Michigan Solar Communities Guidebook

A Practical Guide for Solar Energy Advocates and Local Units of Government

Great Lakes Renewable Energy Association (GLREA)

GLREA
GREAT LAKES RENEWABLE ENERGY ASSOCIATION

www.GLREA.org

Michigan Solar Communities Guidebook

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Purpose: To help Local Units of Government, Organizations and Individuals learn about renewable energy, with an emphasis on solar, and to provide resources to support the deployment of it.

The Delta Solar Project in Delta Township (Lansing), MI.

Photo provided by CMS Energy. Photo credits Mr. Tom Gennara of Gennara Photography in Lansing, MI.

Introduction

A Practical Guide to Solar in Michigan

The *Michigan Solar Communities Guidebook* is designed to be a practical guide for individuals, organizations and local governments that want to support and expand renewable energy to save money on energy expenditures, drive economic development, reduce climate risk and support environmental justice. This Guidebook focuses on community-based efforts, with an emphasis on Community Solar, as a pathway to expand renewable energy and will draw upon best practices, examples and models that have proven to work within the current boundaries of state and federal law.

The Great Lakes Renewable Energy Association (GLREA) has long been at the forefront of developing renewable energy in Michigan. In 2002, GLREA published *Opportunities for Renewable Energy Deployment in Michigan,* which outlined the economic, environmental, and public policy benefits of increased solar energy usage in Michigan. In 2012, Michigan Energy Services, previously the Michigan Energy Office, awarded a grant to GLREA to conduct a study on the potential of Community Solar in Michigan and published its findings in the *Community Solar Guide for Local Government*. In 2022, GLREA was awarded a second grant to update this work and to share information on other tools that local communities can use to promote the use of renewable energy.

As this Guide will explain, solar energy is an effective way of harvesting energy from the sun that can then be made available to residents and businesses as electricity either directly from an on-site system, through the electric grid when generated by an electric utility, or through the electric grid of a Community Solar energy system.

Community Solar enables all residents and businesses to be able to purchase solar energy, including those that could not install an on-site system, thus saving on high energy expenditures, contributing to a cleaner environment, and helping to promote economic development with energy savings and job creation. The Department of Energy (DOE) highlights that transitioning to solar energy through Community Solar allows multiple customers to benefit from a shared solar energy system, and provides a solution for individuals who cannot install their own rooftop solar system.[1]

Many cities in Michigan are moving to embrace renewable energy by establishing carbon reduction strategies, sustainability plans and environmental justice goals. A 2022 Michigan Climate Action Network report stated that "at least 17 Michigan communities have set goals to be carbon neutral or to reach 100 percent renewable energy by 2050." [2]

To aid in achieving these ambitious goals, the 2022 Federal Inflation Reduction Act (IRA) provides new incentives, funding and policies to expand renewable energy and to fight climate change, including support for Community Solar. This is important because more than 50% of Michigan residents cannot access solar energy due to financial barriers to purchasing solar, the roof of their home being unsuitable for solar, or they live in a rental apartment or condominium.

In addition, Governor Whitmer's 2022 *MI Healthy Climate Plan* calls for a 28% reduction of greenhouse gas emissions from 2005 levels by 2025, 52% reduction by 2030, achieving carbon neutrality by 2050, and maintaining net negative greenhouse emissions thereafter. Meeting these goals requires a massive increase in renewable energy paired with robust energy storage. [3] The Clean Energy Future Plan of 2023, an array of clean energy legislation passed in Michigan, can help to make the goals in this plan a reality.

On the legal side, Community Solar builds upon the right of homeowners, farmers, and businesses to install their own solar energy system to provide the electrical power they need, as established by Public Act 295 in 2008. However, no law currently exists in Michigan that explicitly supports and allows for the third-party development of Community Solar projects. Such a law is critical to achieve the wide scale deployment of Community Solar needed in Michigan, to meet the sustainability goals of many cities, and to help meet the goals of Governor Whitmer's *MI Healthy Climate Plan.*

Even though Michigan lacks a formal Community Solar law, several communities and organizations have developed innovative Community Solar projects in partnership with a few utilities. As this Guide will illustrate, these Projects can serve as models for other communities seeking to start Community Solar initiatives in their area.

These Community Solar projects, called 'Clean Energy for Low-Income Community Accelerator' (CELICA*),* were supported, and funded in part by Michigan's Department of Environment, Great Lakes, and Energy (EGLE). A few municipal and rural electric coop utilities in Michigan have developed Community Solar projects for their residents and these are highlighted as well. In addition, some investor owned utilities have developed projects that include elements of Community Solar in partnership with a local community. These projects serve as examples of Community Solar and how they can broaden access and spread the benefits of solar to a larger number of people. They are highlighted in Chapter 3.

1 https://www.energy.gov/eere/solar/community-solar-basics
2 https://www.miclimateaction.org/mi_local_climate_action
3 https://www.michigan.gov/egle/about/organization/climate-and-energy/mi-healthy-climate-plan

Solar panels on a barn.
Photo courtesy of Donna and Lee Andre.

The *Michigan Solar Communities Guidebook* is organized into eight chapters.

Chapter 1 provides a short history of solar and what is currently driving the deployment of solar in Michigan.

Chapter 2 explains the concept of Community Solar, how it works, and what the various operational models are that exist.

Chapter 3 discusses the current Community Solar models and projects in Michigan.

Chapter 4 explains the Great Lakes Renewable Energy Association (GLREA) Solarize Program, a group-buy community model that local solar advocates and cities can use to bring down the cost of solar and increase its deployment.

Chapter 5 explains the concept of 'return on investment', and how individuals and communities can use various methods to evaluate the benefits of solar.

Chapter 6 provides information on another renewable energy source, Geothermal Energy, and explores why Energy Efficiency is an important component of utilizing energy more effectively.

Chapter 7 provides specific information on resources available for local communities in their efforts to deploy renewable energy.

Chapter 8 discusses Energy Storage technologies and benefits.

Finally, there are **Appendices** that provide additional resources such as a Glossary of Terms, various key State and Federal statutes that guide energy policy in Michigan and the United States, as well as other sources of information that should prove useful.

Chapter I

The Deployment of Renewable Energy in Michigan

What is Driving the Expansion of Solar in Michigan?

A Short History of Solar in Michigan

The beginning of the modern era for renewable energy in Michigan began with the 2008 enactment of Public Act 295, called the Clean, Renewable and Efficient Energy Act.

Prior to 2008, efforts were made to lay the groundwork for the enactment of Public Act 295, including the publication in 2002 of a report called *Opportunities for Renewable Energy Deployment in Michigan*, by Great Lakes Renewable Energy Association (GLREA), that outlined the economic and environmental benefits of increased solar energy usage in Michigan. This Report recommended two policy changes to remove barriers and support the increased deployment of solar. The first was to eliminate the increase of property taxes for installing a solar energy system, which was accomplished in 2021. The second policy change was to create a financing program to help people secure loans for installing solar, which was accomplished in 2008 with the creation of Michigan Saves.[4]

Public Act 295 established the policy framework that gave the right to individuals and businesses to install their own renewable energy system and to require the regulated utilities to begin purchasing or generating renewable energy, mainly through wind and solar.

This Act sought to promote the development of renewable energy and energy efficiency to achieve the following goals:

- Diversify the resources used to reliably meet the energy needs of consumers in Michigan,

4 https://michigansaves.org/

- Provide greater energy security through the use of indigenous energy resources available within Michigan,
- Encourage private investment in renewable energy and energy efficiency, and
- Provide improved air quality and other benefits to energy consumers and citizens of this state.[5]

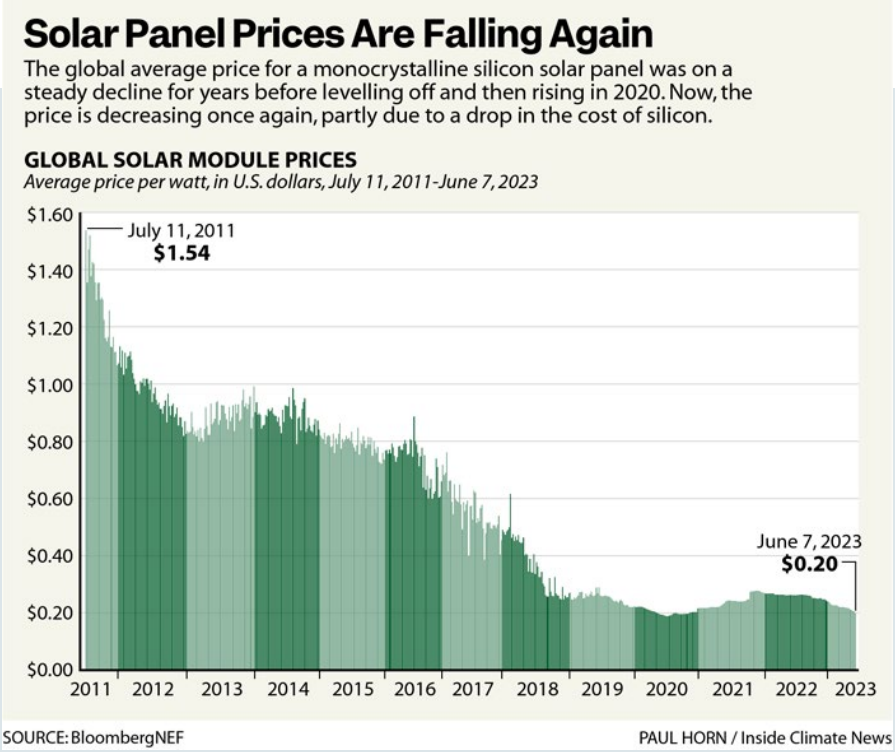
To meet these goals, Public Act 295 required that regulated Michigan utilities meet a new Renewable Portfolio Standard (RPS) that by 2015, at least 10% of the total electricity sold by the utility had to come from renewable energy sources, mainly wind and solar.

Public Act 295 also established the right of homeowners, farmers, and businesses to install their own renewable energy system to generate electricity for their own consumption.

Under this program, any extra solar electricity generated by a small-scale solar system could be exported back to the electric grid and the local utility would have to provide a financial credit to the solar owner, equal to the retail rate of buying electricity from their incumbent utility. This was called the Net Metering Program.

As a result of Public Act 295, Michigan's regulated utilities increased their production or purchase of renewable energy over the next eight years to meet the 10% requirement by 2015, while at the same time, homeowners and small businesses began installing their own solar energy systems. As the demand for solar increased, the cost of installing solar steadily decreased in Michigan and across the United States. The global decrease in price of solar modules is illustrated in the figure below.

In 2016, the Michigan Legislature amended



5 http://legislature.mi.gov/doc.aspx?mcl-460-1001

Public Act 295 by enacting Public Acts 341 and 342. These two Acts made three significant changes to the renewable energy policy framework:

- The Renewable Portfolio Standard was raised from 10% to 15% and the utilities had to meet this new requirement by 2021,
- The Net-Metering Program was changed to the Distributed Generation Program and required the Michigan Public Service Commission (MPSC) to begin a process that would establish a new Outflow Tariff or Financial Credit that small scale solar owners would receive for any solar electricity exported back to the Grid, and
- Required the regulated utilities to submit an Integrated Resource Plan (IRP) to the MPSC for approval, beginning in 2018 and every five years thereafter, on how the utilities plan on producing electricity in the future, taking into consideration cost and other factors.

From 2016 to 2021, the regulated utilities increased their purchase of renewable energy from 3rd party developers, or increased their own renewable energy production to meet the new 15% Renewable Portfolio Standard (RPS). The chart below illustrates the increase in renewable energy capacity that occurred as a result of Public Act 295 as amended in 2016.

Figure 1. Cumulative Commission-Approved PA 295 Renewable Energy Capacity by Commercial Operation Date

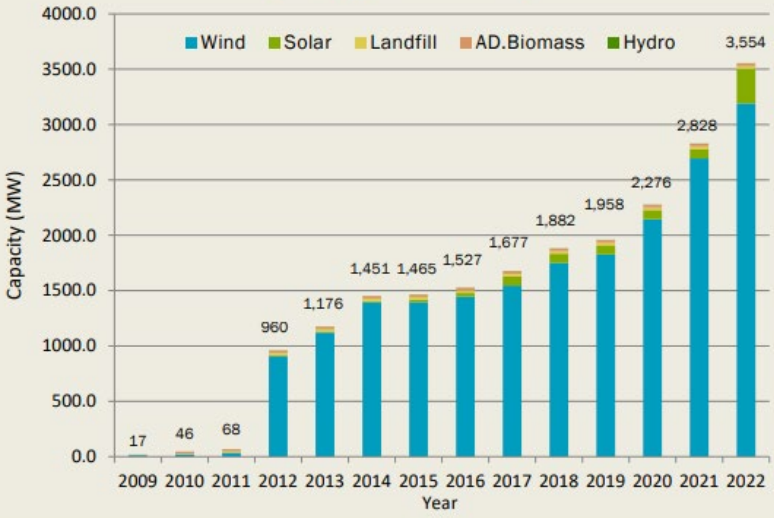


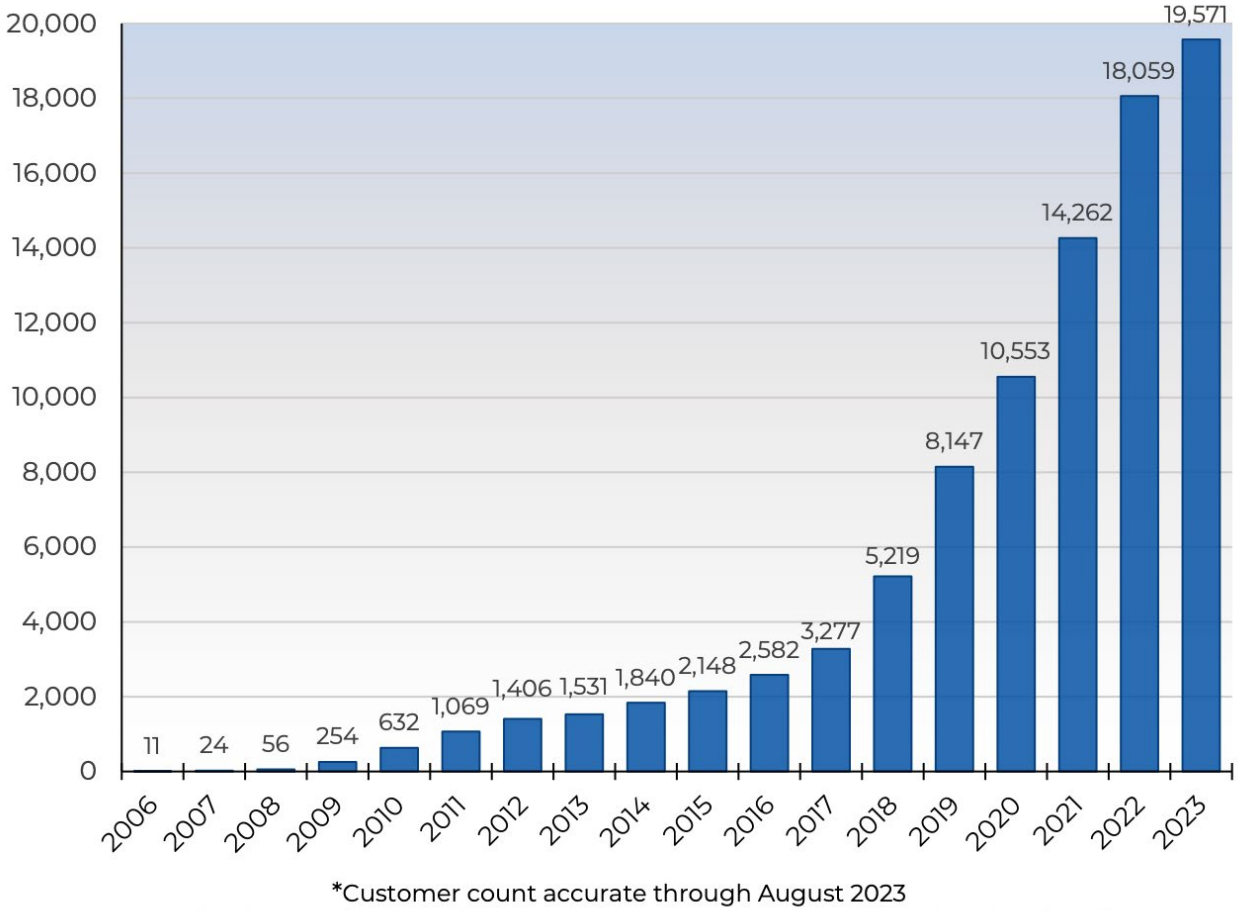
Chart source: Michigan Public Service Commission.

"Report on the Implementation and Cost Effectiveness of the PA 295 Renewable Energy Standard." (2022).

The Michigan Public Service Commission also implemented the new Distributed Generation (DG) Program that replaced Net Metering for new solar customers. Under this Program, electricity that a customer-owned solar energy system produces, reduces the amount of electricity purchased from the electric utility, effectively saving money at the full retail rate. However, when a homeowner or business generates more electricity from their solar

energy system than they can use at any given moment, it is exported back to the electric grid to be re-used by the utilities. Solar owners are compensated for this electricity through the Distributive Generation tariff, but at a lower rate (from the Net Metering program), based on the utility's cost of energy and capacity, which works out to be about half of the full utility retail rate. The chart below illustrates the amount of customers that participate in the DG Program.[6]

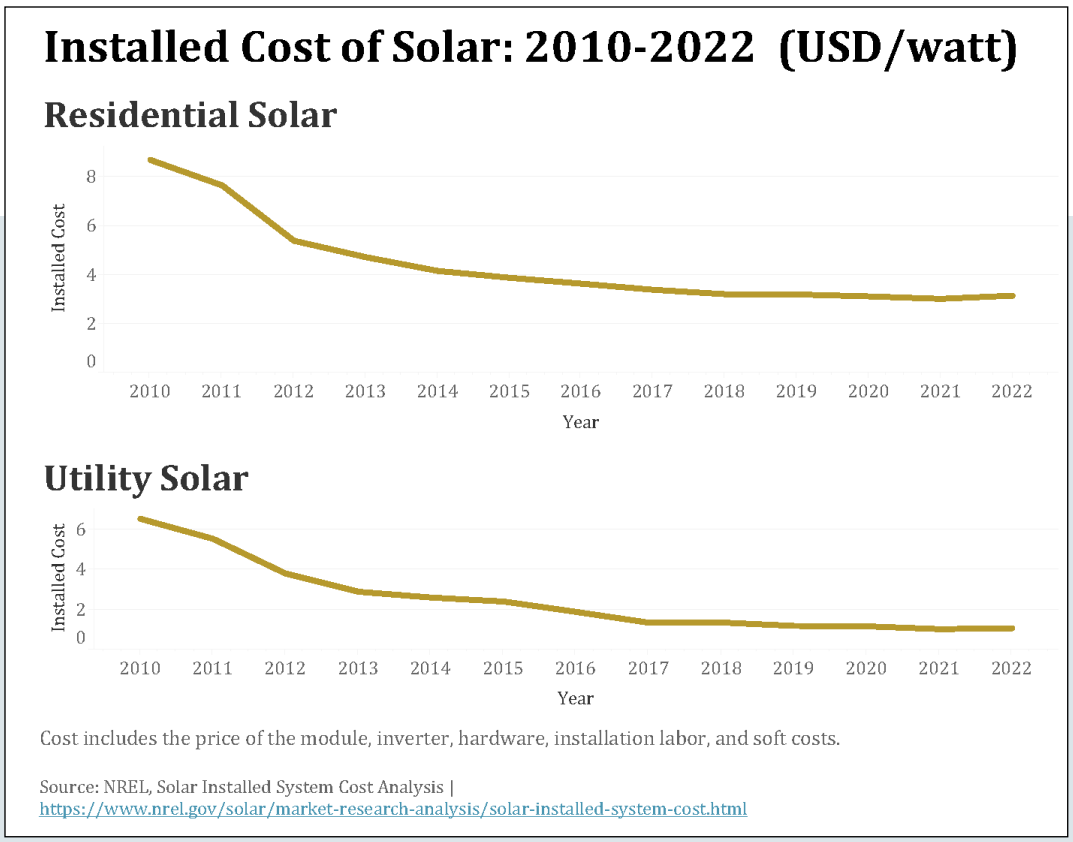
Total Distributed Generation Program Customers from the MPSC



*Customer count accurate through August 2023

Source: 2021 Electric Provider Annual Program Reports, Case No. U-15787 and updated Staff surveys.

6 https://www.michigan.gov/mpsc/-/media/Project/Websites/mpsc/regulatory/reports/RE-DG/2023-Renewable_Energy_Distributed_Generation_Legacy_Net_Metering_Report.pdf



As a result of the 2008 and 2016 laws, as the demand for wind and solar increased, the cost of producing this energy decreased, making solar and wind energy the most cost-effective resources for generating electricity in Michigan.[7] The chart above illustrates the price decrease of installing solar for both the residential and utility sectors from 2010-2022 using aggregate national data from the National Renewable Energy Laboratory (NREL).

For both utility scale and small scale solar, key factors in driving down the price include the reduction in the cost of silicon used in producing solar photovoltaic cells, improvements in manufacturing, and a significant drop in racking and other system costs.

The reduction in price of wind and solar electricity coupled with the health impacts from burning fossil fuels and the increased concerns of climate change, has generated market and political pressure on the utilities to close coal power plants and further increase the production or purchase of electricity from renewable energy sources.

Responding to the cost reductions for renewable energy and rising concerns over fossil fuel generated electricity, the Michigan Public Service Commission (MPSC) requires regulated utilities to evaluate competing fossil and renewable energy sources in their Integrated Resource Plans (IRPs), which has further increased pressure on the utilities to embrace lower-cost renewable energy sources such as wind and solar.

The 2022 passage of the Federal Inflation Reduction Act (IRA) has also increased the growth of small and large scale solar by

7 https://www.betterenergy.org/wp-content/uploads/2020/08/Solar_and_Wind_in_Michigan_Siting_Guide.pdf

offering financial incentives in support of the deployment of this energy.

