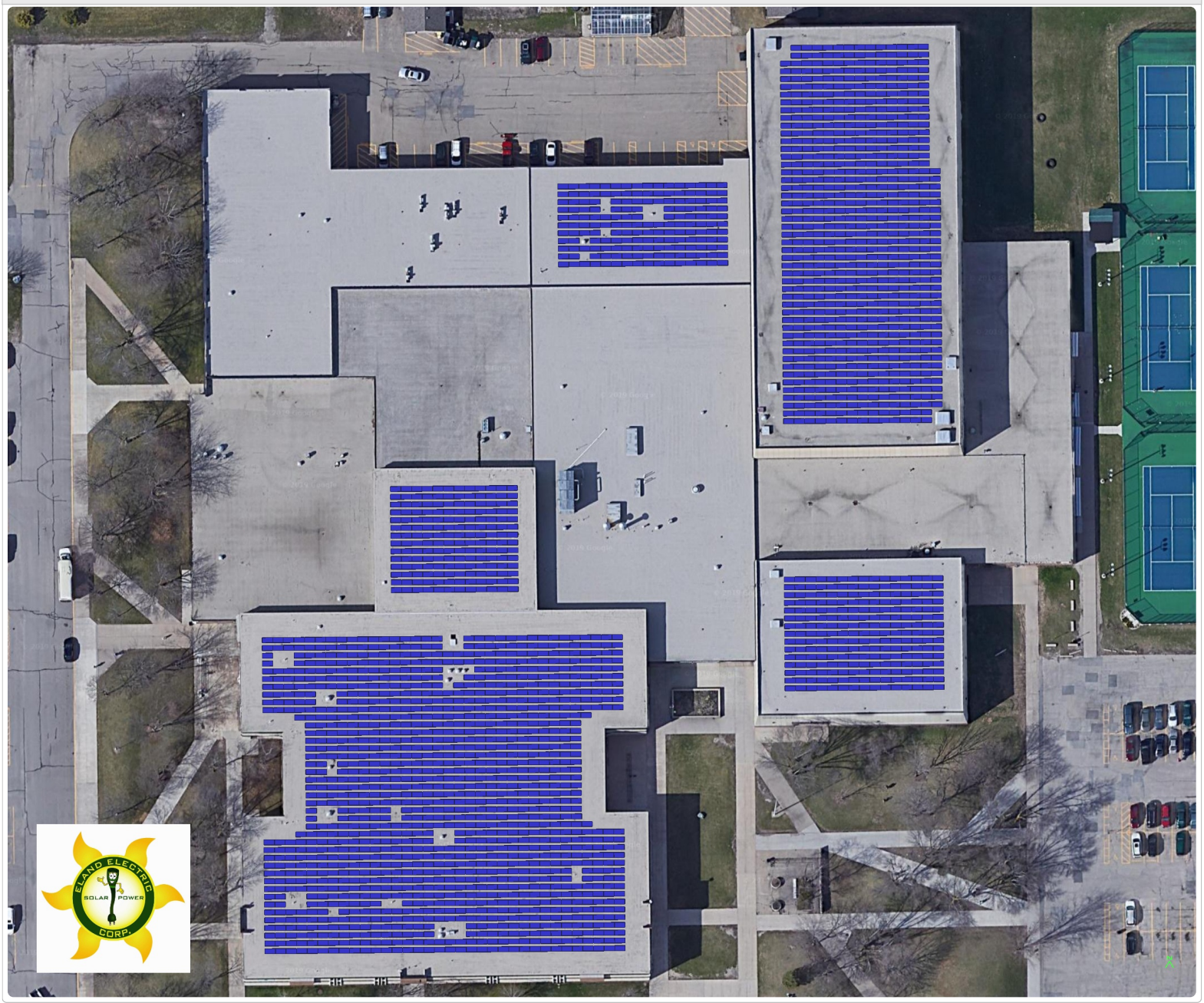
Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	12	13-38	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Field Segment 1	Fixed Tilt	Landscape (Horizontal)	10°	179.50178838738634°	1.6 ft	1x1	1,274	1,229	485.5 kW
Field Segment 2	Fixed Tilt	Landscape (Horizontal)	10°	179.502°	1.6 ft	1x1	168	168	66.4 kW
Field Segment 3	Fixed Tilt	Landscape (Horizontal)	10°	179.502°	1.6 ft	1x1	720	715	282.4 kW
Field Segment 4	Fixed Tilt	Landscape (Horizontal)	10°	179.502°	1.6 ft	1x1	226	225	88.9 kW
Field Segment 5	Fixed Tilt	Landscape (Horizontal)	10°	179.502°	1.6 ft	1x1	177	167	66.0 kW