Most recently in 2023, the Michigan Legislature enacted a series of new laws that were commonly referred to as the Clean Energy Future Plan of 2023. These laws include Public Act 229, Public Act 230, Public Act 231, Public Act 232, Public Act 233, Public Act 234, and Public Act 235.[8]

Highlights from these new laws include:

- **Public Act 229** addresses the Energy Waste and Reduction (EWR) program in Michigan and requires the utilities to increase their mandatory electrical energy-efficiency savings from 1% to 1.5% with financial incentives for the utilities to go beyond the 1.5% goal.
- **Public Act 231** expands the Michigan Public Service Commission's authority to evaluate Integrated Resource Plans that are submitted by the utilities. The Commission can now take into consideration new factors, including the impact on green-house gas emissions, environmental justice concerns, impact on human health and the affordability of energy.
- **Public Act 232** creates the Community and Worker Economic Transition Act, which creates a single state entity to develop a plan and coordinate efforts to address the impact on workers and communities with the shift from fossil fuels to renewable energy resources.
- **Public Act 233** establishes that for solar projects of 50 megawatts or more, for wind projects 100 megawatts or more, or energy storage projects of 50 megawatts or more, the developer can obtain the necessary approval to build from the Michigan Public Service Commission.
- **Public Act 235** amends the Clean and Renewable Energy and Energy Waste Reduction Act (Public Act 295 of 2008). This Act increases the Renewable Energy Portfolio from 15% to 50% and the utilities must meet this new standard by 2030 and then to 60% by 2035 and each year thereafter. Renewable Energy is defined as energy derived from solar, wind or water. This means that the percentage of electricity generated from solar and wind by the utilities must dramatically increase. In addition, this Act requires the regulated utilities to meet a new Clean Energy Standard of 80% by 2035 and then 100% by 2040. The Clean Energy Standard is defined as renewable energy, nuclear energy and natural gas, but only if 90% of the carbon emissions from that natural gas power-plant is captured and sequestered.
- **Public Act 235** also increased the Distributed Generation Cap from 1% to 10% of a utility's average in-state peak load for the proceeding five calendar years. The 10% Cap is allocated with 50% of the Cap for customers with a solar system generating 20 kilowatts or less and 50% for customers generating more than 20 kilowatts but not more than 550 kilowatts. A customer can also install a solar energy system with a generation capacity of 110% of the customer's electricity consumption for the previous 12 months. This provides homeowners and businesses the ability to build a larger solar system to account for an increased need in electricity for when a person plans to buy an electric vehicle, for example.

8 https://www.legislature.mi.gov/documents/2023-2024/publicacttable/pdf/2023-PAT.pdf

Utility Scale Solar – The Transition from Fossil Fuels to Renewable Energy

Utility-scale solar power plays a central role in the reduction of carbon emissions for utilities and the number of large scale solar projects is consistently increasing.[9] This applies to DTE Energy, Consumers Energy, other regulated utilities, municipal electric utilities and rural electric coops.

Michigan has three types of utilities: investor-owned, municipalities and co-operatives, for a total of 66 across the state.[10] The Michigan Public Service Commission (MPSC) regulates the investor-owned utilities and in special circumstances provides oversight on the municipalities and the co-ops. The MPSC regulated utilities include Alpena Power Company, Consumers Energy Company, DTE Electric Company, Indiana Michigan Power Company, Northern States Power Company, Upper Michigan Energy Resources Corporation, and Upper Peninsula Power Company.[11]

Electricity that is generated from a mix of solar, wind, and fossil fuels is sold on a retail basis to residential, commercial, and industrial ratepayers. There are programs that DTE and Consumers offer, where a homeowner or business can pay for electricity that is directly sourced back to renewable energy facilities. An example of this is the Voluntary Green Pricing Plan that DTE offers. Historically this electricity has cost a little more to purchase but in 2023, the price was actually slightly below the normal rates.[12]

Utilities are also beginning to combine solar and wind systems with energy storage and batteries for when the sun is not shining or the wind is not blowing. This increases grid reliability and resiliency and provides backup power.

The Role of the Public Utility Regulatory Policies Act (PURPA)

The Federal Government also plays a large role in the development and deployment of energy in this country.

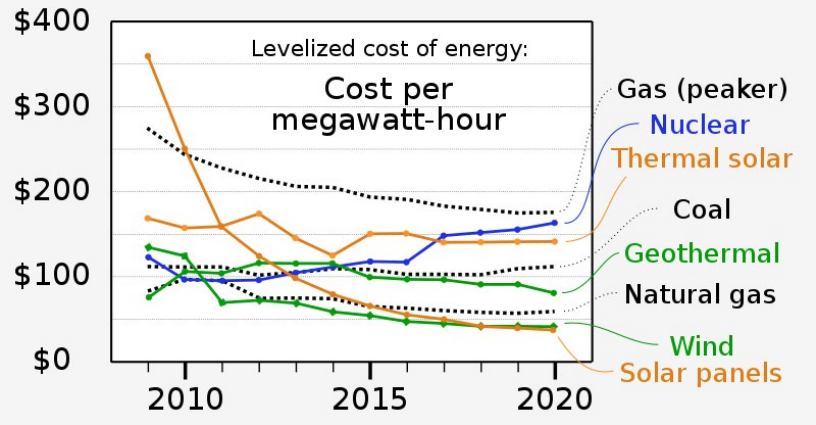
In 1978, the United States Congress passed the Public Utility Regulatory Policies Act (PURPA) to encourage fuel diversity through alternative energy sources and to introduce competition into the electric energy sector. [13]

PURPA set out to accomplish these goals by establishing a class of power generation facilities, known as qualifying facilities (QFs), which would receive a special rate for selling their electricity to the local electric utility. PURPA imposed an obligation on utilities to purchase power from QFs smaller than 20 megawatts, based on the utility's 'avoided cost.' Avoided Cost is equal to the amount the utility would have had to pay to generate the power itself or purchase it from another source. The utility is buying electricity from an energy developer at the price it would have cost the utility to generate it.

PURPA continues to be a significant driver of utility-scale solar projects moving forward because it reflects two key items that drive the solar market:

- **Levelized Cost of Energy -** Levelized cost of electricity is a method that determines the cost of different sources of energy by taking into account all the costs of producing energy, including equipment, construction, financing, maintenance, and decommissioning of generation facilities over time. An example of the levelized cost of energy for different types can be seen in the graph at right.

9 https://seia.org/research-resources/major-solar-projects-list
10 https://utilitysearch.apps.lara.state.mi.us/search
11 https://www.michigan.gov/mpsc/consumer/electricity/electric-utility-addresses-contacts
12 https://www.michigan.gov/mpsc/-/media/Project/Websites/mpsc/workgroups/3rdparty/32019_DTE_MIGP_3CRE_Presentation.pdf?rev=3615ce51d4db4fa68971317899c30629&hash=F10BDC3EEFD21AAA232F4226210C25B5
13 https://www.michigan.gov/mpsc/regulatory/electricity/renewable-energy/purpa



Data source: Lazard's Levelized Cost of Energy Version 14.0.
Lazard.com. Lazard (19 October 2020). Graphic created by RCraig09, 2021.

- **Power Purchase Agreements (PPA**) - A PPA is a contract that is reached between energy buyers and sellers. A buyer of energy such as a utility will buy the electric power generated by a renewable energy project that is owned by a 3rd party developer. PPAs are usually signed for a long-term period of time, usually between 10-20 years. Obtaining a commitment from an energy buyer to buy electricity through a PPA enables developers to secure financing for their projects.

Solar continues to grow dramatically because of PURPA and market pressure on the utilities to purchase lower cost renewable energy.[14]

Deployment of Distributed Solar

Distributed or Small Scale solar, is when a solar energy system is installed on a home, a farm or business and the electric power is utilized by the owner of the home or business. When a solar owner generates more solar electricity than they can immediately use, they can export that electricity back to the grid and receive a monetary credit for that energy. When the solar system is not producing the necessary power for the owner, they can then import electricity back from the utility and draw from the bank of credits they have built up.

The amount of the credit for this electricity under the original Net Metering Program established under Public Act 295 was the same amount as the utility retail rate. This credit, as a result of legislative changes in 2016, was reduced to about 50% of the retail rate under the Distributed Generation Program.

One key factor in the growth of Distributed Solar is the Federal Residential Solar Energy Credit that is sometimes referred to as Federal Investment Tax Credit. This credit reduces the amount of federal income taxes that an individual pays based on a percentage of the cost of a solar energy system, paid for by the taxpayer.

As a result of Congress enacting the Inflation Reduction Act (IRA) in August 2022, the Investment Tax Credit was raised to 30% and extended to 2033. There is no maximum amount that can be claimed. More information on the Investment Tax Credit can be found in Appendix II.

14 https://seia.org/us-solar-market-insight

Businesses can choose to use either the Investment Tax Credit or the Production Tax Credit. The Investment Tax Credit reduces the federal income tax liability by 30% of the cost of a solar system that is installed. The Production Tax Credit is a per kilowatt-hour (kWh) tax credit for electricity generated by solar for the first 10 years of a system's operation. It starts at 2.75 cents per kilowatt and can increase if the project meets additional criteria, such as having domestically produced content or if the project is located in a low income community, and is adjusted annually for inflation.[15]

Solar Businesses - The Engine that Drives the Solar Train

The deployment of Distributed Solar is driven primarily by five factors:

1. **Rising Energy Costs:** Homeowners and small businesses can install their own solar system and be in control of their energy expenditures, knowing that they will save money from not having to buy utility electricity at an ever-increasing cost.
2. **Resilience:** Many homeowners and businesses are motivated by self-reliance with the desire to decrease their reliance on utilities.
3. **Climate Change Concerns:** Solar owners know that by installing their own solar system, they are doing their part in reducing carbon pollution that contributes to climate change.
4. **Solar Technology Innovation:** The cost of solar energy has decreased due to market demand and new technological innovations, including increased solar panel energy production efficiencies. A solar energy system consists of solar panels, racking (that secures the solar panels to the roof of a house or to the ground in a ground mount system), wiring, inverter, with the option of adding battery storage. All these components are seeing new innovations and cost reduction. Solar panels in particular have seen greater efficiencies and cost reduction through the use of low-carbon silicon[16] and advanced manufacturing practices which provide more efficient solar cells at lower cost.
5. **Innovative Entrepreneurship:** Solar installers generally range from small to midsize businesses and install and service a solar system on a customer's property. These firms are licensed and must understand local, state, and federal laws in regard to federal income tax credits, financing and inter-connection with the local utility. Because solar involves electricity, solar installers must meet strict electrical standards for electrical contractors, must obtain local electrical and building permits, and must secure project signoff from the local government building inspector or electrical inspector. Lastly, the solar contractor usually secures the interconnection with the local utility for the solar customer.[17]

Qualifying the Renewable Energy Contractor for Residential or Small Scale Solar & Geothermal

The renewable energy contractor usually assumes responsibility for all phases of the solar or geothermal installation, including:

- **Site Assessment:** To determine the viability of the site for solar or geothermal energy. Is there too much shading? What is the roof orientation for the structure, south, east or west? How much solar can be installed on the roof or on the property? Is there enough land for a geothermal loop system?

15 https://www.energy.gov/eere/solar/federal-solar-tax-credits-businesses
16 Low Carbon Solar Alliance - https://ultralowcarbonsolar.org/
17 For more information on solar contractors see: GLREA Learn About Solar Energy, https://www.2glrea.org/learn-about-solar

- **Renewable Energy Options:** To determine which type of solar panel, inverter or other optional items such as battery storage or electric vehicle charging, to use. In the case of geothermal energy, how big a system does the customer need for their home or business.
- **Proposal:** Providing the entire cost of installing the system, including any options. This proposal will become the basis of the purchase agreement. Potential customers should get a few solar proposals and compare experience, $/watt installed, warranty on parts and labor, etc.
- **Permits:** Secure 100% of Building and Electrical Permits and post-installation approval.
- **Installation:** Complete the installation of the solar or geothermal system.
- **Financing:** Assist in locating financing for customers that request it. One source of financing is Michigan Saves.
- **Guarantees and Warranties:** Explaining all product guarantees and warranties.
- **Service Agreement:** Explain the Service Agreement covering any ongoing service and maintenance.
- **System Monitoring:** Set up the online link to a monitoring site so customers can monitor the system output.
- **Federal Investment Tax Credit:** Explain and provide information needed to secure the Federal Investment Tax Credit for the solar or geothermal system.
- **Payback Period and Return on Investment:** The payback period is the amount of time it takes for solar owners to make back the money of their initial investment. The average range of the payback period for Michigan installations is between 8 to 12 years.

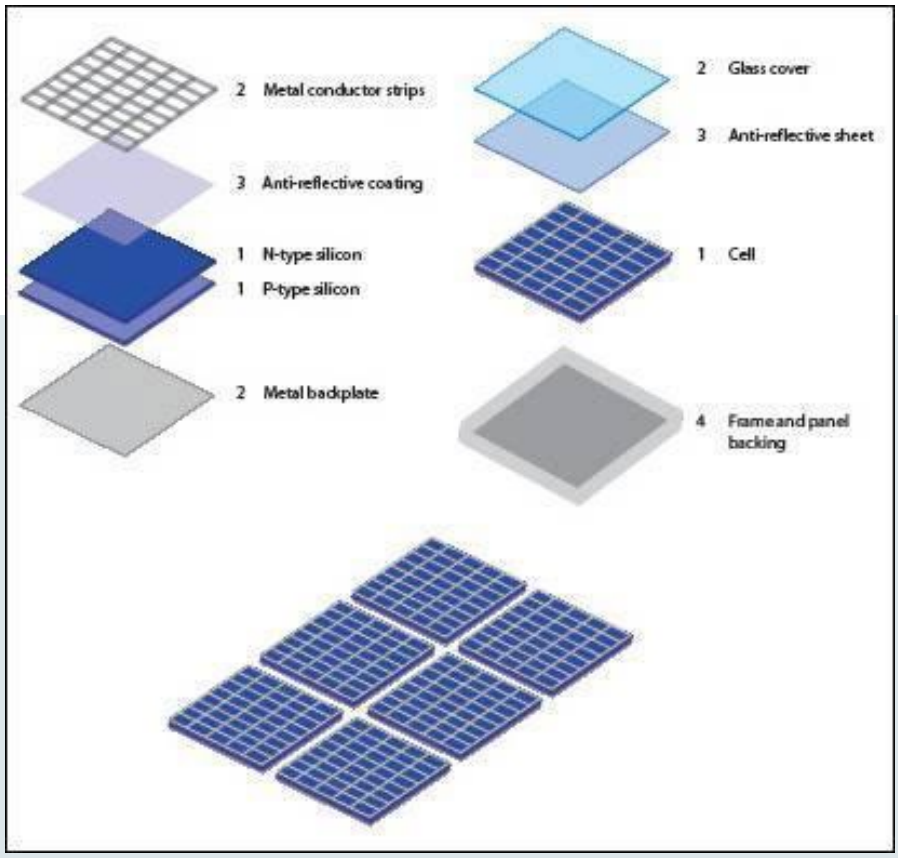
Photo by Alex Snyder, July 2009.
Photo provided by Wayne National Forest.

In Michigan, there are two ways for a solar installer to establish credentials as a reputable firm:

- **Michigan Saves**: Contractors must meet legal and high business standards in order for them to qualify for financing through Michigan Saves for their customers. This organization vets solar installers and maintains a list of qualified solar contractors whose projects are eligible for Michigan Saves financing. (See: https://michigansaves.org/find-a-contractor/).
- **Industry Association Membership**: The old adage that 'you are known by the company you keep' applies in the renewable energy industry. Most reputable renewable energy manufacturers and installers belong to industry associations such as:
    - **Great Lakes Renewable Energy Association (GLREA):** GLREA, a membership-based organization founded in 1992, includes solar and geothermal contractors. GLREA educates about solar and geothermal systems and advocates on behalf of renewable energy businesses and the general public. GLREA

has a list of Solar Contractor Members that is available for public viewing on the website. (See: https://www.2glrea.org/).

- **Michigan Energy Innovation Business Council:** MIEIBC represents large and medium-sized renewable energy businesses in Michigan and is an active lobbying association on their behalf. (See: https://mieibc.org/)
- **Michigan Geothermal Energy Association:** MGEA represents geothermal businesses in Michigan and educates the public about the benefits of geothermal energy. (See: https://mieibc.org/company/mgea/).
- **American Solar Energy Society (ASES)**: ASES is a membership association of solar businesses and associates. ASES publishes Solar Today Magazine, offers qualified training and solar education events, and houses an impressive library of solar-related publications. (See: https://ases.org/)
- **Solar Energy Industry Association (SEIA)**: SEIA is a membership organization representing the interests of solar businesses across the United States. Based in Washington DC, SEIA is the main federal lobbying association for solar businesses. (See: https://www.seia.org/).



Layers of a solar panel.
Image source: Qmwnebvr97, October 2015.

Solar Recycling

Solar energy, like other industries, produces waste. There is manufacturing waste, waste from old solar panels and other components of the solar energy system. Manufacturers can reduce their production waste by adopting more efficient manufacturing processes.

Recycling will become critical to address old discarded solar panels. According to the Chemical and Engineering News,[18] eight million metric tons worth of solar modules will reach their end of lives by 2030, increasing to 80 million by 2050. As a point of comparison, 292.4 million tons of municipal solid waste was generated in 2018, according to the U.S. Environmental Protection Agency.[19]

Currently, solar recycling is in the early stage of development. A solar module contains individual cells of silicon wafers, with doping chemicals such as cadmium and lead. The cells are wired together with copper connectors and wires. The modules are held together between two pieces of glass, in an aluminum or plastic frame, and then covered in clear plastic to protect from the elements. Many parts of a solar panel can be recycled.[20]

Solar Recycling in Michigan

What happens to solar equipment after their useful life expires? Currently, for the owner of the solar, the cheapest and thus most popular end of life solution is to landfill. Solar power becomes solar waste.

For Michigan Energy Options (MEO) putting old solar panels in landfills didn't make any sense. Locate solar on top of one landfill and 30 years later put it underground at another landfill.

Thus, MEO's 'Second Life Solar'[21] effort to find better options: repurpose solar panels that still have life in them and recycle those that do not, making landfilling the last choice, not the first in the industry. While Michigan's solar repurposing and recycling sector is at the early stages, other states and countries are farther ahead in dealing with this impending problem.[22]

Nationally and globally, solar recycling is increasingly getting the attention of the industry and the concerns of local governments, which do not want solar to become a new kind of industrial waste. Michigan alone stands to have its current gigawatt of installed solar soon catapult to eight, 16, perhaps even 30 gigawatts by the 2040s. A gigawatt of solar is approximately 3 million panels. This is a problem that must be addressed.

18 https://tinyurl.com/t3wtzv2
19 https://tinyurl.com/ysussp4y.
20 For more on solar recycling see, Matthew M. Robare, *Solar Recycling Forgotten Amid Political Fights and Supply-Chain Disruptions*, in, Solar Today, Fall, 2022, pp 55.
21 https://michiganenergyoptions.org/second-life-solar/
22 https://hbr.org/2021/06/the-dark-side-of-solar-power

Chapter II

Community Solar in Michigan

Expanding the Solar Option to all People in Michigan

What is Community Solar?

The United States Department of Energy defines Community Solar as any solar project or purchasing program, within a geographic area, in which the benefits of a solar project flow to multiple customers such as individuals, businesses, and other groups including non-profits and places of worship. Community Solar also refers to a solar energy system that is located within a community, where individuals and businesses can either purchase or subscribe to a number of solar panels. The value of the electricity generated by those panels is then credited back to the individual through their utility bill, which can then reduce or eliminate their utility energy expenditure.[23]

The most common method to subscribing to Community Solar is by doing so within one's utility electric service territory. While ideal for a Community Solar project to be within a short distance from a customer's home or business, most customers will be able to subscribe to a solar project within their utility's service territory.

The key feature of Community Solar is that it opens up the solar market to all people. It allows people who may not be able to install solar panels, maybe because they live in an apartment or condominium, the roof of their house is shaded or has a poor orientation to the sun, or they can't afford the full up-front cost of installing their own solar energy system, to be able to purchase solar electricity. Community Solar enables all people to have a choice on what electricity they purchase, because now individuals and businesses can purchase solar electricity without having to install a solar energy system where they live or work.

23 https://www.energy.gov/communitysolar/community-solar

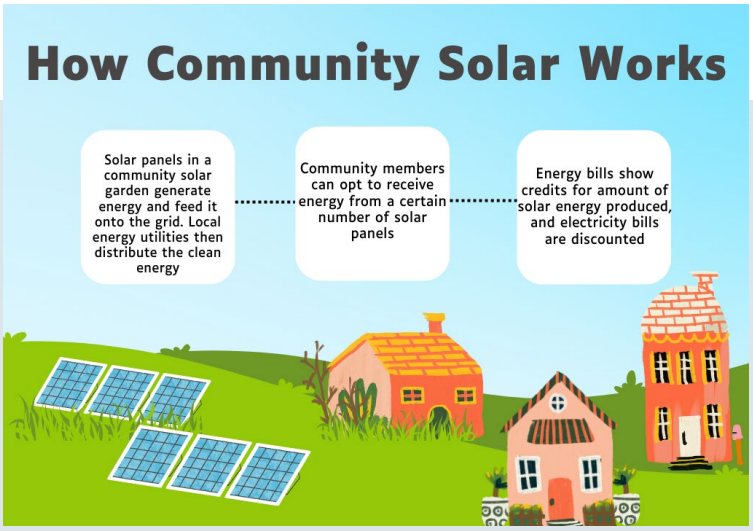


Image created by Chloe Brush

Community Solar also makes the purchase of solar energy accessible to people of all income levels, which promotes energy equity and environmental justice. Low and moderate income families that can't afford the full upfront cost of installing solar, can buy or subscribe to solar panels that meet their budget. Thus, Community Solar enables everybody to be able to obtain lower costing electricity, to contribute to a cleaner environment, and reduce the risk of Climate Change. In addition, because purchasing solar electricity saves money, by expanding the solar option to all people and businesses, Community Solar contributes to local economic development and can create jobs.

For these reasons, Community Solar is supported and promoted by the US Department of Energy (DOE) and the State of Michigan Department of the Environment, Great Lakes, and Energy (EGLE).

How Community Solar Works

Community Solar works just like a standard solar installation where electricity is produced by solar panels, but whereas the electricity generated by a residential system is fed into the person's home electrical system, the electricity from a Community Solar project is fed into the electrical grid. The monetary value of the electricity, or in some cases the kilowatt hours produced (kWh), is then credited to the individual or business owner subscriber, through their utility bill.

This means that an individual or business can purchase solar energy that is generated at a site away from their home, apartment, or business but can still have the value of that electricity credited back to their place of residence or business, as if the solar system was on their property.

Community Solar Models

There are two principal models that are used by community solar developers:

1. The Equity Investment Model, where an individual purchases a certain number of panels at a Community Solar project and is able to apply the Federal Investment Tax Credit to offset a portion of the cost of this purchase[24], or
2. The Subscription Model, where an individual 'subscribes' to a certain number of panels at the community solar installation.

Both models are effective for providing an opportunity for all individuals and businesses to obtain solar energy.

Equity Investment Model

Under the Equity Investment Model, where the participant buys a certain number of panels,

24 https://www.irs.gov/pub/irs-wd/201536017.pdf

Image Source: Ann Arbor Parks and Recreation

the power that is generated by those panels is credited to the participants place of residence in one of two ways:

- The solar electricity generated from the panels is treated as if the solar panels were on the home and therefore reduces the number of kilowatt hours that the participant then has to purchase from the utility.
- The amount of electricity generated by the solar panels is monetized and the participants utility bill is reduced by the amount of money that the solar electricity is valued at.

The Equity Investment Model requires an upfront investment by participants and because they are buying the panels, participants can take advantage of the Federal Investment Tax Credit to off-set 30% of the cost of purchasing the panels. More information on how to use the tax credit can be found in Appendix II. The disadvantage of this model is that it still requires people to pay up front the cost of the panels and a portion of the energy system, which similar to rooftop solar, can be a barrier for low and moderate-income individuals.

Participants can calculate how long it will take to pay off the financial investment in the solar panels through energy savings. Just like rooftop solar, once the initial cost has been 'paid-back' through savings, the participant will receive free electricity for the remaining life of the panels or the Community Solar project.

Subscription Model

Under the Subscription Model, participants are able to 'subscribe' to panels for a modest monthly payment which opens up solar for more people because the financial barrier is reduced. The downside of the Subscription Model is that the solar participant never ends up owning the panels and can't take advantage of the Federal Investment Tax Credit to further reduce the cost.

Under either method, the purchase of the solar panels means that the participant will be able to obtain lower costing electricity than what they were paying for through their utility. This savings will increase over time, as utility rates continue to increase.

Investor-Owned Utility Renewable Energy

Both DTE Energy[25] and Consumers Energy[26] offer a renewable energy option for individuals and businesses who want to buy electricity that is sourced back to solar or wind generation. These options cannot be called Community Solar because they do not have the characteristics of a true Community Solar energy system. Typically with these programs, a participant pays a monthly fee and receives a small credit for the solar electricity that is produced by the number of solar 'blocks' that a person purchases.

Rather than saving money from obtaining electricity from a true Community Solar system, under these utility programs a participant is usually paying more than the standard residential rate in order to obtain electricity generated from solar or wind energy sources. These programs are intended for individuals who support renewable energy and are willing to pay more to obtain it.

Municipal Utilities and Community Solar

There are 40 cities in Michigan that own and operate a Municipal Utility, providing about 10% of Michigan's total electricity needs. Municipal Utilities are described as providing:

> "An electric service to their residents, just as communities provide water and sewer services. As units of local government, municipal electric systems are non-profit, community owned and operated, and regulated directly by the city and customers they serve." [27]

Municipal Utilities are well positioned to support the rapid deployment of solar energy because they have a clear focus on servicing their customers, the citizens of the city, and do not have to make a profit or provide dividends to stockholders like investor-owned utilities do.

Many cities are developing a Sustainability Plan that outlines steps the city can take to address Climate Change. Communities that have a Municipal Utility are uniquely positioned to take steps to meet their sustainability goals and can do so by supporting the expansion of solar through Community Solar. Community Solar can provide clean and lower costing solar electricity to their residents and businesses while reducing carbon pollution and the risk of Climate Change.

The American Public Power Association (APPA), in partnership with the U.S. Department of Energy and the National Renewable Energy Laboratory, have published *The Municipal Utility Community Solar Workbook.* [28] This workbook provides an excellent guide on the process for developing a Community Solar project or program for municipal utilities. The guide includes real-world examples, tools, and processes.

According to an NREL study, there are over 1,600 Community Solar projects operating across the country,[29] in a general size that is the small end of utility-scale projects and the high end of behind-the-meter projects. The general size of utility scale projects opens the overall market for new customers that will now have opportunities that have been previously unavailable.

25 https://solutions.dteenergy.com/dte/en/Products/DTE-CleanVision-MIGreenPower/p/MIGPGREEN
26 https://www.consumersenergy.com/residential/renewable-energy/solar-gardens
27 https://mipublicpower.org/about-mmea/
28 https://www.communitysolarvalueproject.com/uploads/2/7/0/3/27034867/municipal_utility_community_solar_workbook.pdf
29 https://www.nrel.gov/docs/fy21osti/80246.pdf

Community Solar garden in the snow.
Photo by Stephen Coffrin.

Low and Moderate-Income Community Solar

Within the broad category of Community Solar, some projects are specifically designed to target low and moderate income families with the goal of saving the participants money on their high energy expenditures. These types of projects may receive financial support from the State or Federal Government in order to reduce the cost of the developer building the Community Solar project, who in turn can offer lower-costing solar electricity to the participants. The goals of these projects are to reduce the cost of electricity to participating households, which will help the family become more financially stable. For Community Solar projects that involve a traditional utility, the savings for customers should reduce the number of customers that can't afford to pay their utility bill, which is in the utility and state's best interest. Some case examples of these projects are described in Chapter 3.

The Federal Inflation Reduction Act provides a 30% tax credit financial incentive to reduce the cost of developing a Community Solar project by that same amount. In addition, if a Community Solar project is located in a disadvantaged community that has been impacted by legacy fossil fuel generation, is located on a brownfield and uses domestic content, the cost of the project could be further reduced by 60%.[30] This should increase the

30 https://www.solarunitedneighbors.org/learn-the-issues/solar-incentives/how-the-inflation-reduction-act-helps-you-and-your-community-go-solar/

financial viability of Community Solar projects by reducing the upfront project costs, which makes it possible to offer even lower costing electricity from the project.

On-Bill Financing is another option where a family can borrow money at low cost to purchase panels in a Community Solar project, that can then be paid off through energy savings. This enables Community Solar to become a major policy tool in helping low and moderate income families save money and reduce the number of those that are struggling to pay their utility bills.

The Community Solar Challenge in Michigan

The challenge in Michigan is that there is no explicit law that supports the development of Community Solar projects and as a result the investor-owned utilities refuse to work with developers to build them. There is nothing that prevents utilities from working with solar developers to build Community Solar projects but there is also nothing that requires them either.

A Community Solar policy needs to be enacted into state law that requires the utilities to work with developers and to use the utility bill as a mechanism to link the amount of electricity purchased at a Community Solar site to the participant's home residence or business.

Twenty-four states have enacted a Community Solar law, including Minnesota, New York and Massachusetts.[31] Bills have been introduced in Michigan in recent years on a bi-partisan basis that would support Community Solar and require the utilities to connect the electricity generated from the Community Solar project to the grid, and credit the amount of electricity owned or subscribed by a participant on their utility bill.

Michigan's current energy policy provides utilities a complete monopoly in their service territory for generating and selling electricity, except for the option that current homeowners and businesses have for purchasing and installing their own solar energy system. Expanding this solar option to all residents and businesses will require the development of Community Solar projects. A Community Solar law must be enacted to provide this solar option to all Michigan residents and businesses.

To explore Community Solar and its definitions more in depth, visit: https://www.cesa.org/wp-content/uploads/Solar-with-Justice.pdf

31 https://www.epa.gov/green-power-markets/shared-renewables#fn3

Chapter III
Community Solar Case Studies

Developing Models for Community Solar

CELICA Models Promoting Access and Equity

The absence of a Community Solar law in Michigan has not prevented the development of all such projects in the State. But to understand the importance of enacting this law, let's compare Michigan with Minnesota. Michigan has seven community solar projects as of August 2023 while Minnesota, which does have an enabling law, has 400 projects.[32]

Another key challenge for Community Solar is that 'community' suggests that all community members can participate in these projects. Unfortunately, this is not always possible for individuals and families who lack the financial means to do so. Most, but not all, Community Solar projects in Michigan come with a participant cost, either an upfront investment or a monthly subscription price that can add to a low-income customer's energy burden.

An equitable and fair transition from fossil-fuels to renewable energy needs to include everyone, not just those who can afford solar. How to make solar energy available to low and moderate-income families is a problem but enacting a Community Solar would be a huge step to promoting solar equity.

Across the country, a number of pilot projects have been launched, funded through federal and state grants, implemented by nonprofits and community groups, all seeking to develop a sustainable model for Community Solar projects that include both market-rate and 'income-qualified' utility customers.

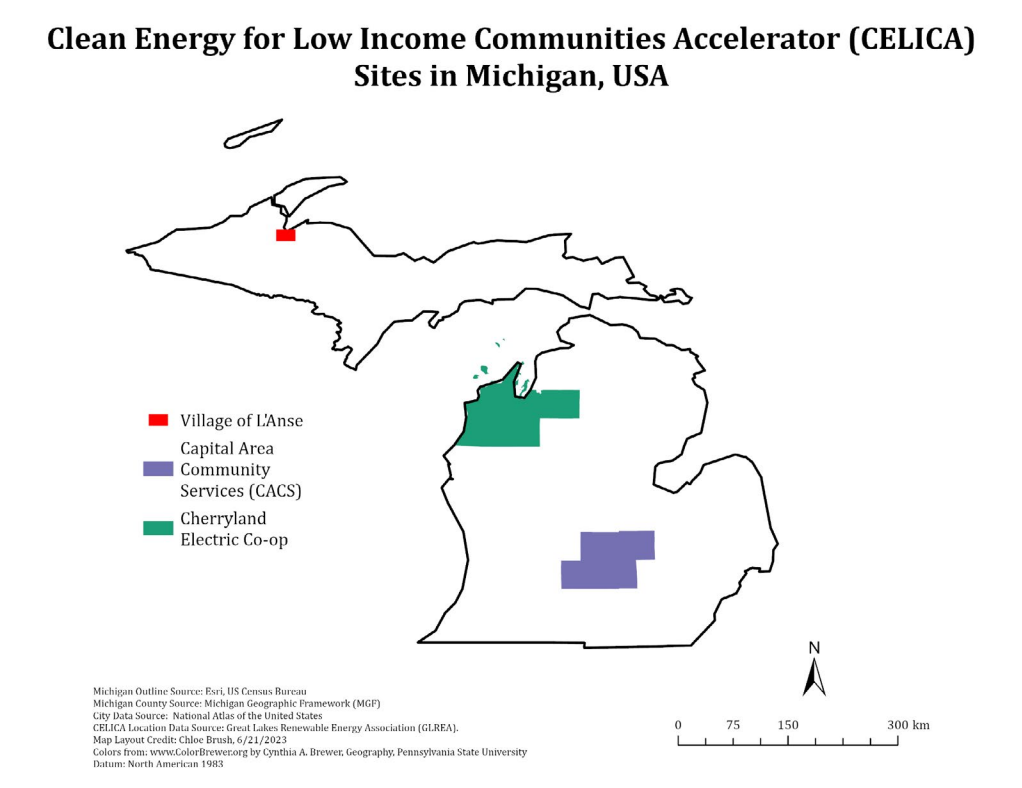
32 https://www.energy.gov/communitysolar/states-collaborative

In 2017, the State of Michigan Energy Office, now Michigan Energy Services, began a novel approach to providing access to renewable energy for low-income households by supporting the development of several Community Solar projects. The program seeks to determine if Community Solar can be a viable option to reduce the energy burden for low-income families. These projects have had data gathered and analyzed, been modified, and involved the expertise of Michigan and national Community Solar experts.

energy access while providing a practical, replicable solution to reducing low-income household's energy burden. The CELICA model is similar to a subscription model introduced in Chapter 2, but includes additional unique elements.

Cherryland Electric

It is fitting that Cherryland Cooperative Electric, in the northwest corner of the Lower Peninsula, would pilot the first Michigan CELICA project given that this utility was the first to create a



The preliminary results of the Low-to Moderate-Income Access Program, a pilot through the U.S. Department of Energy's Clean Energy for Low Income Communities Accelerator (CELICA), is encouraging. Participants are seeing a reduction in their monthly utility bill and are having less difficulty in paying their bills on time.

What follows are profiles of three shared solar projects that promote equity and renewable

market-rate Community Solar program in 2016. This part of Michigan is a vacation spot, with approximately one out of six jobs being related to tourism. However, this is also a region of extremes in affluence and subsistence. One out of six children in the area live in poverty.

Cherryland serves six rural counties in the Traverse City Region, with a total of 36,000 members. The Northwest Michigan Community

Action Agency (NMCAA), provides services to low-income residents, in these counties and four additional ones. NMCAA's 2021 needs assessment of the Region, states that affordable housing is a fundamental problem: "Lack of access to quality affordable housing is both a cause and a condition of poverty. It is a family need though it is also a community problem." [33] Within the affordable housing sector are household expenses, which include utility costs. At its worst, unpaid utility bills can lead to a series of cascading effects that can lead to eviction and homelessness.

The Cherryland team, which includes the Michigan Department of Health and Human Services Bureau of Community Action and Economic Opportunity, devised a low-income community solar program that paired renewable energy with energy efficiency at the front end for participants. To qualify for the program, participants had to first receive a free 'weatherization' service for their home, which included insulation, LED lights and other energy-saving measures, as well as some energy education. Once accepted into the program, participant households were allotted bill credits equivalent to the production of nine solar panels at the community solar array. On average, each household's share translates into a $20-$30 a month savings, or $350 a year.

Included in the data, being tracked at the beginning and then updated since the initial 50 customers began receiving credits in 2018, are occupants 'comfort and satisfaction' change if any, in late payments, and where the financial savings on energy bills is now being spent. To answer the question, "What are you doing with your utility bill savings?" respondents said paying medical bills (16%), buying food (16%) and making home repairs (16%). For Cherryland Electric, late payments decreased slightly.

Because this was the first of its kind, Michigan Energy Services wanted to learn as much about the project as possible. Data was therefore gathered and analyzed, including:

- Electricity usage before and after enrollment into the solar credit program.
- Number of participants needing direct low-income energy assistance.
- Behavioral change commitments to energy waste reduction.
- Stability in paying monthly bills and establishing a path towards energy self-sufficiency.

Karl Hoesch, a University of Michigan researcher brought in to conduct an analysis, concluded that the "first year of the program was largely a success." This success has in turn, bred more success. In 2021, Cherryland and nearby municipal utility Traverse City Light & Power, expanded the low-income community solar program to 20 more households in the region. The need is great, according to Tish Stave, Northwest Michigan Community Action Agency Housing and Energy Efficiency Services Director. In her outreach to sign up participants for the program, she found everyone to be excited. "They like that they don't have solar panels on their property to take care of," she said. "And they like that they are lowering their carbon footprint." The Community Solar model exists seamlessly alongside the weatherization program, Stave observes.

It is this combination that is the key. Energy efficiency upgrades to the home reduces energy costs and makes the home more comfortable. Then with Community Solar, electricity costs are reduced which saves the family money.

33 https://pv-magazine-usa.com/2023/05/25/minnesota-expands-community-solar-program-to-allow-more-lmi-customers-projects-to-5-mw/

Village of L'Anse

Across the Straits of Mackinac in the Upper Peninsula is the Village of L'Anse. L'Anse, a French word meaning 'cove,' sits at the bottom of the picturesque Keweenaw Bay. Up the Keweenaw Peninsula some 30 miles is Michigan Technical University (MTU), which factors into how and why L'Anse would become the second site of a CELICA Community Solar project in Michigan.

Photos of the Cherryland CELICA Project.
Courtesy of Cherryland Electric Cooperative.

L'Anse City Manager Bob Lafave describes his community as tight knit, working class and proud of their 'Yooper' roots. For Bob, renewable energy was already an interest when the opportunity presented itself to include a low to moderate-income component to a Community Solar project that he was developing. It became about equity for him. "Anybody who lived in the community who wanted solar could be involved," he said, "if we did this thing right."

L'Anse, with a population under 2,000, had already installed a modest solar energy system of 11 kilowatts on its wastewater treatment plant that provided most of the electricity needs for its municipal buildings. Its municipal utility purchases the bulk of its electricity from a wholesale power producer called WPPI Energy. Setting its sights on more local solar generation, L'Anse engaged Michigan Technical University (MTU) and the Western Upper Peninsula Planning and Development Region to determine two critical aspects of Community Solar: How much will it cost to build and how much will it cost customers to participate? If the price is too high for either, the project won't work.

MTU Professor Richelle Winkler and her students conducted surveys, research and analysis to determine the optimal size of an array based on community interest and what people were willing to pay to participate. However, this was a 'market-rate' analysis and not reflective of the reality of low and moderate-income families. In other words, lower income residents would likely not be able to afford the price despite efforts to drive down the cost of building a Community Solar project. The economics of solar are dictated by market forces, the cost of solar panels and accompanying equipment, and the cost of installation. Both have dropped significantly in recent years, but still not enough to get the access and equity piece that Bob Lafave wanted to see in L'Anse.

Bob then worked with Lisa Thomas and Robert Jackson of Michigan Energy Services and together they created a low-income component to the L'Anse Community Solar program project. The array was energized in the spring of 2019 and subscribers began to receive credits on their bill in December.

Participants here, like with Cherryland Electric, had to first have their homes upgraded with weatherization improvements and they had to be at 200% of the federal poverty level to qualify for the program. Participants then could lease between one and ten solar panels for a specific number of years. Panel costs were brought down by the CELICA program and included an On-Bill Financing option for participants, who paid $0.90/month/panel for a term of 25 years. This cost, assessed on their monthly bill, is offset by the monthly bill credit of $0.95/kWh for the output of their share of the overall 110 kilo-watt system. This translated into an average monthly savings of $21-$23 or $298 the first year.

It's important to emphasize that 'On-Bill Financing' for customers for energy efficiency and renewable energy projects helps to reduce barriers to access. Community Solar projects often require participants to pay up front in full for the amount of solar energy they would like to receive for the next 25 years. This is quite different from normal monthly utility billing. On-Bill Financing allows a homeowner to use debt to access lower costing electricity from Community Solar, but that debt is being serviced monthly by the credits being generated from the Community Solar array. L'Anse's Community Solar design makes lower costing renewable energy available to the entire community, including families in need, just as Bob Lafave set out to do.

Consumers Energy

Michigan has three types of utilities: investor-owned, municipals and co-operatives, for a total of 66 across the state. The Michigan Public Service Commission regulates the investor-owned utilities and in special circumstances provides oversight on the municipalities and the co-ops.

As explained in the next section, Consumers Energy has been running the Solar Gardens Sunrise program for years, which allows participants to subscribe to solar projects in which they receive credits on their bill that correspond with their monthly payments of a 'solar block.' Consumers Energy states on their

Pictured is the ribbon cutting of the solar array and the panels in the winter.
Courtesy of the Village of L'Anse.

website, they "offer several ways for you to pay, with plans to fit every budget. For as little as $8 per month, you can subscribe to solar energy."[34]

Consumers Energy recognized that for low-income customers even a modest fee could make it more difficult for them to pay their electricity bill or participate in the Solar Gardens Sunrise program. As a result, Consumers Energy teamed up with Capital Area Community Services (CACS) and Michigan Energy Services in the Department of Environment, Great Lakes and Energy, which provided funding to put together a program that would enable low-income families to be able to access solar energy.

Capital Area Community Services (CACS) works with low-income households in Clinton, Eaton, Ingham, and Shiawassee Counties and provides services that range from Head Start, tax preparation, food security and weatherization. Weatherization is designed to help lower fuel costs by making homes more energy efficient. Insulation, LED lights, and refrigerator replacement have long been mainstays in the weatherization program, but solar is new.

Miguel Rodriguez, the Executive Director of Capital Area Community Services, said that their clients interested in accessing community solar through Consumers Energy, had to be qualified through the weatherization program. The three participating organizations are following the results, before and after participants are getting solar energy, with each qualifying household getting the equivalent of electric power from six virtual solar panels. How much will this renewable energy reduce their monthly bills? That's the question everyone is interested in learning, although at this juncture it is too early to have definitive answers yet.

Lessons Learned from CELICA Projects

Anna Adamson from the Clean Energy States Alliance analyzed these three CELICA projects and compiled important lessons learned from the experience.[35] More information can be found in her report "Partnering to Reduce Energy Burden: A Michigan Community Solar and Weatherization Pilot."

Her key findings are the following.

Partnerships

Part of the success of these projects can be attributed to having successful partnerships with utilities, state energy agencies, and weatherization organizations. These partners state that effective and frequent communication throughout the program is why the partnership was successful. When designing the program, the partners should be active in developing the scope, goals, and each partner's responsibilities. Furthermore, partners should create a transparent, organization-wide commitment to the program so that employee turnover won't affect the partnership's success.

Pricing

Another lesson learned is that it is essential to create the program so that low- and moderate-income households can participate. To increase accessibility to lower-income households, L'Anse used a tiered model. The lowest tier required no upfront costs and low monthly payments. The tiered model allowed households to choose a payment plan that worked best for them.

Furthermore, organizations should gauge the price sensitivity of their community. For example, L'Anse found that community members were more likely to participate in the program if one solar panel did not cost more

34 https://www.consumersenergy.com/residential/renewable-energy/solar-gardens

35 https://www.cesa.org/wp-content/uploads/Michigan-Case-Study.pdf

than $350. From there, they could establish accurate subscription tiers. Programs should also minimize the cost for participants while maximizing the impact and energy savings for each household. The number of solar panels households receive should be enough to reduce their energy burden meaningfully.

Utilities

When developing a Community Solar program, utilities should devote the resources necessary to create a foundation for the program. Utilities should also develop simple contracts for prospective Community Solar subscribers and should also "consider what their billing system is capable of detailing." Since new charges and credits will be added to subscribers' bills, a utility should know if its billing system can factor in these additions.

Furthermore, L'Anse recommends that utilities should plan to devote extra staff to develop a Community Solar program. Onboarding additional staff or developing the project at a time when current staff can spend ample time on it is necessary to ensure the success of the program.

Climate

Those interested in installing a Community Solar array need to consider the local area's climate beforehand. Arrays should be installed in the Spring or Summer when high production is occurring. If solar panels are not working correctly, a low output is more noticeable during the time of year when production levels should be high.

Rural Communities

L'Anse states that it had trouble finding contractors that could service its area and help build its Community Solar array. Programs in rural and remote areas should anticipate delays and should develop a plan for how panels can be serviced in the future.

Other Michigan Community Solar Models

In addition to the CELICA projects, there are other Community Solar projects in Michigan that are important to acknowledge.

Consumers Energy Solar Gardens

Variations are common with Community Solar projects across the country, including in Michigan. Consumers Energy, an investor-owned utility based in Jackson, has been offering what it refers to as Community Solar to its customers since 2016. Although this program is not true Community Solar as defined in Chapter II, it does offer an option for interested participants to obtain renewable energy from solar arrays independent from their home or business.