Detailed Layout



Appendix D

ELAND ELECTRIC CORPORATION

3154 HOLMGREN WAY • GREEN BAY, WI 54304

(920) 338-6000 (920) 338-6009

WWW.ELANDELECTRIC.COM

A 989.08 KW SOLAR PHOTOVOLTAIC SYSTEM

A BUDGET TO:

Oshkosh North High School

Monday, December 9, 2019

Budget #19259

PREPARED BY: Jesse Michalski

Estimator/Project Manager

Eland Electric Corporation

(920) 609-3546

jessemi@elandelectric.com

12/9/2019 Budget # 19259

Oshkosh North High School
1100 W Smith Ave
Oshkosh, WI 54901

Attn: Julia

RE: COMPLETE TURN-KEY INSTALLATION OF A SOLAR PHOTOVOLTAIC SYSTEM AS DESCRIBED IN THE SCOPE OF WORK BELOW

As per your request and based on the information collected during the site visit, emails and phone calls, you will find below the proposed scope of work and cost associated with the installation of your solar system.

- Installation of a complete turn-key 989.08 KW DC rated system comprised of the following major components:
  - (2504) REC 395W Solar Modules
  - (1252) SolarEdge Optimizers and (8) SolarEdge String Inverter
  - (1) 10-degree ballasted roof mounted racking
  - (1) Online energy monitoring and performance package with owner supplied active internet connection
- All Permits, Utilitiy applications and Focus on Energy reservation and incentive applications.
- Electrical interconnection made as per the local utilities rules and regulations and in conjunction with the PSC119 Interconnection Guidelines.
- All work done in accordance with National, State and Local electrical codes in addition to being performed by employees in accordance with Wisconsin ACT 143, statewide licensing law.
- Project designed and managed by a NABCEP (North American Board of Certified Energy Practicioners) certified PV installer and installed by all state licensed electricians.
- Price listed below is all inclusive of the items listed above. This reflects the up-front installed price. Any rebates and incentives will be calculated from this price.

  ◊ **Budget:** **$ 1,563,100.00**

- Please contact me with any questions.

Sincerely,

Jesse Michalski

Estimator/Project Manager
Eland Electric Corporation
(920)-609-3546
jessemi@elandelectric.com

SOLAR PHOTOVOLTAIC (PV) RETURN ON INVESTMENT CALCULATOR FOR:

Oshkosh North High School - 1100 W Smith Ave - Oshkosh, WI 54901

SYSTEM SIZE	989.08	DC rated capacity of the system (KW)
INSTALLED COST	$1,563,100.00	Up-front cost to install the system
ESTIMATED MAX. FOCUS GRANT	$60,000.00	Cash-Back reward from Focus on Energy
ESTIMATED TAX INCENTIVES	$0.00	Estimated 30% ITC plus MARCS 5-year depreciation
POST INCENTIVE INVESTMENT	$1,503,100.00	Cost after rebates and tax incentives used for ROI calculations
PROJECTED ANNUAL PRODUCTION	1,237,472	Annual energy generated (kWh)
ANNUAL VALUE OF ENERGY YEAR 1	$105,229.33	Function of annual energy and utility rate
UTILITY INFLATION RATE	1%	Rate of utility cost increase
BLENDED UTILITY RATE	0.085	Blends utility rate, fixed charges and over generation at avoided cost
15-YEAR ANNUALIZED RATE OF RETURN	0.68%	Annualized rate of return on investment (IRR) calculation
25-YEAR ANNUALIZED RATE OF RETURN	5.46%	Annualized rate of return on investment (IRR) calculation
BREAK-EVEN POINT (YRS)	14.32	The point in time (yrs) when the system has paid for itself
COST/WATT INSTALLED	1.58	Metric to look at the cost per watt installed ($/watt)