The Consumers Energy program emphasizes ease and flexibility for participants under Voluntary Green Pricing (VGP), a construct of the Michigan Public Service Commission. Voluntary Green Pricing (VGP) allows a customer to voluntarily specify a certain amount of electricity purchases to be from renewable energy resources. The costs of the programs are billed to participating customers."[36]

VGP was created to stimulate greater investment by utilities, investor-owned, municipal and cooperatives into solar and wind energy, by having customers pay slightly higher rates for electricity traced back to renewable energy, than regular rates for electricity that includes a mix of fossil and nuclear fuel sources, in addition to renewables. With VGP, a customer is signaling their support for purchasing electricity generated from the wind or sun.

36 https://www.michigan.gov/mpsc/consumer/electricity/voluntary-green-pricing-programs

Consumers Energy Solar Gardens provide customers purchasing options through subscriptions of 'solar blocks,' with no contracts, no cancellation fees and no "installation or upkeep hassles." While some customers prefer their own rooftop solar system at their home or workplace, others find the convenience of Community Solar to be a big selling point. The Consumers Energy program of 100% Michigan-Made Solar Energy is convenient as Community Solar projects go.

away, flipping DC current from the solar panels to AC and then interconnecting to the nearby distribution grid. This site is a 3 megawatts array. Western Michigan University has a one-megawatt array and Cadillac slightly less than that. The Cadillac site also has an 885 kWh DC battery storage system and a pollinator habitat.

The statistics are impressive from these three projects: more than 9,400 megawatt hours of clean energy produced as of the end of 2022.

Photos of the arrays at GVSU, Western Michigan University, and Cadillac.
Photos courtesy of Consumers Energy.

To date, Consumers Energy has three community solar sites in service: Grand Valley State University (GVSU), Western Michigan University and in Cadillac, Michigan.

The newest site is on a brownfield location in Cadillac, a great example of reusing a moribund industrial site for 21st century energy generation.

The university sites have combined partnerships between Consumers Energy and faculty and students. At the Allendale Community Solar gardens at GVSU, visitors can see row after row of 11,200 solar panels on a still summer day, silent except for the occasional birdsong and the dozens of inverters whirring

Wolverine Power - Spartan Renewables

Wolverine Power is a cooperative power generator owned by Cherryland Electric and other Michigan electric cooperatives. Roughly 20% of Wolverine's fuel source is from wind and solar. "We listen to our members and are able to capitalize quickly on renewable energy opportunities," said Craig Borr, President and CEO of the Michigan Electric Cooperative Association (MECA). "Michigan's electric cooperatives moved into renewable energy because it was the right thing to do from an environmental standpoint," said Borr. "But it turns out it's also the responsible thing to do from a financial standpoint."

In addition to having stakes in wind farms, Wolverine's subsidiary, Spartan Renewables, built two Community Solar arrays across from their headquarters in Cadillac and one in Cassopolis. Under the SpartanSolar Community Solar Program, any customers of the electric cooperatives can participate in this community solar program and receive on-bill credits.[37]

MEO also worked with the Lansing Board of Water & Light (LBWL) and the City of East Lansing to create the East Lansing Community Solar Park, which was energized at the start of 2019. This Solar Park won Michigan Energy Innovation Business Council's 2019 Project of the Year. This 455-kilowatt array has 150 members, who are LBWL residential, commercial, and public sector customers

Marquette Board of Light and Power and Lansing Board of Water & Light

Not to be outdone by the investor-owned utilities and coops, municipal utilities (or 'munis') have also embraced Community Solar projects. The first muni Community Solar project was developed in Marquette at the Board of Light and Power's headquarters. Built in 2018, this Community Solar project is the first in the Upper Peninsula. Built by Peninsula Solar, a local solar company, the 155 kilowatt array is built on racking to account for the area's sizable snowfall. Michigan Energy Options (MEO), a nonprofit with an office in Marquette, helped design and market the subscription program for the utility.[38]

across their mid-Michigan territory. The park is located on a closed landfill and Michigan Energy Options added a pollinator habitat instead of turf grass or gravel, which was typical at that time of construction.

This project harnessed the federal Investment Tax Credit (ITC) of 30% by Michigan Energy Options creating a for-profit LLC and partnering with a tax equity investor. Community Energy Options, LLC owns and operates the park and has the Power Purchase Agreement (PPA) with the power off-taking utility, Lansing Board Water and Light. Participants lease 'shares' which are equivalent to one solar panel per share, and can have up to 80% of their electricity load in these 'offsite' or 'virtual' panels. LBWL customers

37 https://www.spartansolar.com
38 https://mblp.org/green-programs-2/

paid upfront for their shares and realized each month an on-bill credit equal to their percentage of output the overall park produces.

Today, the park continues to provide carbon-free electricity to the incumbent utility, and will continue to do so for 20 more years. The park also provides a flowery habitat for bees and other insects, birds, and small mammals, including a resident woodchuck.[39]

The East Lansing Community Solar Park.
Courtesy of John Kinch.

39 https://www.lbwl.com/about-bwl/renewable-energy

Chapter IV

GLREA Solarize Program

A Program to Educate and Reduce the Cost of Purchasing Solar

Community Education and Group Buy Program

The growth and expansion of small scale distributed solar is an essential component of transitioning from fossil fuels to renewable energy and important for any effort by cities and states to decarbonize and achieve sustainability goals.

One key initiative to expand solar is to implement a program that combines education on the benefits of solar with a group buy discount that reduces the cost of purchasing solar. Various group buy programs have been around for years with the central idea that solar installers are willing to reduce their price for installing a solar system if a number of homeowners or businesses agree to purchase solar in a group buy.

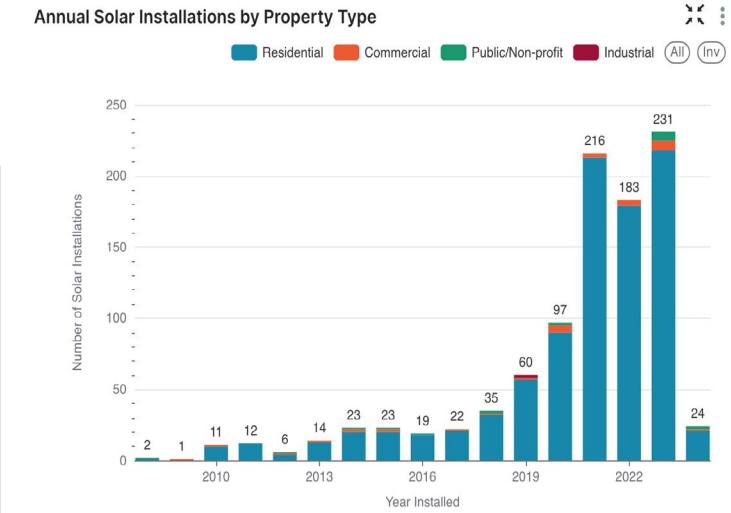
The challenge is that these programs are hard to organize and implement. Solar installers, whose profit margins are small, have little or no incentive to organize such an effort. To be successful, these programs must be directed with dedicated resources and staff, either by renewable energy non-profit organizations, like the Great Lakes Renewable Energy Association (GLREA), or by cities that view these programs as a key component of their effort to achieve their sustainability goals.

In 2020, the City of Ann Arbor successfully launched a new ‘affinity-based’ group buy purchasing model, managed by Julie Roth in the Office of Sustainability and Innovations.

The key innovation in this program is that individuals are found who are willing to serve as hosts for meetings and they invite people they have a pre-existing relationship or affinity with. Examples include relationships based on personal friendships, people from the neighborhood, or members from a house of worship or community organization.

Members of the affinity group are invited to a no commitment meeting to learn about solar energy and the process of purchasing solar. At these meetings, a speaker talks about the benefits of solar, and a solar installer talks about the process of purchasing solar and answers any questions.

At this meeting, an individual announces their intention to purchase solar and invites others to join in on the group buy. If a threshold of interested customers is reached, discounts between 5% to 15% are applied to all participants that agree to purchase solar from the solar installer. The threshold is pre-defined in an agreement with the solar installer with the size of the discount dependent on the number of participants. In some cases, an additional manufacturer's discount can be applied as well as any local incentives.



Source: City of Ann Arbor permitting data. Excludes state-permitted properties.

In just over two years, Ann Arbor's Solarize participants installed over three megawatts (MW) of new residential solar in the community. Based on the average Ann Arbor experience, an average of 44 people would attend a meeting, 32 would then take the next step and request an estimate of the size and cost of installing solar for their home, and then half of this group would commit to getting solar and receive the group buy discount.

Results will vary, but the program works well when people are brought together who already have a relationship with each other and have an interest in learning about solar energy.

Building on Success – GLREA Solarize

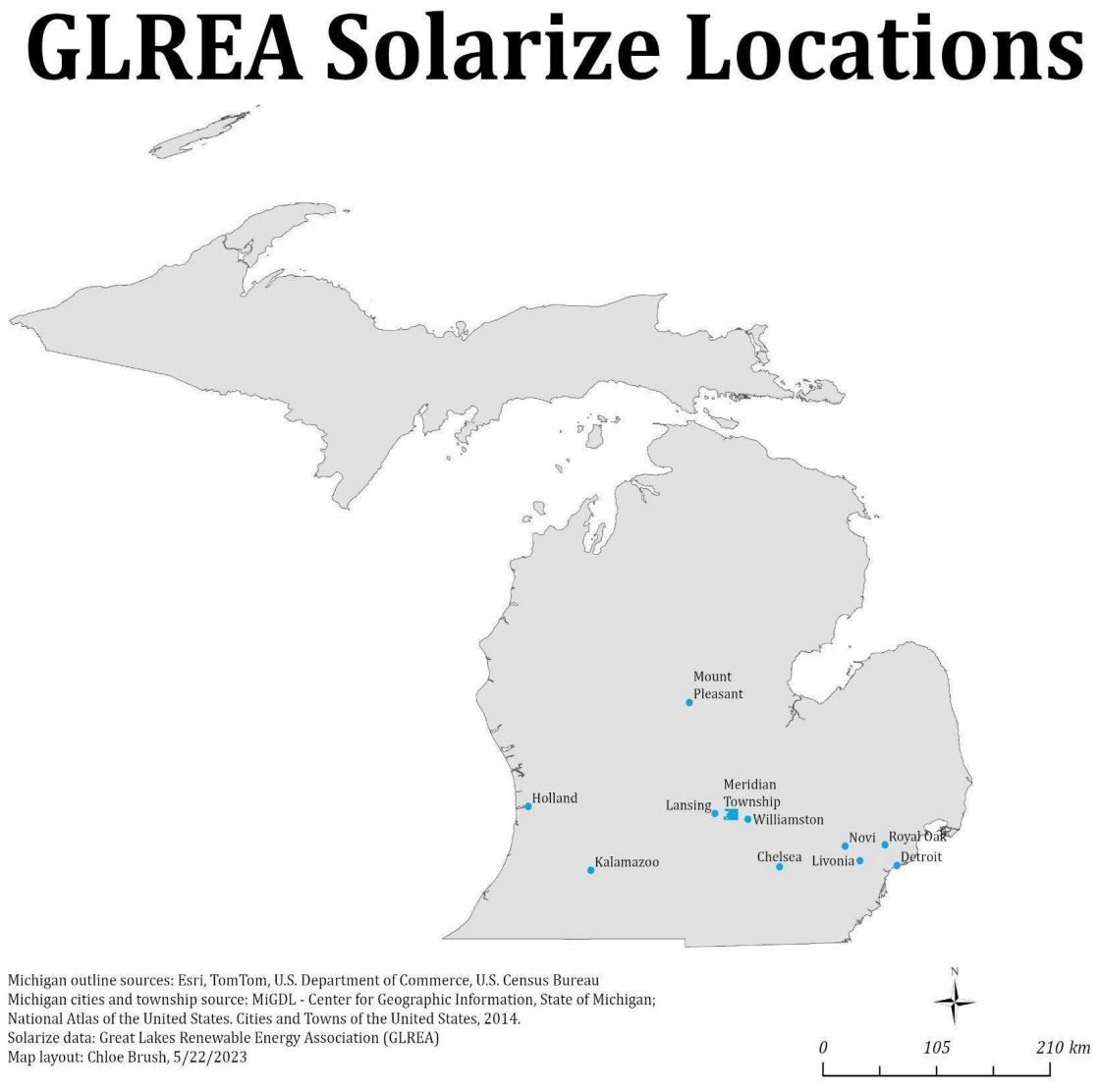
In 2021, the City of Ann Arbor encouraged the Great Lakes Renewable Energy Association (GLREA) to use this affinity-based program to launch new Solarize programs around Michigan. Under a grant from the Michigan Department of Environment, Great Lakes and Energy (EGLE), GLREA is providing support to any individual, city, or organization that wants to implement this Solarize Program.

The GLREA Solarize Program, like the Ann Arbor program, promotes a community based educational group-buy program that brings together homeowners with solar installers to learn about solar energy and if a certain percentage of homeowners end up purchasing

solar, they will receive a discount that reduces the cost of installing solar.

This approach can help strengthen neighborhoods and communities by building upon neighbor-to-neighbor or peer to peer affinity relationships. This model works for two distinct groups:

- Individuals seeking to increase the number of solar owners in their community. Often people who already own solar become involved with Solarize to share their experiences and encourage others to purchase solar.
- Communities seeking to increase the number of solar owners to help achieve sustainability goals for that community. Examples include reducing carbon emissions, improving the quality of life and stimulating economic development.



Locations of GLREA Solarize Programs since March of 2022.

Discounts for Bulk Purchases

A key goal of this program is to reduce the cost of installing solar for homeowners or businesses. Through this program, participants can receive a group-buy discount from the solar installer on top of the 30% Federal Investment Tax Credit and a possible manufacturer's discount.

The solar installer has to agree to the discount structure, but a common structure with this program is installers reducing the installation price by 5% if at least three systems are installed, 10% if seven systems are installed and 15% if ten systems are installed.

With GLREA Solarize, residents choose the solar installer they wish to work with and then organize a meeting by reaching out to their friends and neighbors, either on Zoom or face to face at someone's home, place of worship, or neighborhood community center. At this meeting, the benefits of solar energy are explained and then a Solar Installer shares the installation process and what kind of discount they can provide if several attendees at the meeting agree to purchase solar.

Generally, there are two types of solar discounts offered through solarize programs:

- **Cost-of-Sales Discounts:** These are discounts provided by the solar installer who pass along marketing cost savings to participants in this solar group-buy program. All discounts are calculated against the total cost of the solar system, generally referred to as the $/Watt installed and not against individual components of the system.
- **Manufacturers Special Pricing Discounts:** Some manufacturers are willing to offer discounts to installers that use their solar panels or other solar system components who reach a certain sales volume. Some communities that offer Solarize Programs of sufficient size can also secure these discounts for aggregated program participants.[40]

By offering a group buy discount and factoring in the 30% Federal Investment Tax Credit, the price of installing solar is reduced, making it more financially attractive to a greater portion of the public. By reducing the cost of purchasing solar, the time it takes for a solar owner to pay off their investment is reduced, which strengthens the financial incentive to invest in a solar energy system.

Team Roles and Responsibilities

The key personnel of the GLREA Solarize program is the Organizer, the Host, and the Solar Installer. The Organizer can be a resident, city employee, or a solar advocate willing to oversee the implementation of this Program. The Host is an individual who either already owns solar or is interested in obtaining solar and is willing to host and invite people to a meeting. In some cases, the Host and Organizer roles will be combined, and the same individual will take on the responsibilities of both.

At the meeting, the Organizer or Host will present information about solar and then the Solar Installer will explain the process of getting solar and the group-buy discount program that is being offered.

The following are the specific tasks of each of these three roles:

Solarize Organizer

- Is the person that is driving this Program within the Community.
- Finds individual(s) to act as Hosts and helps them to find a Solar Installer and to recruit Participants.

40 See McNaughton - McKay, Ann Arbor, MI, SPA program.

- Works with the Host to set up a time for the informational meeting, either on Zoom or in-person.
- Works with the Installer to obtain the group buy discount.
- Following the meeting, works with the Installer to track interest and maintain communication with the individuals from the meeting.
- Oversees post installation monitoring and repeats the process if interested in doing so.

Solarize Host

- Works with Organizer to vet Installers and selects a final Solar Installer.
- Recruits interested people to attend an Informational Meeting.
- Works with the Organizer and Installer to develop the Agenda for the Meeting.
- Attends the Meeting and shares their enthusiasm for solar.

Solar Installer

- Is a vetted installer with Michigan Saves and agrees to the group-buy discount program.
- Attends the informational meeting, explains the process of purchasing solar and the group-buy discount.
- Following the Informational Meeting, the Installer provides an estimate for every interested participant. They will provide timely communication with participants following the meeting.
- Provides final price quotes to those interested participants.
- Installs the solar for the participants that sign contracts and provides the group-buy discount to reduce the cost of installing.

Timeline

1. **Find the Organizer:** This could be a solar advocate, a city employee or a local organization to oversee the local Program.
2. **Find the Host:** The Host is an individual who is either interested in purchasing solar or has already purchased solar and is enthusiastic about sharing their interest in solar with their neighbors or affinity groups.
3. **Find the Installer:** This is a solar business that is willing to participate in the Solarize Program and is willing to offer the group-buy discount. The Installer is required to agree to a predetermined discount structure and has the capacity to handle a large number of solar customers at once. In some cases, the Host already has an Installer to work with.
4. **Schedule a Meeting:** The Host and Installer agree on a date to schedule an Informational Meeting for interested participants. The Host reaches out to their network of contacts to invite people to the meeting using various methods. The goal is to get at least 40 people signed up to attend the Meeting.
5. **Hold the Informational Meeting:** At the meeting the benefits and the process of obtaining solar is explained and all questions are answered. At the end of the meeting, names, emails and phone numbers are collected of those people who are interested and want to move to the next step.
6. **Post-Meeting:** After the Informational Meeting, the Solar Installer will follow-up and provide estimates of the installation cost for each meeting attendee that is interested in obtaining solar. Either the Organizer or the Host will stay in

In Person Solarize Meeting. Photo provided by Julie Roth.

communication with the Installer and the interested Participants and will keep track of the estimation process.

7. **Monitor and Repeat:** Once all the estimates have been provided, interested parties will sign a contract to purchase solar, the group-buy discount is applied and the solar energy systems are installed. The Organizer can then begin the process of finding a new Host and setting up the next Informational Meeting if interested in doing so.

Tool Kit

A Tool Kit has been created and is available on the GLREA website that provides all the information on the Solarize Program, including a Sample Informational Meeting Agenda, Sample PowerPoint, Meeting Flyers, FAQ sheets, Tracker forms, etc.

To receive this Tool Kit, visit www.glrea.org or contact:

Solarize GLREA – Contact John Freeman, Executive Director, GLREA, (313) 655-7945 email: jfreeman13@comcast.net. GLREA Website: www.glrea.org.

Solarize Ann Arbor – Contact Julie Roth, Senior Energy Analyst, Office of Sustainability & Innovations, City of Ann Arbor MI a2gov.org/sustainability / a2gov.org/electrify / Solarize.

Chapter V

Solar and Geothermal Energy - Return on Investment

How to Evaluate an Investment in Solar and Geothermal

Introduction

There are two primary reasons why individuals, businesses and local governments support the expansion and deployment of renewable energy.

The first is for economic or financial benefits. The cost of generating electricity from a solar energy system or heating your home with a geothermal heat pump is now less than buying electricity from a utility or from heating your home with natural gas. The money that is saved from lower energy expenditures can then be utilized by families or businesses for other purposes. On a broader scale, this represents an economic development strategy when a local government encourages renewable energy across the community.

The second is the environmental benefits that occur as a result of transitioning from fossil fuels to clean renewable energy. Since solar energy converts energy from the sun into electricity, it does not generate carbon or other toxic emissions associated with burning fossil fuels. Another source of clean renewable energy that can be utilized is geothermal. Geothermal harnesses the natural heating and cooling aspects of the earth underground or water through heat pumps to provide heat and air conditioning. More on this can be found in Chapter VI.

By installing a solar energy system or a geothermal heat pump, individuals and businesses can do their part in contributing to a cleaner environment, reducing carbon pollution and fighting climate change. Furthermore, local governments can meet their sustainability goals of reducing carbon, improving public health outcomes and reducing climate change by supporting the deployment of renewable energy.

These two motivations mutually reinforce each other. Individuals, businesses and governments can save money and promote economic development while contributing to a cleaner environment and fighting climate change. The financial and environmental benefits are the two primary forces driving the transition from fossil fuels to renewable energy to generate electricity and to provide building heating and cooling.

As stated earlier, not all homeowners or businesses can install their own solar energy system. Community Solar plays an important role in electrification by broadening access to lower costing solar energy to all individuals and businesses which benefits the entire community.

For many people, the decision to purchase solar is based upon the financial benefits. We now discuss the Return on Investment (ROI) as a performance measure that is used to evaluate an investment in a solar energy system, including Community Solar.

This Chapter discusses three different ROI measurements: a Financial Return on Investment, Environmental Justice Return on Investment, and an Embodied Carbon Return on Investment.

Red Tailed Hawk perched on solar panels in Ann Arbor.
Photo courtesy of Deb Nystrom

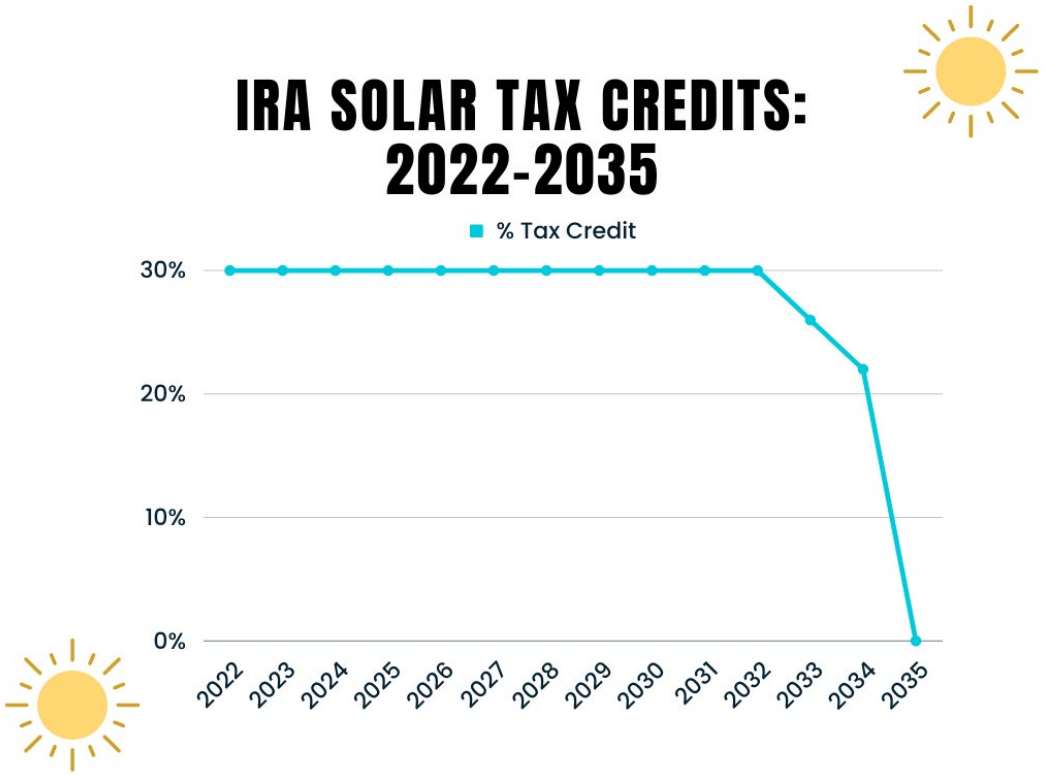
Financial Return on Investment

A Financial Return on Investment (ROI) calculates how long it takes for a purchaser of solar or geothermal to pay for their investment by saving on the cost of energy from their utility. This applies to individuals and businesses

that install their own solar system or purchase solar through a Community Solar array, and those who finance Community Solar systems. A financial ROI can be gained through:

- **Savings:** The individual who installs a solar or geothermal energy system, or who buys solar energy from a Community Solar array, is able to obtain electricity at a lower cost than from the local utility. This savings pays off their investment. Depending on the size of the system, it can take between 8 to 10 years to pay off the cost of the system.[41] With solar panels warranted for 25 years, once the system is paid off, the homeowner is essentially receiving free electricity for the remaining life of the system. The savings will increase as utility rates continue to increase.
- **Investment:** Community Solar Developers generally have investors that provide the capital to build the Community Solar project. Developers and investors make money in three ways: by reducing their taxes by taking the 30% Federal Investment Tax Credit, by the depreciation on the solar asset, and by receiving a return on their investment.

The 2022 Federal Inflation Reduction Act (IRA) extends the 30% Investment Tax Credit for 10 years to 2032 and is now applicable to schools, local and state governments, Houses of Worship, and other non-profits who previously were not eligible for the tax credit because they did not pay federal income taxes. The chart below depicts the timeline for the tax credit.



Source: Solar Energy Industries Association, Solar Investment Tax Credit (ITC).
Graph created by Chloe Brush

41 https://palmetto.com/learning-center/blog/solar-panel-payback-period-guide

Community Solar

Community Solar projects are usually put together by developers and investors who want to take advantage of the tax benefits for investing in these projects and want to make a return on their investment. These investors are called 'tax equity investors' and they provide the capital to build these projects.

Different communities across the United States are exploring ways to increase the number of people that can participate in Community Solar projects by trying to reduce the cost of solar energy as much as possible. One way of doing this is co-mingling incentives such as grants and loans with investor dollars to bring down the cost of purchasing or subscribing to the panels.

Other Financial Incentives

As discussed in Chapter IV, for the residential and small business solar market, discounted pricing is sometimes offered by solar installers to incentivize people to purchase a solar energy system.

The strategic intent of the Solarize Programs, where multiple people commit to buying solar and therefore receive a group-buy discount, could also be applied to a Community Solar project whereby the developer offers a discount if multiple people buy or subscribe to panels at the Community Solar project.

The United States Department of Agriculture also offers solar grants under the Rural Energy for America Program (REAP) to farmers and small businesses in rural parts of Michigan that want to produce their own renewable energy.

Furthermore, cities and foundations sometimes provide funds to bring down the cost of purchasing solar for targeted communities, such as low and moderate-income families or people living in urban environments. These funds along with low interest loans from Michigan Saves,[42] a state created renewable energy loan fund, improves the return on investment and allows low to moderate income families to invest in solar at a discount.[43]

Solar panels in goat pasture, Bath, MI.
Photo courtesy of Tom DelGiorno.

42 See: https://michigansaves.org/residential-homes/

43 For example, while it is used primarily for residential solar applications, the Grace Sweeney Solar Rebate program started with $74k. The City of Ypsilanti provided $6k, a block grant kicked in $50k for low-income homes, and in June 2022 the Downtown Development Authority (DDA) kicked in $100k for businesses. The city now has a total of $230k to trigger more solar projects, including community solar.

Calculating the Financial Return on Investment

Calculating the financial return on investment is a project specific effort. How a solar project is financed, which tax credits apply, other financial incentives and of course the cost of the solar system are all included in the return-on-investment calculation. An interested solar purchaser should work with their solar installer to make this calculation.

Environmental Justice Return on Investment

Environmental Justice is generally defined as the fair treatment and meaningful involvement of all people regardless of race, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. The Environmental Protection Agency Office of Environmental Justice and External Civil Rights works to rectify the disproportionate harm caused by pollution and climate change risk to communities of color and low-income cities and counties.[44]

The United States Department of Energy *Solar Futures Report* states that,

> "The fossil-fuel-energy system has yielded innumerable benefits for modern society, but also generates significant societal costs in the form of public health damage, environmental destruction, and climate change impacts. The benefits and costs of the existing energy system have not been equitably distributed. Low-income and communities of color have borne disproportionately large shares of the costs of the existing system, have enjoyed fewer benefits, and have been largely shut out of energy system planning and procedures."[45]

Dr. Robert Bullard, often characterized as the father of environmental justice, says that the average African American household emits 20% fewer greenhouse gasses than white households and yet are forced to bear a disproportionate burden of the harms by living near dirty energy such as coal-fired power plants. African Americans are also at greater risk of energy price shocks, spending 30% or more of their income on energy than whites.[46]

Another example of the disproportionate harm that can occur to marginalized communities is illustrated by research conducted by Dr. Tony Reames from the University of Michigan. Dr. Reames found that energy efficient options, such as LED light bulbs, can cost people who live in low income neighborhoods twice the amount of what it costs in higher income areas.[47]

Community Solar - Environmental Justice Return on Investment

The upfront cost of purchasing solar energy makes it difficult for many low-income families to purchase solar. Community Solar helps to address this problem because an individual does not have to pay the full upfront cost of installing a solar system but can invest a smaller amount of money in purchasing or subscribing to a number of panels that will help them

44 See: https://www.epa.gov/environmentaljustice

45 See: https://www.energy.gov/eere/solar/solar-futures-study

46 See: Bullard, Robert D. "Environmental Justice in the 21st Century: Race Still Matters." *Phylon (1960-)*, vol. 49, no. 3/4, 2001, pp. 151–71. *JSTOR*, https://www.jstor.org/stable/3132626; Bullard, Robert. "Climate Justice Benefits of Dismantling Energy and Transportation Apartheid." *Dr Robert Bullard*, 13 Dec. 2011, https://drrobertbullard.com/climate-justice-benefits-of-dismantling-energy-and-transportation-apartheid/; "Dr. Robert Bullard: The Father of Environmental Justice." *Climate One*, 16 Oct. 2020, https://www.climateone.org/audio/dr-robert-bullard-father-environmental-justice#:~:text=Robertpercent20Bullardpercent3Apercent20Whenpercent20youpercent20don,grocerypercent20storepercent20andpercent-20floodpercent20protection; and, Smith, Jamil.

47 https://yaleclimateconnections.org/2019/05/led-bulbs-cost-more-in-poor-areas/

save money on energy bills and allow them to participate in the solar transition.

Community Solar allows investors to secure tax benefits which can decrease the solar project cost and thus enables lower income individuals and families to participate in the program. Enabling lower income communities to be able to obtain clean renewable energy is an important element of achieving Environmental Justice.

Environmental Justice Return on Investment (EJ-ROI) addresses the situation that wealthy communities produce excess carbon emissions and transfer the negative consequences of these emissions to low-to-moderate income communities that actually produce lower carbon emissions.[48] These consequences include more extreme temperatures, heavy downpours, flooding and negative health outcomes.[49]

The EJ-ROI compares the increasing cost of disaster recovery with the cost of reducing climate change risk with the implementation of solar energy. As previously stated, Community Solar eliminates financial barriers of entry for low and moderate income families and communities of color to purchase solar energy. However, in order to develop Community Solar projects a state law must be enacted that requires the utilities to work with developers to put together these types of projects.

Assuming we enact a law in Michigan that supports Community Solar, the development of these projects will still have to balance two conflicting propositions; the project needs to sell solar electricity at a rate that provides a decent rate of return for the project investors while also enabling low-income customers to be able to buy power at a lower rate than is being offered by the local utility.

If allowed under law, local units of government could partner with developers to direct Community Solar energy to targeted segments of the community. Local governments could raise funds and co-mingle funding sources (grants, investments and loans) to structure the financing of community solar projects that would provide solar electricity at favorable rates.[50] The graph below illustrates the solar adoption rates in identified disadvantaged communities from the Department of Energy from 2010-2021.

Low Income Community Solar Business Models

The following are examples of Community Solar models being used to target benefits to low and moderate income communities:

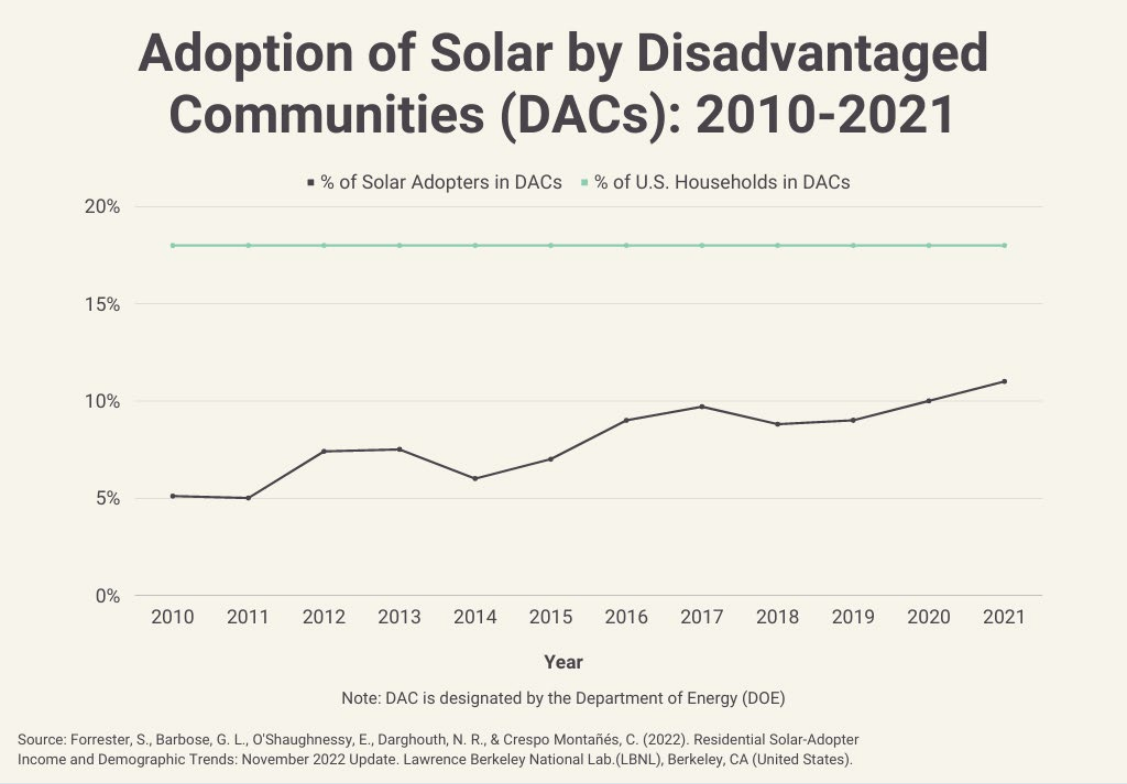
- **Groundswell Sharepower** is a nonprofit organization that organizes Community Solar projects to reduce energy burdens on low-income families. Groundshare's SharePower program enables participants to purchase their energy from a local community solar project and share their energy savings with their neighbors. Under this model, when individuals subscribe to the SharePower program, a portion of their solar savings is given to

48 For example, in 1992, Michigan's Pollution Control Board approved a power plant in Genesee Township next to a predominantly Black community. The power plant burned demolition wood waste, sometimes coated in lead paint, along with other toxic and nontoxic materials.

49 See: Ashley Dawson, *Extreme Cities: The Peril and Promise of Urban Life in the Age of Climate Change* (New York: Verso) 2017.

50 For more information please see: (1) Interstate Renewable Energy Council. (2016). *Shared Renewable Energy for Low-to Moderate-Income Consumers: Policy Guidelines and Model Provisions: https://www.thesolarfoundation.org/resources/shared-renewable-energy-for-low-to-moderate-income-consumers-policy-guidelines-and-model-provisions/*; (2) DenHerder-Thomas, Timothy, Jonathan Welle, John Farrell, and Maria McCoy, 2020, *Equitable Community Solar: Policy and Program Guidance for Community Solar Programs that Promote Racial and Economic Equity*, https://ilsr.org/wp-content/uploads/2020/02/Equitable-Community-Solar-Report.pdf.; (3) Heeter, Jenny, Lori Bird, Eric O'Shaughnessy, and Samuel Koebrich, 2018, *Design and Implementation of Community Solar Programs for Low- and Moderate-Income Customers,* National Renewable Energy Laboratory, NREL/TP-6A20-71652, https://doi.org/10.2172/1488510.

'Empowered' households that have incomes that are less than the area median income. Individual subscribers receive local clean power and Empowered households receive cost savings on their energy bill. This model supports energy equity by making solar savings available to people in historically underserved communities.[51]



Graph created by Chloe Brush.

- **Community Solar REIT** offers financing of construction loans and flexible mortgage loans for small to mid-sized solar project developers by creating a program where solar projects are treated like real estate investments that are long-term, passive, and secure. Under this model, the investor invests their money in solar property which pays a return from the power sold to end users and utilities. This is similar to the Real Estate Investment Trusts (REIT) model, where the investment is in a piece of real estate that is rented and the rents collected produce profits which are distributed to the investors. Sol-REIT signed a partnership agreement with Source Renewables in 2022 to finance over 100 MW of Community Solar development projects in northeastern United States to bring solar to disadvantaged and underserved communities.[52]

51 See: Groundswell - https://groundswell.org/
52 See: https://www.sol-reit.com/

Categories	Environmental Exposure	Environmental Effects	Sensitive Populations	Socioeconomic Factors
Indicators	NATA Air Toxics Cancer Risk NATA Respiratory Hazard Index NATA Diesel Particulate Matter Particulate Matter ($PM_{2.5}$) Ozone Traffic Density	Proximity to Cleanup Sites Proximity to Hazardous Waste Facilities Impaired Water Bodies Proximity to Solid waste Sites and Facilities Lead Paint Indicator Proximity to RMP Sites Wastewater Discharge Indicator	Asthma Cardiovascular Disease Low Birth Weight Infants Blood Lead Level Life Expectancy	Low Income Population Black, Indigenous, People of Color Population Educational Attainment Linguistic Isolation Population Under Age 5 Population Over Age 64 Unemployment Housing Burden
Sub Scores	**Environmental Conditions** (Average percentile of Environmental Exposure indicators + 0.5 x average percentile of Environmental Effects indicators) / 1.5		**Population Characteristics** (Average percentile of Sensitive Population indicators + average percentile of Socioeconomic Factor indicators) / 2	
Score	**Final Composite Score = Environmental Conditions score x Population Characteristics score** **MiEJScreen Score**			

Understanding Environmental Justice – Interactive Mapping Tool

The Michigan Office of the Environmental Justice Public Advocate, in cooperation with the Interagency Environmental Justice Response Team Data and Research Workgroup, developed MiEJScreen, an interactive mapping tool in response to the 2018 recommendations by the Michigan Environmental Justice Workgroup.[53]

MiEJscreen is an interactive mapping tool that identifies Michigan communities that are disproportionately impacted by environmental hazards. This tool allows users to explore the environmental, health, and socioeconomic conditions within a specific community, region, or across the entire state. The MiEJscreen score allows users to understand how communities experience environmental justice impacts relative to others. These results are depicted in the form of a map so that different communities can be compared to one another. The MiEJScreen Scoring Methodology is described below:

A census tract with a high score is one that experiences a higher pollution burden and vulnerability than census tracts with low scores. The tool calculates a final MiEJScreen score for a given census tract relative to the other tracts in the state by multiplying the environmental conditions and population characteristics components together. MiEJscreen ranks census tracts based on data that are available from state and federal government sources.

The purpose of the tool is to assess cumulative factors that communities in Michigan may have to contend with and to help inform decisions, allocate resources, address community specific concerns, and inform future planning to improve the environment and quality of life for all residents of Michigan. This tool can be used

53 See: https://www.michigan.gov/egle/-/media/Project/Websites/egle/Documents/Maps-Data/MiEJScreen/MiEJScreen-Factsheet.pdf?rev=626af-950b12349e499657e243b93af31 **Scoring Matrix**: https://www.michigan.gov/egle/-/media/Project/Websites/egle/Images/Maps-Data/ArcGIS-Online/MiEJScreen/MiEJScreen-Score-Matrix.png?rev=d8fb9a056792416fb2cb3b4c5af25e13;

by solar installers, local units of government, nonprofits, and others to help identify which areas can benefit the most from clean energy. The MiEJscreen map is available online.[54]

Embodied Carbon - Return on Investment

In addition to saving money on electricity costs, the other principal factor that drives people to support solar energy are the environmental benefits and that solar helps to reduce climate change risk.

But in addition to reducing carbon pollution, there is a growing concern regarding the amount of carbon that is used to manufacture solar panels and the other parts of a solar energy system. This is called Embodied Carbon. An Embodied Carbon Return on Investment concerns the materials and fuels used to produce and install a solar system.[55] Solar projects with low embodied carbon produce a quicker environmental return on investment than those that have high embodied carbon.

There are initiatives underway to help remove carbon from the solar supply chain.

- **Low Embodied Solar Panels:** Producing high quality silicon crystals that make up a solar panel is a complex and high energy-intensive process.[56] Low embodied carbon, high-efficiency solar cells are now being produced to create new types of solar panels, manufactured in facilities powered by renewable energy. (See Ultra-Low Carbon Solar Alliance https://ultralowcarbonsolar.org/).
- **Low Embodied Carbon Electronics:** Work is being done to reduce the amount of carbon in the manufacturing of solar-related products including micro-inverters and electric vehicle chargers. The Institute of Electrical and Electronics Engineers (IEEE) works with manufacturers to demonstrate that their products meet the Institute of Electrical and Electronics Engineers '1680 Family of Green Electronics standards'.[57]
- **Low embodied carbon materials:**[58] In addition to solar cells and electronics, other solar system support materials, such as concrete and steel, make up a portion of embodied carbon in the infrastructure.[59] But new techniques are being developed to create lower embodied carbon materials, such as 'green steel' and 'clean concrete'[60] for racking and support structures. This is another way carbon can be reduced in solar installations.[61]
- **Low Embodied Carbon Plastics:** Plastics are used throughout the renewable energy supply chain, in packaging, containers, wiring insulation, coatings, embodied electronics, and control switches. It is important that renewable energy installations use new plastics with low embodied carbon.
- **Up-Recycled Materials**: Using up-recycled materials in solar panels and other system

54 See:https://www.michigan.gov/egle/-/media/Project/Websites/egle/Documents/Maps-Data/MiEJScreen/MiEJScreen-Factsheet.pdf?rev=626af950b12349e499657e243b93af31

55 https://circularecology.com/solar-pv-embodied-carbon.html

56 By contrast, making high purity silicon costs two orders of magnitude more primary energy than making aluminum from bauxite, and three orders of magnitude more than smelting iron and making steel.

57 "Standards" are legal performance metrics. Standards are the distilled wisdom of people with expertise in their subject matter such as manufacturers, sellers, buyers, customers, trade associations, users or regulators. *Environmental management standards* help reduce environmental impacts, reduce waste and be more sustainable. *Electrical and electronics standards* are set by the IEEE.

58 See: Circular Ecology report on embodied carbon - https://circularecology.com/solar-pv-embodied-carbon.html

59 See: ArcelorMittal - https://corporate.arcelormittal.com/about.

60 For a good primer on low carbon concrete see: *Greenhouse Gasses: Set in Green Concrete*, in, The Economist, November 6 2021, pp 69.

61 The City of Ann Arbor, Energy Commission, has passed a Resolution requesting that the City Council use,, encourage, and promote both the city and other entities to use low Embodied building materials in building and infrastructure projects involving concrete and steel. See: http://a2gov.legistar.com/View.ashx?M=F&ID=9613016&GUID=F376259B-5D4E-4D6F-986F-2F872B671A19.

components can offset embodied carbon in new materials. Upcycling is a design process for recycling that creates high quality products out of the waste of other products such as solar panels, that can then be reused. Current recycling processes often require substantial energy and generate additional waste in the process. Materials that are designed to be recycled into new products through upcycling have none of these negative characteristics and can reduce the overall amount of embodied carbon. Success in low-carbon manufacturing will result from increased market demand for these types of products for residential and commercial solar.[62]

Conclusion

The Financial, Environmental Justice, and Embodied Carbon Return on Investments are performance measures that can be used to evaluate an investment in a solar, community solar, geothermal, or non-solar energy system. It is the combined usage of these three metrics that makes distributed and Community Solar viable options to combat climate change, protect the environment, support low to moderate income communities in Michigan, and stimulate renewable energy-related economic development.

62 https://tinyurl.com/3dux2xrd

Chapter VI

Utilizing Other Sources of Renewable Energy

To Save Money and Reduce Carbon Emissions

Distributed Energy Generation - Non-Solar Options

Distributed Generation is a term describing the generation of electricity for use on-site, rather than being transmitted over the electric grid from a large-centralized facility, such as a natural gas or coal power plant. Communities that support the deployment of locally produced and consumed solar energy can help residents and small businesses to save money and support a cleaner environment.

However, there are other types of renewable energy that can also reduce energy cost and reduce carbon pollution. These types include geothermal, hydro, wind, and biomass. In addition, utilizing 'energy efficiency' techniques can provide significant energy cost savings and reduce the amount of energy consumption while contributing to a local community's sustainability plan.

This Chapter explores Geothermal Energy and Energy Efficiency, with examples of deploying these efforts.

Geothermal Energy - How Does It Work?