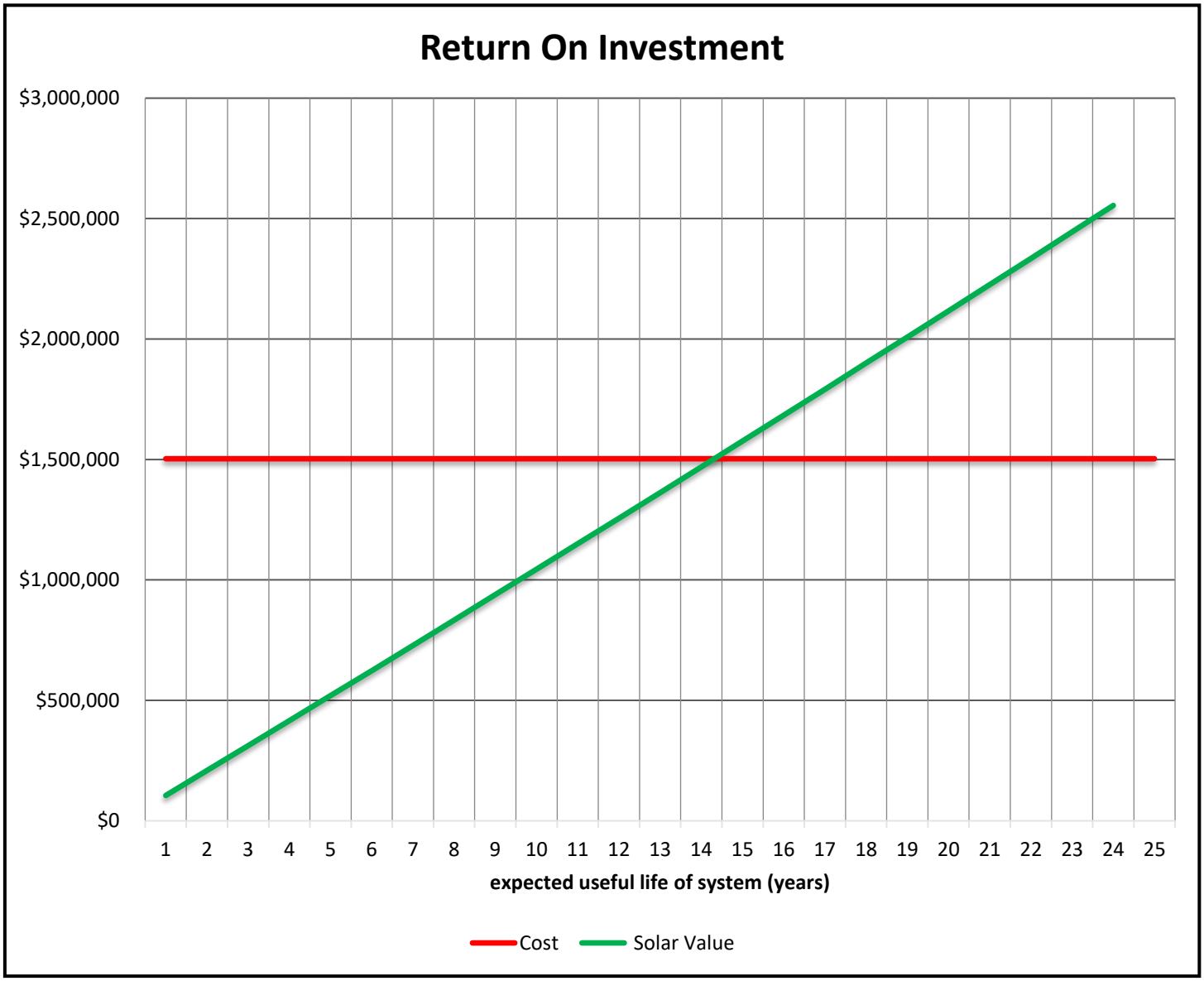
SYSTEM YEAR	1	2	3	4	5
INFLATED UTILITY RATE ($/kWh)	$0.09	$0.09	$0.09	$0.09	$0.09
KWH/YEAR PRODUCTION	1,237,472	1,200,348	1,191,945	1,183,602	1,175,317
VALUE OF ENERGY PRODUCED	$105,229	$103,093	$103,395	$103,698	$104,002
CUMMULATIVE ENERGY VALUE	$105,229	$208,323	$311,718	$415,416	$519,418