Geothermal Energy is utilized by harnessing the differential in the heat that exists under the Earth with that of the surface. According to the U.S. Energy Information Administration (EIA), the heat from the Earth has been radiating from the Earth's core for about 4.5 billion years. The temperature at the center of the Earth, about 4,000 miles deep, is about the same as the surface of the Sun.[63] The heat is continuously replenished by the decay of naturally occurring radioactive materials providing an inexhaustible supply of energy, making Geothermal a renewable energy resource. [64]

Geothermal energy can be utilized by Ground Source Heat Pumps (GHP) that capture the heat close to the surface of the Earth to provide heating and cooling for residential homes and businesses. Ground Source Heat Pumps are designed to replace Heating, Ventilation, Air-Conditioning (HVAC) systems in businesses and homes and represent the most widely used application of geothermal energy. These GHP systems can be used almost anywhere to heat and cool homes and buildings as well as to supply hot water.[65]

A Ground Source Heat Pump system consists of three components:

1. **Ground Heat Exchanger:** This is a group of pipes buried in the ground or immersed in a surface water body that absorbs heat or cool from the surrounding environment. The Ground Heat Exchanger transfers heat between the ground and the fluid, usually a water or antifreeze mixture, that flows through the pipes.
2. **Heat Pump:** This transfers the thermal energy from the Ground Heat Exchanger to the energy Delivery System.
3. **Delivery System:** This consists of ductwork in the home or building for forced-air heating and cooling, or in-floor piping for radiant heating.

Temperatures at an average depth of 30 feet remain relatively constant, between about 10°C (50°F) and 15°C (59°F). For most areas, this means that sub-service temperatures are usually warmer than the air in winter and cooler than the air in summer.[66] During the winter (heating season), the Earth serves as a heat source, and during the summer (cooling season), the Earth serves as a heat sink.

Once installed, the ground heat exchanger is connected to a ground source heat pump, which transfers the thermal energy from the ground into the indoor energy-delivery system in the winter months. During summer months, the system operates in reverse, becoming an air conditioner and using the ground heat exchanger to disperse excess heat from indoors to the ground.[67]

The Heat Pump can be set up as a closed loop system (horizontal, vertical, pond/lake), or an open loop system. See the diagrams that follow.

63 "U.S. Energy Information Administration - EIA - Independent Statistics and Analysis." *Geothermal Explained - U.S. Energy Information Administration (EIA)*, https://www.eia.gov/energyexplained/geothermal/.

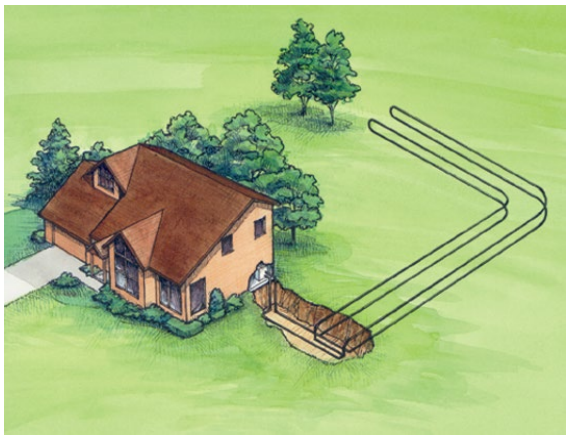
64 Blodgett, L., and K. Slack. "Geothermal 101: basics of geothermal energy production and use, Geothermal Energy Association, Washington, DC." (2009).

65 U.S. Department of Energy. *GeoVision: Harnessing the Heat Beneath Our Feet.* May 2019, https://www.energy.gov/sites/default/files/2019/06/f63/GeoVision-full-report-opt.pdf.

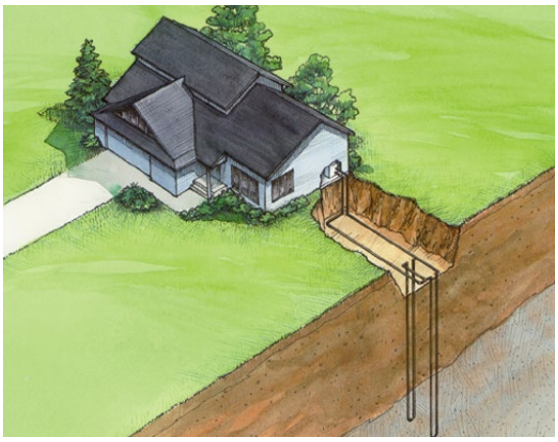
66 Ibid

67 Ibid

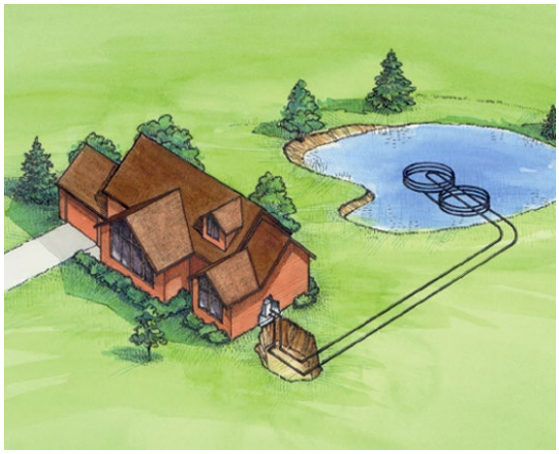
Geothermal Closed Loop System - Examples



Closed Horizontal Loop



Closed Vertical Loop



Closed Lake/Pond Loop

Open Well Loop

(Images used with permission from Water Furnace International)

The Benefits of Geothermal Energy

The following are the primary benefits of geothermal energy.

- **Reliability:** Since Geothermal energy comes from a consistent energy source, it eliminates the spikes and valleys that can be characteristic of other power sources such as propane, solar, or wind. Ground Source Heat Pumps generally last 20 years or more with the underground piping infrastructure lasting between 25-50 years compared to gas or oil furnaces that usually last around 15 years.[68] Geothermal energy

68 U.S. Department of Energy. *Guide to Geothermal Heat Pumps*. Feb. 2011, https://www.energy.gov/sites/prod/files/guide_to_geothermal_heat_

also has a high-capacity factor, which means geothermal energy operates 24 hours a day, with steady output nearly all of that time.

- **Safer and Environmentally Conscious:** Ground Source Heat Pumps (GHPs) are safer because there are no open flames as compared to gas furnaces which run the risk of gas leaks or gas explosions. Furthermore, since GHP's are more efficient than gas furnaces or air conditioners, it has a smaller carbon footprint. Geothermal systems can reduce energy consumption by 25% to 50% compared to air source heat pump systems.[69]
- **Efficiency:** GHPs are superior to traditional Heating, Ventilation, Air-Conditioning (HVAC) systems in terms of energy efficiency and the ability to provide a quiet, zero-emission heating and cooling system with high reliability and long system life. GHPs require less maintenance than propane or gas systems. For homeowners, there are no outdoor units for air conditioning which leaves more space around the house. Inside the house, the unit requires less infrastructure and does not require flames or emit smells that are common with propane or gas systems.

Challenges to Geothermal

The following are general challenges to geothermal energy.

- **Economics:** Geothermal has a high upfront cost but will lead to energy savings over the life of the system. The price of the system will vary depending on the size of the system and the needs of the residence or business. The 30% Federal Investment Tax Credit is available for geothermal energy systems, to reduce the cost of the system. Some utilities in Michigan, such as DTE Energy and Cherryland Electric, offer rebate programs, where consumers can receive money back for their geothermal installations and appliances.[70]
- **Drilling Costs and Care:** Because drilling is required to install the pipes, care must be taken to use proper drilling techniques.[71] The cost of drilling and installing loops required for Ground Source Heat Pump systems has increased over recent years but as the market for geothermal grows, the cost should come down.
- **Community Ground Source Heat:** Geothermal district heating and cooling systems can use geothermal energy to provide heating and cooling to multiple residences and businesses through an underground distribution network. However, a bigger system requires more piping and generally more land.

Examples of Geothermal Energy Projects

The United States Department of Energy supports the development of community scale geothermal heating and cooling and is providing funding for development of these systems.

> "By enabling communities to design and deploy community-scale geothermal heating and cooling systems, we can expand equitable energy access and foster greater local participation in the energy transition. Wider adoption of these systems can go a long way in decarbonizing the building and electricity sectors and support the Biden Administration's goal of reaching net-zero emissions by 2050."[72]

pumps.pdf.

69 Ibid

70 https://www.newlook.dteenergy.com/wps/wcm/connect/dte-web/home/save-money-energy/residential/rebates-and-offers/air-conditioners.

71 U.S. Department of Energy. *GeoVision: Harnessing the Heat Beneath Our Feet* . May 2019, https://www.energy.gov/sites/default/files/2019/06/f63/GeoVision-full-report-opt.pdf

72 Kelly Speakes-Backman, DOE's Principal Deputy Assistant Secretary for Energy Efficiency and Renewable Energy, U.S. Department of Energy

The following are three case examples that demonstrate its potential:

- **Pinewood Forrest Geothermal Community**: In 2017 Pinewood Forrest, a 234-acre community in Fayetteville, Georgia, became the first large-scale fully geothermal community in the United States. Every single-family home and townhome in the community was outfitted with a geothermal heat pump system in place of a traditional HVAC system. At its completion, Pinewood Forrest will include 600 single-family homes, 100 townhomes, and 600 apartments all with geothermal heat pump systems.[73]

- **Wyandotte, Michigan**: In 2011, Wyandotte, Michigan received a $560,000 Neighborhood Stabilization Grant from the federal government to create a geothermal utility. The city hired Cappy Heating & Air Conditioning from Livonia, Michigan to drill 48 ground source wells and connected several homes to each well. Homeowners that signed up to use the geothermal system had utility bills 25% to 70% lower than traditional heating and air-conditioning systems.[74]

- **Michigan State Capitol in Lansing:** In 2021, the Michigan Legislature decided to upgrade the heating and cooling system of the Michigan State Capitol to a geothermal energy system. The project cost around $70 million and will save the Capitol (taxpayers) around $300,000 a year on heating and cooling. [75] Outside on the Capitol grounds, 224 loops were drilled and installed 500 feet underneath the surface.

Federal Funding in Michigan

In April of 2023, a planning grant from the Department of Energy (DOE) was awarded to the City of Ann Arbor to support the development of community geothermal heating and cooling. The city will receive $588,000 to design a community geothermal project. Ann Arbor was the only community in Michigan to receive funding for this initiative with the funding going towards supporting "the eventual deployment of district-level geothermal systems with underground distribution networks connected to geothermal heat pumps."

The geothermal system will be located in the lower-income Bryant neighborhood. It aims to cover 75% of the heating and cooling load and will eliminate the energy burden for 262 households, the Bryant Elementary School, the Washtenaw County Community Mental Health and the City's Wheeler Service Center public works facility. Ann Arbor has one year to draft a plan for the system and for the DOE to approve the design and grant additional funding for implementation of the project.[76] Missy Stults, sustainability office director for Ann Arbor, said that the City's intent in seeking the DOE planning grant is "to understand how best to design a district geothermal system that is capable of handling diverse load profiles, the costs of that work, including upfront and operational costs, and technical opportunities and challenges the city may have to navigate."[77]

(DOE), *Community Geothermal Heating and Cooling Design and Deployment Funding Opportunity*

73 See: https://www.bizjournals.com/atlanta/news/2017/09/19/234-acre-pinewood-forrest-going-fully-geothermal.html.

74 Bullard, George. "Wyandotte Turns up the Heat." *Hour Detroit Magazine*, 5 Oct. 2010, https://www.hourdetroit.com/community/wyandotte-turns-up-the-heat

75 Kaufmann, Larry. "The Michigan State Capitol Went Geothermal-Should You?" *Michigan Country Lines Magazine*, 28 Apr. 2021, https://www.countrylines.com/our-energy/the-michigan-state-capitol-went-geothermal-should-you/#:~:text=Geothermal%20has%20been%20installed%20in,work%20just%20like%20your%20refrigerator

76 https://www.countrylines.com/our-energy/the-michigan-state-capitol-went-geothermal-should-you/

77 https://www.mlive.com/news/ann-arbor/2023/04/ann-arbor-nets-federal-funds-to-design-huge-scale-geothermal-energy-system.html#:~:

A sign for an April 5, 2023 public meeting to discuss Ann Arbor's Bryant neighborhood sustainability project.

Ryan Stanton | The Ann Arbor News

Energy Efficiency

The United States Department of Energy defines Energy Efficiency (EE) as:

> The use of less energy to perform the same task or produce the same result. Energy efficient homes and buildings use less energy to heat, cool, and run appliances. Energy-efficient manufacturing facilities use less energy to produce goods. Energy Efficiency is one of the easiest and most cost-effective ways to combat climate change, reduce energy costs for consumers, and improve the competitiveness of United States business. Energy efficiency is also a vital component in achieving net-zero emissions of carbon dioxide through decarbonization.[78]

Local governments can improve energy efficiency of government buildings and promote policies and programs that assist local residents and businesses with improving the energy efficiency of their homes and offices.

Michigan Energy Services in the Department of Environment, Great Lakes, and Energy supports local community energy efficiency projects, and other energy efficiency initiatives:

- **Architecture 2030 Districts**: The Architecture 2030 Districts work towards meeting the energy, water, and transportation emissions reduction targets for existing buildings and new construction called for in its 2030 Challenge for Planning. Many local communities in Michigan, like Ann Arbor and Grand Rapids, have adopted 2030 programs. Interested parties should contact their local governments to learn more about these initiatives[79].
- **Michigan Saves**: Michigan Saves operates a Better Buildings for Michigan energy

text=Ann%20Arbor%2C%20which%20is%20receiving,connected%20to%20geothermal%20heat%20pumps.

78 See: https://www.energy.gov/eere/energy-efficiency

79 https://2030districts.org/annarbor/

efficiency and financing program for community-based energy efficiency programs. The best practices and lessons from this Program are readily applicable to local communities seeking to initiate community-level energy efficiency programs.[80]

- **Property Assessed Clean Energy (PACE) Program:** Working in partnership with local financial institutions, PACE is a financing program that allows business owners to make upgrades in energy efficiency, water efficiency and renewable energy, with no money down. Operated by Lean and Green Michigan, PACE is a financing tool that enables businesses to eliminate the need for upfront capital and can spread the cost over 25 years so that the savings generated from the project are greater than the annual PACE loan repayment, which generates immediate positive cash flow. Interested parties can contact Lean and Green Michigan to learn if their community offers PACE Program funding in their community.[81]
- **Michigan Public Service Commission Energy Waste Reduction Low Income Work Group:** The Michigan Public Service Commission established the Energy Waste Reduction (EWR) Low Income Workgroup in April of 2018 with the support and participation of other State agencies, utilities, and diverse stakeholder groups. The Low Income Workgroup is working to identify and address low income energy issues, energy waste reduction measures, and create new initiatives that reduce the cost of the energy burden on Michigan's low income energy consumers and communities.[82]
- **Michigan Catalyst Communities:** The Catalyst Communities Initiative is a comprehensive program to provide education, training, planning and technical resources to local governments as they work toward their sustainability goals. This program offers an array of resources on various environmental, social, and economic topics to help communities across Michigan make a decarbonization transition.[83]

Conclusion

Local communities should be utilizing and promoting Geothermal Energy to provide heat and cooling for homes and business and should be encouraging the expanded use of Energy Efficiency measures to reduce the amount of energy needed to run appliances and to reduce the loss of energy in homes and business. Tax incentives, government grants, and private financing are available to promote Energy Efficiency and Geothermal Energy as a way to achieve energy savings and to reduce carbon pollution.

80 See: http://michigansaves.org/wp-content/uploads/2016/06/BetterBuildings-for-Michigan-Final-Report.pdf#:~:text=Final%20Report%20September%2030%2C%202013%20iii%20Executive%20Summary,across%20the%20state%20over%20the%20past%20three%20years.
81 https://michigansaves.org/wp-content/uploads/2020/03/BetterBuildings-for-Michigan-Final-Report.pdf
82 https://www.michigan.gov/mpsc/commission/workgroups/low-income-workgroup
83 https://www.michigan.gov/egle/outreach/catalyst-communities

Chapter VII

Resources to Support Local Communities

Resources and Technical Assistance Available to Support Solar Deployment

The purpose of this Guidebook is to encourage and provide local communities, local units of government and advocates with information on how to expand renewable energy. This Chapter provides information and resources to support an increased deployment of solar energy.

SolSmart and SolarAPP+

These are two initiatives developed by the United States Department of Energy to support and encourage the deployment of solar energy by local units of government. They are described below.

SolSmart Program

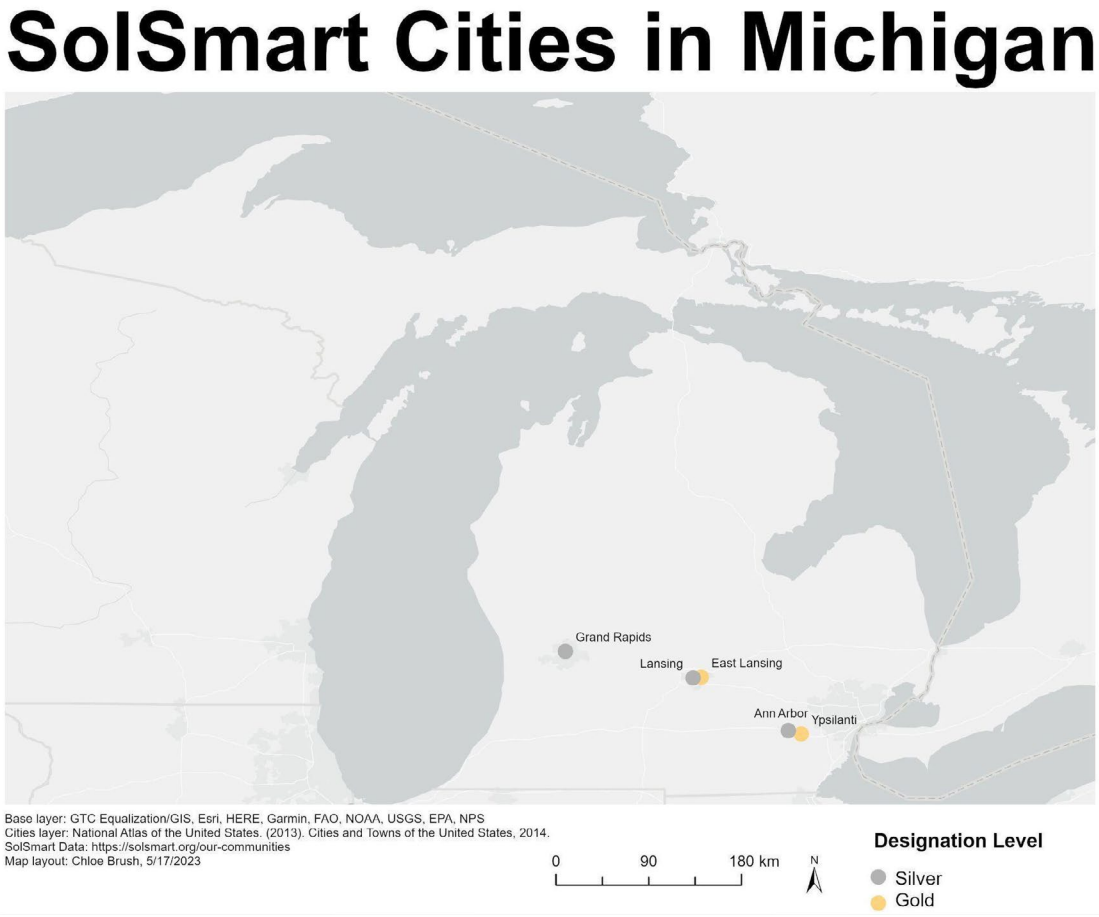
SolSmart is a national program initiated and funded by the U.S. Department of Energy (DOE) and is led by the International City and County Management Association (ICMA), the Interstate Renewable Energy Council (IREC), and other individuals with expertise in solar energy and local government management. The purpose of this Program is to help communities, businesses, and homeowners obtain solar by making it a fast, easy, and affordable process.

SolSmart supports efforts by cities, counties and other local governments, to reduce barriers to obtaining solar. Examples include permitting,

interconnection, education, and funding. This Program provides no-cost technical assistance from a team of national experts and can even assign SolSmart Advisors to help advise communities on how best to implement solar.

To take advantage of the help that SolSmart provides, a community simply needs to request a consultation with a technical assistance provider for either in-person or remote assistance.[84] SolSmart holds in-person presentations across the country to provide information regarding local or regional solar challenges and solutions, as well as other available opportunities.

Remote assistance includes communication with your community's SolSmart technical assistance provider via email, one-on-one phone calls, or group conference calls. Other available resources include subject matter webinars, the online resource catalog, and the SolSmart Hotline.[85]



SolSmart Advisors are fully funded, highly trained, and experienced staff assigned and ready to help communities take these first steps of designation and guide them to success in using the SolSmart program.[86] There is no cost to the community for these services.

84 https://solsmart.org/designation-criteria
85 https://solsmart.org/resources/
86 https://solsmart.org/our-team

Recently, as part of the Justice40 Initiative, the Interstate Renewable Energy Council (IREC) launched the SolSmart Engagement Partners program to encourage underserved communities into the SolSmart program. Organizations can apply to suggest "priority communities," which are defined as a city, town, or county government where at least 50% of the census tracts within its borders are deemed disadvantaged according to the DOE.[87] After an initial consultation and a plan is developed to implement SolSmart objectives, the community receives no-cost technical assistance through the program to adopt practices that will allow them to deploy solar energy. IREC also provides organizations that recruit a priority community with training and education on solar energy and the SolSmart program.

The SolSmart Program does not have direct funds to provide to communities, instead it offers technical assistance from national solar experts at no charge to communities.

The Program awards local government points using objective criteria for removing obstacles to solar energy development. In acknowledging their achievements, SolSmart Communities receive designations based on this point system of SolSmart Platinum, Gold, Silver, or Bronze. The designation process is made simple by the no-cost consultation and the help of technical assistance providers. [88]

SolSmart Designation

To receive a Solsmart Designation, communities must meet the requirements across five categories of the SolSmart criteria:

1. **Permitting and Inspection:** These requirements provide solar developers and installers with a transparent, efficient, and cost-effective approval process.

- Example: Post an online statement confirming a three-business day turnaround time for applying for a residential solar building permit.

2. **Planning and Zoning:** Requires the government to set forth a vision for the community's clean energy future, and establish zoning codes that provide clear and transparent regulations on the development and use of solar energy within the jurisdiction.

- Example: Review zoning requirements and identify restrictions that intentionally or unintentionally prohibit solar energy development (height restrictions, visibility restrictions, screening requirements, etc.)