SYSTEM YEAR	6	7	8	9	10
INFLATED UTILITY RATE ($/kWh)	$0.09	$0.09	$0.09	$0.09	$0.09
KWH/YEAR PRODUCTION	1,167,089	1,158,920	1,150,807	1,142,752	1,134,752
VALUE OF ENERGY PRODUCED	$104,307	$104,612	$104,919	$105,226	$105,535
CUMMULATIVE ENERGY VALUE	$623,725	$728,337	$833,256	$938,482	$1,044,017

SYSTEM YEAR	11	12	13	14	15
INFLATED UTILITY RATE ($/kWh)	$0.09	$0.09	$0.10	$0.10	$0.10
KWH/YEAR PRODUCTION	1,126,809	1,118,921	1,111,089	1,103,311	1,095,588
VALUE OF ENERGY PRODUCED	$105,844	$106,154	$106,465	$106,777	$107,090
CUMMULATIVE ENERGY VALUE	$1,149,861	$1,256,015	$1,362,480	$1,469,257	$1,576,346

SYSTEM YEAR	16	17	18	19	20
INFLATED UTILITY RATE ($/kWh)	$0.10	$0.10	$0.10	$0.10	$0.10
KWH/YEAR PRODUCTION	1,087,919	1,080,304	1,072,742	1,065,232	1,057,776
VALUE OF ENERGY PRODUCED	$107,404	$107,718	$108,034	$108,350	$108,668
CUMMULATIVE ENERGY VALUE	$1,683,750	$1,791,468	$1,899,502	$2,007,852	$2,116,520

SYSTEM YEAR	21	22	23	24	25
INFLATED UTILITY RATE ($/kWh)	$0.10	$0.10	$0.11	$0.11	$0.11
KWH/YEAR PRODUCTION	1,050,371	1,043,019	1,035,718	1,028,468	1,021,268
VALUE OF ENERGY PRODUCED	$108,986	$109,306	$109,626	$109,947	$110,269
CUMMULATIVE ENERGY VALUE	$2,225,506	$2,334,812	$2,444,438	$2,554,385	$2,664,654



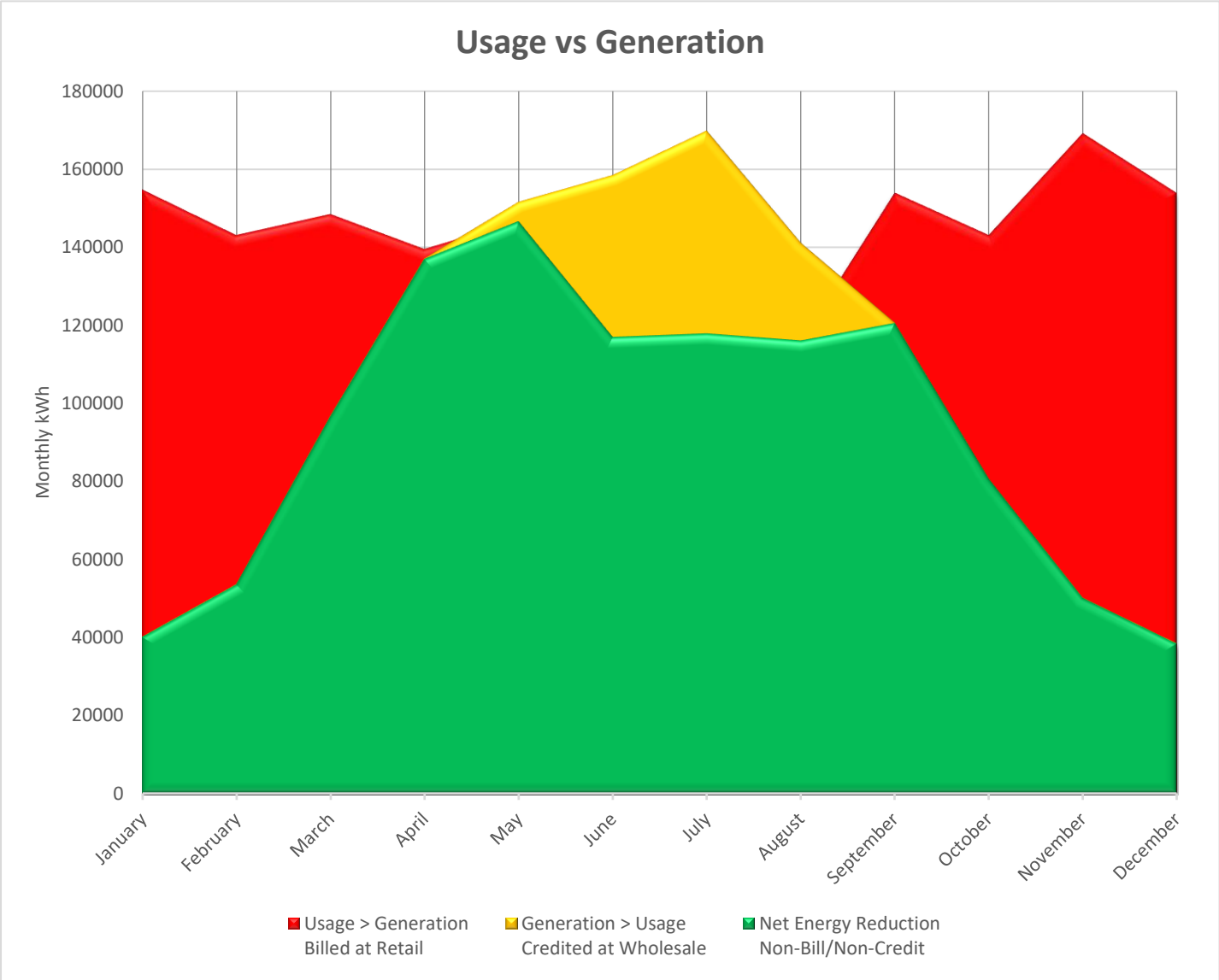
Graph depicting your initial investment and the value of the solar energy over time. For this reason, a solar PV project should be considered or at least approached as an investment opportunity in addition to all the other beneficial reasons to utilize solar as a renewable source of energy.