3. **Government Operations:** These criteria map out ways that local governments can utilize government infrastructure to increase solar capacity and engage community members on solar energy.

- Example: Install solar energy on local government facilities or government-controlled land.

4. **Community Engagement:** Require local governments to provide clear information, public education, and inclusive engagement opportunities to help residents and businesses interested in solar energy to make informed decisions.

- Example: Establish partnerships with local community organizations focused on serving disadvantaged communities to define your community's solar equity goals, develop implementation strategies, and establish a plan for tracking and reporting on progress.

5. **Market Development:** Utilize methods to make solar more affordable for homes

87 https://energyjustice.egs.anl.gov/
88 https://solsmart.org/designation-criteria

and businesses while improving business opportunities for solar installers.

- Example: Support a community-wide group purchase program (e.g. Solarize Program) to reduce the cost of solar for residents, and reduce barriers to solar energy for renters, multifamily buildings, or low-income neighborhoods.

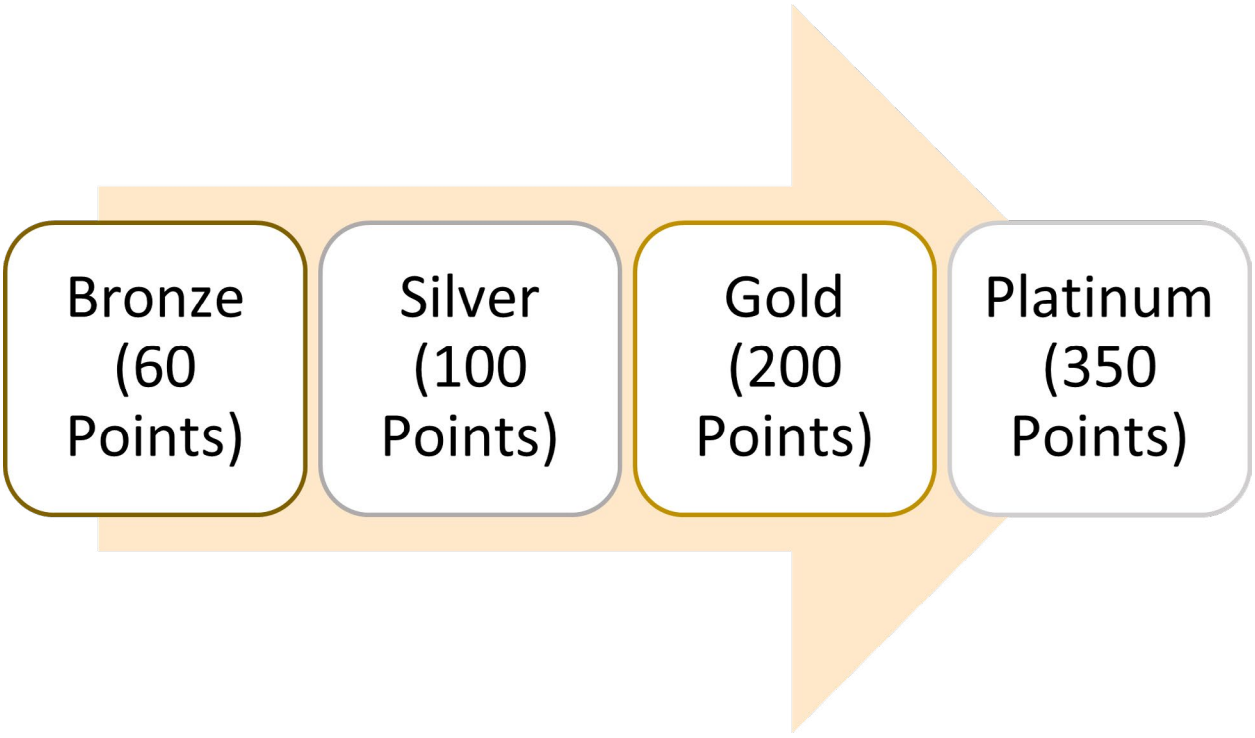
To be considered for all levels of designation, communities must meet the overall program prerequisites, which include completing a Solar Statement, Solar Permitting Checklist, and a Zoning Review. They must also reach the point requirements through a mixture of required and elective activities. Examples of elective activities include ensuring zoning ordinances for large-scale solar include a native perennial vegetation standard, requirements for new local government facilities and retrofits to meet a threshold to be solar-ready and posting online resources about residential solar energy financing options and incentives.

To qualify for the SolSmart **Bronze** designation, a community must meet the initial program prerequisites (completing a Solar Statement, Solar Permitting Checklist, and a Zoning Review). Additionally, Communities then need to earn 20 points in 1. Permitting and Inspection and 2. Planning and Zoning categories and receive 20 points within the remaining categories for a total of 60 points.

To qualify for the SolSmart **Silver** designation, a community must meet the requirements for SolSmart Bronze. Communities then need to earn additional points in 1. Permitting and Inspection, 2. Planning and Zoning, and 3. Community engagement and earn a total of 100 points within the five categories mentioned above (40 points beyond the Bronze level).

To qualify for the SolSmart **Gold** designation, a community must meet the requirements for SolSmart Silver. Communities then need additional credits in 1. Permitting and Inspection and 2. Planning and Zoning and earn a total of 200 points across all five categories.

To qualify for SolSmart **Platinum** designation, a community must meet the requirements for Solsmart Gold. Communities then need



to earn additional credits in 1. Permitting and Inspection, 2. Government Operations, and 3. Community Engagement and earn a total of 350 points across all five categories. The SolSmart National Designation Program allows all cities, counties, and regional organizations to be eligible to join and receive the many benefits of the designation.

These SolSmart designations bring many benefits to local governments and the local solar industry.[89] With a SolSmart designation, local governments can start saving money by making the approval process more efficient and helping communities better manage tight budgets and limited taxpayer resources.

This Program can also help grow the local economy by supporting economic development efforts including improved business prospects for solar companies, the creation of new jobs, and lower electric bills that enables homeowners and business to reinvest the savings into their home or business,

SolSmart communities receive national recognition and the opportunity to further distinguish their community from others. With the option for elective criteria, communities can customize their SolSmart point portfolio to best fit their needs.

SolarAPP+

SolarAPP+, short for Solar Automated Permit Processing, is a software tool developed by the National Renewable Energy Laboratory (NREL), in collaboration with Authorities Having Jurisdiction (e.g., local governments, fire marshals, electrical inspectors) Solar Energy Industries Association, and others. This software helps businesses or individuals by running compliance checks and reducing the time frame of the permitting process.

SolarAPP+ is an online web portal that automates the plan review and process for issuing permits to install code-compliant residential solar energy systems. This tool uses inputs provided by the contractor to automatically perform a compliance check to make sure the proposed system is safe and code compliant. After this is complete, then the installation practices, workmanship, and adherence to the approved design are verified by the local permitting authority throughout the inspection process.

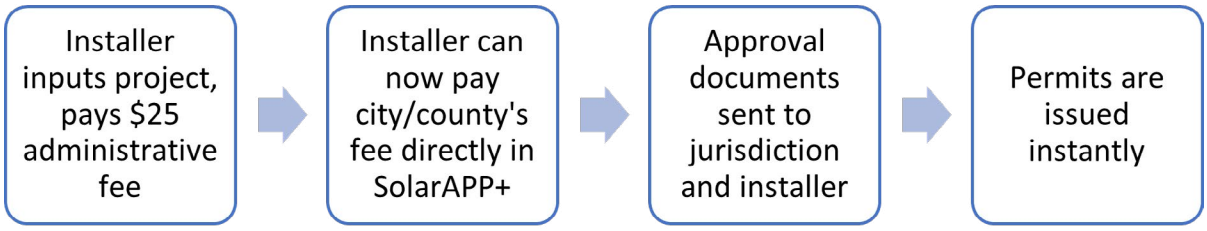
This software's purpose is to reduce the time for a solar business to obtain the necessary solar permit, which will reduce the time and cost of installing a system energy system. SolarAPP+ provides this service at no cost to the local government. Once the software is established within the permitting authority, to utilize the SolarAPP+, an installer registers an account to get started. [90] Once an account has been established, an installer then applies with the design specifications. SolarAPP+ checks the application to ensure the design is code compliant and then issues the permit. Installers pay the local government permitting fee with the app, alongside a $25 SolarAPP+ fee. The entire process is designed to be quick and easy and significantly cuts down the time involved with the permitting process.

SolarAPP+ is adaptable and offers two options to best meet the needs of different jurisdictions. The Stand-Alone Model is for email, mail, and in-person jurisdictions and the Integration Model is for jurisdictions already using some type of online permitting portal.[91]

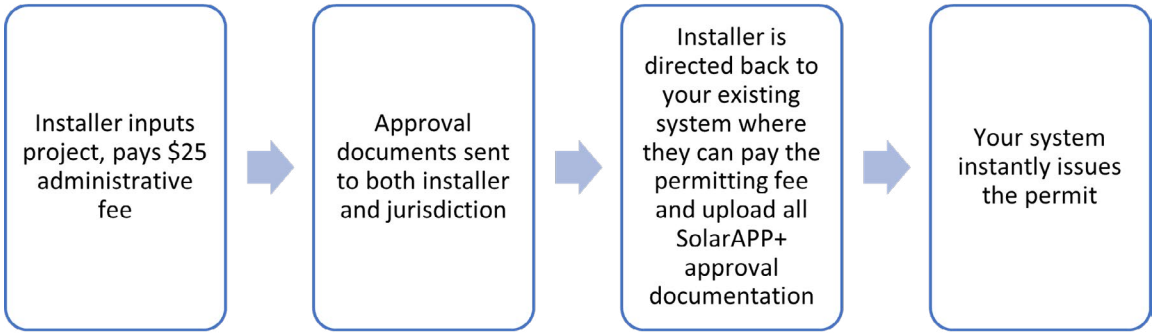
SolarAPP+ Permitting Processes

Stand-Alone Model (for jurisdictions who only accept applications via email, mail, or in person):

89 https://solsmart.org/why-solsmart
90 https://help.solar-app.org/article/81-basic-account-help-registering-a-new-account
91 https://help.solar-app.org/article/48-integration-model-vs-standalone-model



Integration Model (for jurisdiction already using an online permitting portal):

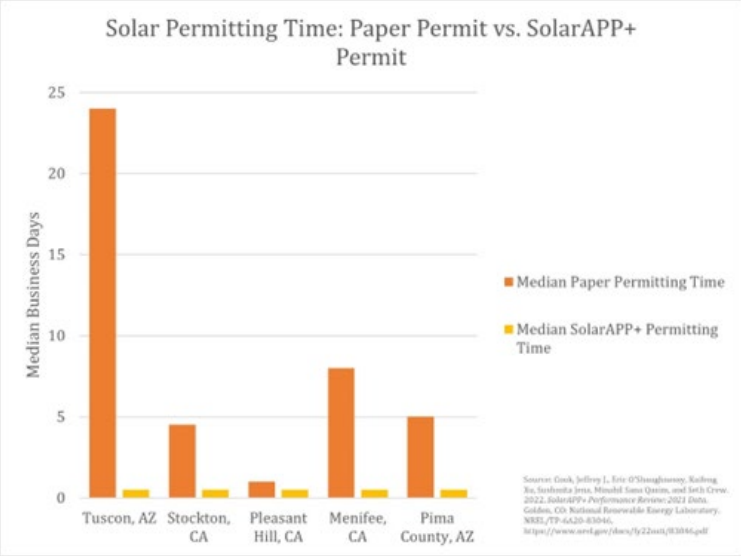


Implementing SolarAPP+ in your community is made simple and easy by using the following four steps. First, Select the right Model for your community, either Stand-Alone or Integration. Second, input local settings unique to your jurisdiction, including permitting contacts, jurisdiction boundaries, and local wind and snow variables. Third, set up an instant permit workflow that is tailored to your Model. And finally, invite one-to-three installers to test your SolarAPP+ permitting process and then open SolarAPP+ to all installers.

In 2022, the National Renewable Energy Laboratory (NREL) released a SolarAPP+ Performance Review that found the software had eliminated 134,000 days of delays for solar adoption.[92] Between 2021-2022, the number of communities that had launched or piloted SolarAPP+ grew from 13 to 31, and 90 communities were testing the app. This Report also found that SolarAPP+ shortened project timelines by 13 business days and were 29% less likely to fail inspections than traditionally permitted projects. Furthermore, SolarAPP+ processed 11,000 permits in 2022, a 300% increase from the year before. This increase translates to local jurisdictions saving roughly 10,000 hours of staff time.

This low-cost permitting software provides many benefits to local governments making it easier for them to quickly and safely approve standardized rooftop projects for solar panel installation which will support major growth within the solar industry. [93]

92 https://www.energy.gov/eere/solar/articles/annual-report-use-solarapp-doubles-across-country
93 https://solarapp.nrel.gov/docs/SolarAPP_Benefits_Memo.pdf



Graph comparing the permitting time for solar projects with and without SolarAPP+.

How SolSmart and SolarAPP+ Work Together

Given the purpose of each program, SolSmart and SolarAPP+ complement each other well. SolSmart encourages local governments to reduce barriers to the deployment of solar energy, while the Solar APP+ software helps governments to streamline the solar permitting process. Utilizing SolarAPP+ also gives local governments a significant number of required credits for SolSmart.

One of the requirements for achieving platinum SolSmart status is utilizing a pathway for instant approval of residential rooftop solar systems. The SolSmart guidebook specifies SolarAPP+ as a way for jurisdictions to achieve this requirement. Additionally, governments receive 5 SolSmart credit points for simply receiving a demonstration of an instant approval platform such as SolarAPP+. Utilizing SolarAPP+ provides SolSmart communities with an easy way to achieve higher designations and to implement more solar infrastructure.

Michigan Saves

Michigan Saves is a non-profit organization that partners with credit unions and banks to provide lower costing financing for homeowners and businesses to purchase solar and geothermal energy systems and to make energy efficiency upgrades. Homeowners or businesses interested in securing a loan from Michigan Saves can work with a contractor who has already been vetted by Michigan Saves. The contractor provides the cost for installing the energy system or energy efficiency upgrades and once approved by the client, then applies for the loan from Michigan Saves.

For more information and up to date interest rates and loan products, contact Michigan Saves, 230 N. Washington Square, Suite 300, Lansing, MI 48933. Tel: (517) 484-6474, info@michigansaves.org.

Rural Energy for America Program

This is a program through the United States Department of Agriculture that provides guaranteed loan financing and grant funding to farmers, other agricultural producers and rural small businesses for purchasing renewable energy systems or to make energy efficiency improvements. Grants may be obtained up to 50% of the total eligible project cost and the loan guarantees up to 75% of the total eligible project cost.

Businesses must be located in rural areas with 50,000 people or less but agricultural producers can be located in rural or nonrural areas. To learn more about this program or to apply go to https://www.rd.usda.gov/programs-services/energy-programs/rural-energy-america-program-renewable-energy-systems-energy-efficiency-improvement-guaranteed-loans/mi.

Rural Energy Savings Program

This is another program that is run through the United States Department of Agriculture, which provides loans to rural utilities and other companies who in turn make loans to individuals to implement cost effective, energy efficiency improvements. The goal is to help lower energy bills for rural families and businesses and reduce barriers to investments in energy efficiency projects.

Eligible borrowers include utilities, municipalities and other local units of governments, and nonprofit organizations.

To learn more about this Program or to apply go to https://www.rd.usda.gov/programs-services/electric-programs/rural-energy-savings-program.

National Community Solar Partnership

Sponsored by the United States Department of Energy and the Office of Solar Energy Technologies, the *National Community Solar Partnership (*NCSP) is a program bringing together the Department of Energy and Community Solar stakeholders to expand access to community solar to every American household.[94] There are three goals of this program:

- Make community solar accessible to every household in the United States,
- Ensure community solar is affordable for every household in the United States, and
- Enable communities to realize supplementary benefits and other value streams from community solar installations.

To achieve these goals, NCSP is providing tools and information to design and implement successful community solar projects. This program partnership will provide these through three major activities:

- **Network Infrastructure**: Partners have access to an online community platform, virtual and in-person meetings, webinars and other tools to engage with United States Department of Energy (DOE) staff and each other to share information and strategies.
- **Technical Assistance**: Partners have access to technical assistance resources from DOE, its National Laboratories, and other third-party experts for support on unique local challenges.
- **Collaboration**: Structured groups of partners, called collaboratives, form around specific goals to address common barriers to solar adoption by learning from each other and sharing resources.

94 https://www.energy.gov/communitysolar/community-solar

Another essential part of the National Community Solar Partnership is the Low-Income Clean Energy Connector.[95] This program includes a digital tool that makes community solar with verified savings and strong consumer protections more accessible to households participating in government-run low-income support programs. The Connector is intended only for Low-Income Home Energy Assistance Program (LIHEAP) recipients. LIHEAP is a program that assists eligible low-income households with home energy costs.[96]

For more information go to: https://www.energy.gov/eere/solar/national-community-solar-partnership

National Community Solar Partnership: Justice40 Initiative

Community Solar enables solar to be accessible to all Americans, particularly low-to-moderate income families, renters, and other community members for whom traditional rooftop solar is often out of reach. Rather than putting solar on their own home or building, community solar allows energy users to subscribe to a shared system of solar panels, often located within their community.

The Justice40 Initiative requires that 40% of overall benefits of many Federal Program Investments, including investments in clean energy and energy efficiency, to flow to disadvantaged communities.[97] The National Community Solar Partnership (NCSP) is working to implement this initiative by working closely with the United States Department of Energy's Office of Economic Impact and Diversity to align efforts on creating equitable access to community solar.

Justice40 builds on the important partnerships the Federal Government has with community and civil rights organizations, tribal nations, communities of color, as well as Historically Black Colleges and Universities. The National Community Solar Partnership is working to increase commitments to research, development, and deployment of community solar in communities that have been left behind in the energy transition.

NCSP operates a Center for State and Local Solutions that provides resources to enable strategic investments in energy efficiency and renewable energy technologies through the use of innovative practices across the United States by a wide range of stakeholders, in partnership with state and local organizations and community-based nonprofits.[98]

For more information, contact the NCSP **stateandlocal@ee.doe.gov**.

Green House Gas Reduction Fund - Solar for All

Through this $7 billion Environmental Protection Agency competition, Solar for All will award up to 60 grants to states, territories, Tribal governments, municipalities, and nonprofits to expand the number of low-income and disadvantaged communities primed for residential solar investment - enabling millions of low-income households to access affordable, resilient, and clean solar energy.

Through Solar for All, the Greenhouse Gas Reduction Fund will transform the status quo, putting billions of dollars of solar panels on the homes of low-income families and closing the equity gap in access to solar energy.[99]

95 https://www.energy.gov/communitysolar/low-income-clean-energy-connector
96 https://www.liheap.org/
97 https://www.whitehouse.gov/environmentaljustice/justice40/
98 https://www.energy.gov/eere/slsc/state-and-local-solution-center.
99 https://www.epa.gov/greenhouse-gas-reduction-fund/solar-all

Local Community - Solar Zoning and Planning Guidance

Local Government is required to establish Zoning and Planning regulations for the development and placement of solar and wind projects within their local jurisdiction. This can be a challenge, especially for small local communities without much staff or limited expertise.

The University of Michigan Graham Sustainability Institute, Michigan State University, Michigan State University Extension Service, and Michigan EGLE developed a guidebook, *Planning and Zoning for Solar Energy Systems: A Guide for Michigan Local Governments* to provide support for local governments engaged in proactive planning for solar development and for establishing zoning ordinances to regulate solar development.[100]

This Guidebook explains the importance of solar energy in Michigan and the benefits to local communities. It also offers principles around how solar energy systems might fit within various land-use patterns across and presents sample zoning-ordinance language.

This guidebook was written for local planners, legal counsel, and local officials. It was released to the public on October 5, 2021. This free guide is available at extension.msu.edu/solarzoning.

100 The guide is available at extension.msu.edu/solarzoning

Chapter VII

Electrical Energy Storage

Incorporating Energy Storage to Broaden the Reach of Renewable Energy

Introduction

Electricity for lighting, heating, cooking or any other use requires continuous production and distribution. As a result, an electrical grid was built across the United States to supply electricity from many sources and to meet the local demands for its use. One unique feature of electric energy is that the amount of electricity that is demanded has to be generated and immediately deployed or utilized, unless stored. This requires balancing the production of electricity with the demand for it. But now with the development and deployment of batteries, electricity can be generated and then stored for later use for both small scale behind the meter solar or at the transmission or distribution grid level with larger utility scale solar production.

The use of Energy Storage is gaining traction as a means of maximizing renewable energy for homeowners and small businesses, for improving the resilience and reliability of the electric grid, and for assisting in overall decarbonization efforts. According to the United States Energy Information Administration and the United States Department of Energy, electric energy storage addition in the United States is expected to double in 2024[101] with an estimated 10 to 100 gigawatts of energy storage systems likely to be deployed over the next decade.

Energy Storage usually involves batteries paired with a renewable energy source like solar and serves either a single home, farm or business, or

101 U.S. Energy Information Administration (EIA), In-Brief Analysis, January 9, 2024.

multiple loads and demands that a utility serves. Utilizing energy storage in a system of aggregated batteries at multiple facilities can provide significant dispatchable energy for the grid and is attractive for a resilient supply of electricity to critical first responders like hospitals, police and fire stations, and food distribution centers.

At its simplest, a battery is installed behind the meter at a residence or commercial building as shown in Figure 1:

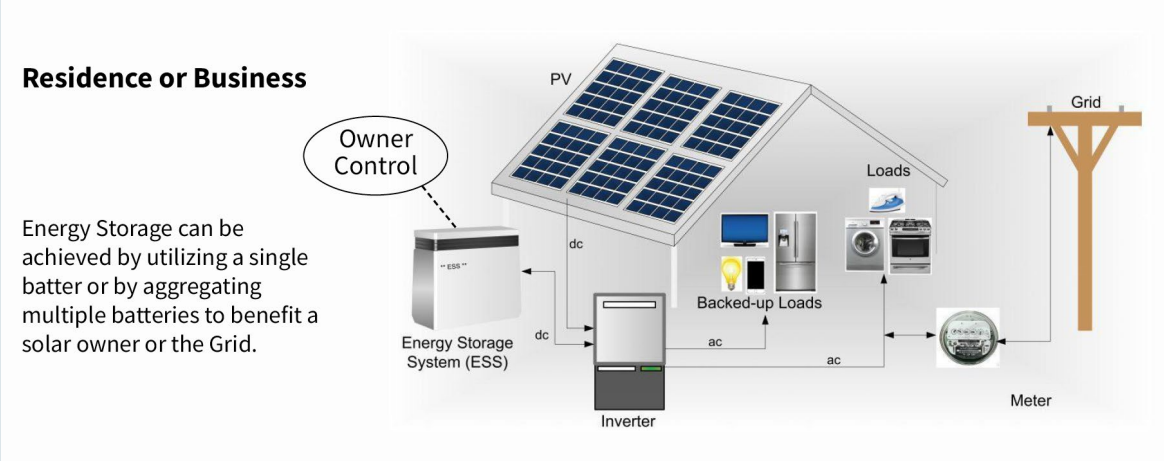


Figure 1 – Individual Energy Storage with Aggregation[102]

For homeowners and businesses, the extra solar electricity generated that is not immediately used, can charge a battery and the stored electricity can then be used at night after the sun has set. Utilities can also build large battery storage systems and store renewable electricity that can be used at later times such as during peak demand, when for instance air conditioning is in high use.