Shading Derate Factor	1	Factor to reduce output based on site specific shading
Monthly Usage Factor	1	Factor to adjust estimated usage if not provided by the customer
kWh/KW Peak Factor	1251	Amount of annual energy output from 1KW capacity
System Size (KW)	989.08	Total system size
Standard Utility Rate	$0.09	Amount you pay per kWh
Wholesale Rate	$0.04	Amount the utility credits you per excess kWh
Fixed Utility Charge	$22.00	Non-recoverable "fixed" utility sur-charge

MONTH	ENERGY USAGE	ENERGY PRODUCED	% DROP IN USAGE	USAGE COSTS	SOLAR VALUE	% OF COST REDUCTION
JANUARY	154800	40066	26%	$13,954.00	$3,605.94	26%
FEBURARY	143100	53516	37%	$12,901.00	$4,816.44	37%
MARCH	148500	96648	65%	$13,387.00	$8,698.32	65%
APRIL	139503	136983	98%	$12,577.27	$12,328.47	98%
MAY	146715	151506	103%	$13,226.35	$13,395.99	101%
JUNE	117000	158360	135%	$10,552.00	$12,184.40	115%
JULY	117900	169765	144%	$10,633.00	$12,685.60	119%
AUGUST	116115	140962	121%	$10,472.35	$11,444.23	109%
SEPTEMBER	153911	120573	78%	$13,873.99	$10,851.57	78%
OCTOBER	143100	80668	56%	$12,901.00	$7,260.12	56%
NOVEMBER	169200	50075	30%	$15,250.00	$4,506.75	30%
DECEMBER	153900	38350	25%	$13,873.00	$3,451.50	25%
TOTALS:	1703744	1237472		$153,600.96	$105,229.33	69%
AVERAGE	141979	103123	73%			

NOTES:

1. In months where the usage exceeds the generation, the entire generation value is offset at the utility rate.
2. In months where the generation exceeds the consumption, the amount of generation that equals the consumption is calculated at the utility rate and the excess is added to the value at the wholesale rate.
3. If actual utility usage was not provided, the above numbers are considered average home usage for our area.



The above graph represents the correlation between usage, consumption and the "net" difference. The green shaded area is considered the baseline and will represent the "net" energy that you will not pay for nor get paid for. Areas that are shaded in red above the green are amounts of energy that you will need to purchase at the retail rate. Areas shaded in orange above the green are amounts of energy that you will sell to the utility at the wholesale rate.

Notes:

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