Energy Storage can bridge the gap between large generating plants powered by coal, nuclear or natural gas, and large solar or wind energy systems, by reducing the intermittency of the latter. Improving the effectiveness and therefore utilization of renewable energy through Energy Storage, reduces carbon emissions by reducing the need for electricity generated from fossil fuel power plants and therefore provides economic benefits. Energy Storage supports the expansion of solar and wind electricity because it addresses the intermittent production of this energy and can therefore provide a steady stream of renewable electricity locally to communities and at larger scales to the grid.

Renewable energy and battery storage can also be incorporated into a 'microgrid' that can then be utilized by a single facility or to a connected group of buildings, like on a college campus. A microgrid is a group of interconnected loads and distributed energy resources that acts as a single controllable entity with respect to the greater transmission and distribution grid. Microgrids typically operate as a part of the overall grid (known as in parallel) but can also disconnect from the larger grid during a power outage and operate as a smaller grid (known as 'island' mode) serving homes, businesses or groups of buildings even when the larger grid is not operating.

102 Derived from: Dinic, T., "Energy Storage Systems", Electrical Business, March 14, 2017.

Microgrids can then connect together to form a 'community wide' grid that combines distributed renewable energy sources with storage, that has the potential to take advantage of economies of scale, enabling participation by residents or businesses who would otherwise be unable to install their own energy system. This type of system could provide a return-on-investment to justify the construction of these types of "connected" systems and can benefit the larger grid through added resiliency.

through mid-spring must be taken into account as well as new energy sources such as electric vehicle-to-grid energy deployment.

However, unlike a Community Solar project, an Energy Storage system is unlikely to be developed as a standalone project but will be paired with a solar or wind system. The benefits of Community Solar and Storage are well known,[104] but as of now, there has not been a single Energy Storage project paired with a

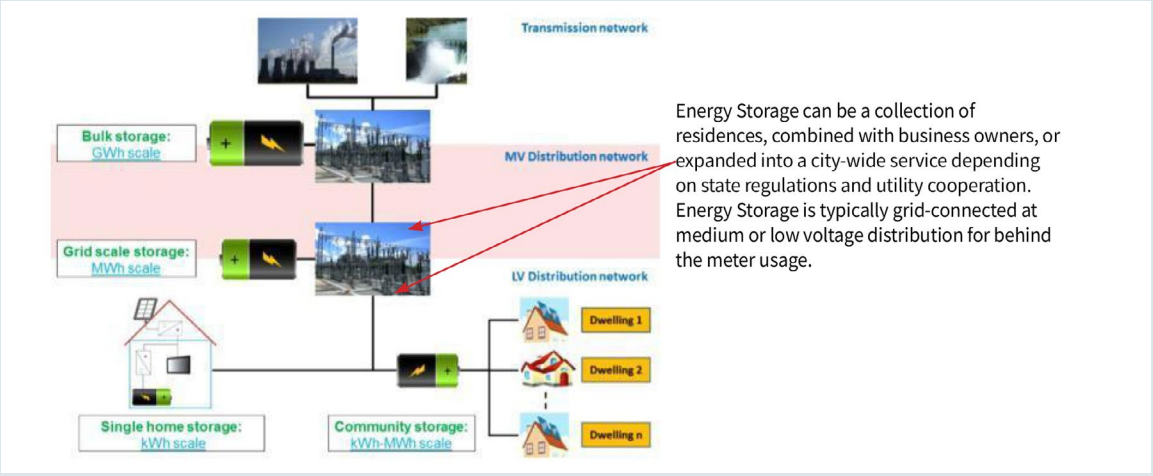


Figure 2 – Energy Storage and Distributed Energy Resource Configurations[103]

Storage has the ability to preserve and move solar energy through time, freeing utilities from generating power to closely match the demand for electricity, as well as increasing resilience and reducing power outages to the community.

Energy Storage is best utilized when electricity demands from homeowners or businesses can be quantified across all seasons. Factors such as decreased solar production from mid-fall

Community Solar project in Michigan, but there are examples in other states where this has occurred.

Energy Storage Technologies

For purposes of this Guidebook, Energy Storage will focus primarily on batteries as shown on Figure 3, which identifies various electricity storage technologies that are being deployed:

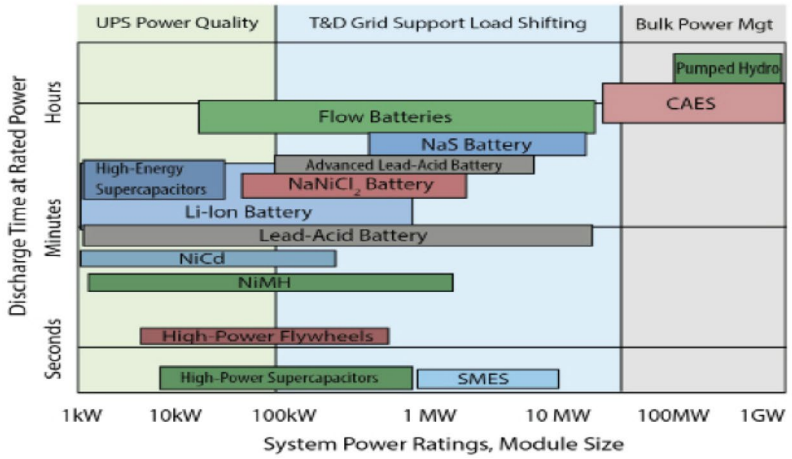
103 Derived from: Parra, D., Patel, M., et.al., "An Interdisciplinary Review of Energy Storage for Communities: Challenges and Perspectives", Renewable and Sustainable Energy Reviews, Science Direct, 2017.

104 Smart Electric Power Alliance (SEPA), "The Microgrid Playbook: Community Resilience for Natural Disasters", April 2020, and U.S. Department of Energy (DOE), Office of Electricity (OE), "DOE Selects 14 Communities to Leverage Energy Storage to Increase Resiliency and Long-term Affordability", March 2022.

Figure 3 – Electricity Storage Technologies

Virtually all Energy Storage deployed to-date has been with lithium-ion batteries with 4 to 6 hours of capacity. Increasingly, flow batteries are entering the market as they offer longer-duration storage capabilities, which is

operating Energy Storage projects are currently utility owned and are located at the distribution site on the grid (called utility substations), with the near-by community benefiting from this infrastructure. These benefits are less tangible to the broader community than local solar homeowner storage, even though the utility



Long-duration storage at least 6 hours and includes advanced battery, pumped hydroelectric, compressed air and gravity.

attractive to businesses and the electric grid for added resilience. Larger alternative storage systems from compressed air or gravity storage (potential energy created storing compressed gasses for later passage through a turbine or generator or by lifting heavy objects using a pump or motor to a height that yields electricity when later dropped) may also be attractive when the goal is to provide larger amounts of stored energy. Like solar and wind energy, most Energy Storage technologies do not generate air or water pollution and the environmental impacts over the life of the system are low.

Energy Storage Benefits

Except for small-scale 'behind the meter battery storage' for solar homeowners, most

energy storage improves grid reliability. As energy storage is increasingly being developed and deployed, it will be important for utilities and developers to educate community members about the benefits of large scale storage as investments are made.

A key factor in the deployment of Energy Storage systems is the economic benefit to the system owners. Although the cost for battery storage has decreased and offers strong benefits for grid outages, the value of energy delivered from storage has not been addressed in utility rate structures and this has negatively impacted deployment. This issue needs to be addressed.

Energy Storage benefits can be difficult to measure and often require an assessment of the electricity demand and opportunities that exist within the grid distribution system. The following is a list of key benefits or Use Cases and Value Streams of Energy Storage.

Table 1 – Use Case and Value Streams for Energy Storage (ES)

Use Case	Description and Suitable Technology	Overall Value	Benefits to:	
			Small Scale - Behind the Meter	Distribution Grid
Energy Arbitrage and Rate Reduction	Storage charged by renewables during off-peak hours and dispatched on-peak; increased revenue from receiving utility is obtained	Potentially high	Yes	No
Demand Charge Reduction and Rate Reduction	Stored energy dispatched on demand to avoid higher rates during peak demand; or to increase revenue from distribution utility	Potentially high	Yes	No
Demand Response (DR)	Storage deployed to either balance loads behind the meter during high demand; or upon a demand call from a utility with DR revenue	Depends on DR payment value	Yes (revenue)	Yes
Grid Stability/ Power Quality	Storage deployed to stabilize frequency, voltage or power quality on the utility grid	Low	Depending on Scale and Use	Depending on Scale and Use
Renewable Energy Deployment	Storage used to capture all excess renewable energy produced behind meter for future use	High	Yes	No
Resiliency	Storage called upon during loss of utility grid, for the duration of outage and sized to meet critical demands behind meter	High	Yes	Yes, Depending on Scale
Avoidance of Transmission & Distribution Upgrades	Energy Storage can benefit the utility grid by pairing production capabilities and existing distribution to meet community demands	Low, unless energy storage is compensated	No	Yes
Decarbonization	Storage offers the ability to reduce fossil fuel power plants when coupled with renewable energy generation	High, when ES sized to reduce carbon emissions	Yes	No

Adapted from: https://www.nrel.gov/docs/fy17osti/70035.pdf

Energy Storage – Service Life and Recycling

Most electric storage systems will utilize either Lead-Acid or Lithium-Ion batteries. Both of these batteries can be sized and connected to meet specific facility use cases. The expected service life of batteries is significantly affected by their care, monitoring, and usage. Most batteries perform best when installed in cool, dry environments and when they function in daily or periodic deep cycles between recommended maximum and minimum states of charge and ten years of service is a reasonable target.

The capacity of batteries is typically specified in terms of Power (kilowatt, or kW) and Energy (kilowatt-hour, or kWh) to enable them to be sized for specific uses. Experience has shown that batteries set up to charge daily and discharge to shave peak loads (partial), with balance of capacity left as reserve for outage protection, can yield a suitable service life, whereas those used to help stabilize grid frequency and cycle frequently, may only function for a year or less. Many resources[105] exist which compare and contrast battery capabilities for use in buildings or community energy storage, with the following summaries offered:

Lead-Acid

Significant use in transportation and for critical building loads has led to valuable knowledge on performance, risks (e.g., acid spills), and recycling. Nearly all lead-acid batteries in use today and into the future will be recycled. Lead acid batteries utilize common materials, are of lower cost, and are more readily available than lithium-ion and other batteries but have a lower energy density, are less efficient, and have a shorter service life particularly when used extensively or discharged below minimum states of charge.

Lithium-Ion

Expanded use in transportation and stationary grid connected applications has led to many different chemistries and types with lithium nickel-manganese-cobalt (NMC) and lithium iron phosphate (LFP) being the most prevalent. Depth of discharge, charge/discharge, and expanded use cases are significant advantages over lead acid batteries and are now available from many suppliers complete with robust battery management systems which protect operations and lower the need for any regular maintenance.

Lithium-ion (particularly nickel-manganese-cobalt) have a greater fire risk than other batteries but advancements in battery management systems and installation guidance such as that in National Fire Protection 855[106] have greatly reduced this risk. Recycling of lithium-ion batteries is gaining traction with an estimated 25%+ of all grid-tied lithium batteries now being recycled and many batteries from the automotive industry are being repurposed into grid-tie applications.

Summary

In summary, detailed design of a community energy storage system will define which battery type, size, and configuration makes the most sense for the specific application. There are many case histories to draw from and commercial offerings from companies like Tesla, sonnen, Alpine, and Fortress to consider. Once system size, interconnection with grid, alignment with renewable energy sources, and loads, and control goals are defined by the owner, an appropriate energy storage design can be implemented.

105 Lithium-ion vs. Lead Acid Batteries | EnergySage; Lithium Ion vs Lead Acid Batteries: Which is Best for Your Off-grid System? - Practical Off-Grid Living (practicaloffgridliving.com)

106 National Fire Protection Administration NFPA) 855, Standard for the Installation of Stationary Battery Systems (NFPA 855 Standard Development)

Conclusion

Energy Storage coupled with solar or wind energy offers a compelling alternative to fossil fuel generated electricity and particularly at the local community level. The key benefits include:

1. **Resilience:** Power outages to critical facilities such as hospitals, police and fire departments, or food distribution centers can be devastating to human life and the local economy. Energy Storage can provide power during an outage and keep these buildings and operations powered to serve the needs of the community.
2. **Expansion:** Energy Storage enhances the value of renewable energy and thus supports the expansion of solar and wind generated energy which provides many environmental benefits. The extra solar or wind electricity that is generated and cannot be used immediately, is stored and then used later in the day or evening.
3. **Savings:** In addition to benefits to solar homeowners, behind-the-meter storage can also provide benefits to utilities by reducing their need to bring on expensive 'peaker-power' plants during periods of high demand for electricity, because solar owners are not purchasing electricity from the grid.

Individuals and businesses should consider the financial and environmental benefits of battery storage when they are installing their own renewable energy system. At a minimum, lithium-ion or other battery technologies offering 4 to 12 hours of storage capability powered by solar or wind, should be considered.

The cost of Energy Storage continues to decrease as demand grows along with technological improvements. The Federal Investment Tax Credits and other financial incentives can further reduce the cost of ownership. Furthermore, the Clean Energy Legislation passed in 2023, specifically Public Act 235, establishes a statewide energy storage target of 2,500 MW. Investor Owned Utilities (IOUs) are required to begin filing annual storage reports no later than Dec. 31, 2024[107]. When benefits are properly evaluated, the return on investment for Energy Storage can be determined and justified, which will further support its increasing use in the near future.

107 https://www.michigan.gov/mpsc/commission/workgroups/2023-energy-legislation

Appendix I.
Glossary of Terms

AC Power (Alternating Current): An electrical current that reverses its direction many times a second at regular intervals, typically used in power supplies. It is considered the standard form of electrical power.

Attached or Stand-Alone Solar System: A solar system in which solar panels are attached directly on the building (typically the roof) or adjacent to the property (stand-alone) in a ground-mounted system.

Bulk-Purchasing Program: A program that facilitates the bulk purchasing of solar to help lower the installed cost for people participating in the program.

Climate Change Risk: The concern that as a result of the increase in carbon dioxide in the atmosphere, the planet's temperature is increasing which will impact the climate on the Earth and all life on this planet.

Community Solar: Community Solar is defined by the United States Department of Energy (DOE) as **"**any solar project within a geographic area, in which the benefits of the solar project flow to multiple customers such as individuals, businesses and other groups." Community Solar has multiple names, including solar gardens and solar farms. For the purposes of this Guidebook, Community Solar is defined as the DOE defines it.

DC Power (Direct Current): is an electric current that is unidirectional, so the flow of charge is always in the same direction. As opposed to Alternating Current (AC), the direction and amperage of direct current does not change. It is used in many household electronics and in all devices that use batteries. The photovoltaic cells on solar panels generate electricity from sunlight in the form of DC and are usually converted to Alternating Current by an inverter.

Detached Systems: Also known as a Ground Mount System, is a solar system that is not attached directly to a building but is supported by a structure that is built on the ground.

Distributed Generation Tariff: This is the amount a utility pays the solar owner for the excess power generated by their system that is fed into the grid for reuse by the utility. The Distributed Generation Program in Michigan was enacted into law by the Michigan Legislature and is based upon the Inflow/Outflow billing mechanism. 'Inflow' is the electricity the customer imports or purchases from the utility. 'Outflow' is the electricity generated by an individual's solar system that is not used on-site and is instead exported back through the electric grid. Solar owners are compensated for this exported energy by the utility and it's called a Distributed Generation Tariff.

Electron: An electron is a small particle that has a negative charge of *electricity* and travels around the nucleus of an atom. In a solar cell, photons of sunlight slam into and dislodge the electrons around the nucleus of the silicon atom. The dislodged, free-floating electrons are channeled into a wire as electricity.

Electricity: Electricity is a flow of electrons or electric current that is used to run machines, appliances, etc. Electrons are flowing from individual solar cells in a solar panel where they join electrons in the solar array to produce electricity.

Electrical Generation: Is the production of electricity from various sources, including

electric generators that are powered by heat from the combustion of fossil fuels (coal, natural gas, oil) in a steam boiler, or directly when the photons of sunlight strike and dislodge electrons in a solar cell.

Electric Power: Is the rate at which electrical energy is transferred by an electric circuit and is measured in watts. For homeowners and businesses, electricity is bought or sold in kilowatt-hours (kilowatts multiplied by hours).

Electricity Transmission: Is the system of large capacity wires that transmit large amounts of high voltage electric power that flow to substations, then through the distribution wires and then to customers. Solar generated electricity can be sent along the same transmission lines as fossil fuel generated electricity or it can be generated directly on site, thus bypassing the transmission system.

Electric Vehicles: Are vehicles that are powered with electric motors and use electricity to power the vehicle instead of an internal combustion engine that is powered by gas or diesel fuel. Electric vehicles (EVs) operate off of batteries that need regular charging.

Embodied Carbon: Is the carbon that is contained within the materials used in a solar system plus the carbon used to generate the energy that was used in the production, transportation, and installation of solar modules and other system components.

Energy Efficiency: Is an approach that emphasizes the reduction of the consumption of energy by utilizing more efficient appliances or increasing the use of insulation and other construction techniques to reduce the loss of heat in the winter and cool air in the summer.

Environmental Justice Return on Investment (EJ ROI): Describes the situation where high-income communities produce excess carbon emissions and transfer the negative consequences of these emissions to low-to-moderate income communities that produce lower carbon emissions, such as air pollution, health concerns and flooding. The EJ ROI compares the increasing cost of disaster recovery with the cost of climate change risk mitigation with solar energy.

Gigawatt: A unit of power equal to one billion watts.

Global Warming: Refers to the continued increase of greenhouse gas emissions that lead to weather extremes of heat and cold, flooding and other related social and economic costs such as health concerns and food insecurity.

GLREA: Great Lakes Renewable Energy Association, a non-profit organization that works to expand the adoption of renewable energy in Michigan.

Grid: The infrastructure of power lines, transformers and substations that deliver electric power to homes, businesses and other buildings. The Grid is owned and managed by electric transmission companies and electric utility companies, though it's regulated by State and Federal Energy Commissions.

Hard costs: The costs for the hardware and materials included in a solar installation.

Home Rule: The Home Rule City Act (P.A. 279 of 1909) and the Home Rule Village Act (P.A. 278 of 1908) provides a framework for cities and villages to exercise a range of self-governing powers. Michigan's cities, townships, and villages are subject to home rule and are places where a community solar program could be located. However, existing utility laws prohibit this in areas served by Michigan utilities.

Installer: A contractor that installs solar or geothermal energy systems.

Integrated Resource Plan (IRP): Is a comprehensive long-range plan developed by the regulated utilities in Michigan and submitted to the Michigan Public Service

Commission showing how the utility plans to provide reliable, affordable and electric service to its customers for the next 5, 10 and 15 years. This Plan is reviewed by the Michigan Public Service Commission and is approved or denied.

Interconnection: The link between a utility company and a building that enables power to move in either direction.

Inverter: A device that converts Direct Current (DC) power generated by solar panels into Alternating Current (AC) power that can then be used in a home or be exported back to the Grid.

Investor-Owned Utility (IOU): Is a regulated private corporation that generates and sells electricity to industrial, commercial and residential ratepayers and is regulated by the Michigan Public Service Commission.

Kilowatt: A unit of power equal to one thousand watts.

Local Governments: Consist of cities, townships and villages.

Master Plan: A document adopted by a local government under the Michigan Planning Enabling Act (P.A. 33 of 2008) that establishes a vision and guide for the community's future growth and land use.

Megawatt: A unit of power equal to one million watts.

Michigan Energy Services: The United States Department of Energy provides Michigan with funding to operate a State Energy Office. Michigan Energy Services educates and works with individuals, business, communities and non-profit organizations to support the deployment of renewable energy and energy efficiency to promote a higher quality of life and economic development.

Michigan Healthy Climate Plan: In 2022, Governor Whitmer developed the *Michigan Healthy Climate Plan* that strives to reduce green-house gas (GHG) emissions from 2005 levels of 28% by 2025, 52% by 2030, achieve carbon neutrality by 2050, and maintain net negative GHG emissions thereafter. Meeting the 2050 goal will require a switch to 100% clean, renewable electricity paired with robust energy storage and reducing other sources of GHG emissions.

Microgrid: Is an interconnected group of loads and distributed energy resources acting as a single controllable grid entity, with the ability to connect and disconnect from the larger grid to operate in grid-connected or island mode. Microgrids with solar plus storage can enhance local energy resilience if designed to provide power during a grid outage.

Net Metering: Is the older program in Michigan that was used to credit a solar owner whose solar system produced more electricity than could be used at a moment in time. Net metering allowed solar owners to send excess solar electricity back to the Grid and receive a kilowatt-hour (kWh) credit during a billing period equal to the retail cost of electricity that the utility sold. Net Metering was changed in 2016 to become the Distributed Generation Program which lowered the compensation to the solar owner for the extra solar electricity sent to the grid from their solar energy system.

Off Grid System: A solar energy system that is connected to the utility grid is a grid-tied system, while a system with battery storage that is not connected to the utility grid is considered an off-grid system.

Payback: The number of years it takes to recover the cost of installing a renewable energy system from the savings from not having to buy electricity, or natural gas from a utility.

Permitting: The process by which a local unit of government allows for development activities in their jurisdiction. Before installing a renewable energy system, a permit must be secured from the local unit of government.

Photovoltaic (PV): A method of generating electrical power by converting sunlight into direct current electricity by using solar panels.

Power Purchase Agreement (PPA): A Power Purchase Agreement is a contractual agreement between energy buyers and energy sellers that sets the price and duration of the energy purchase.

Public Utility Regulatory Policies Act (PURPA): In 1978, this Federal Law was enacted to encourage competition, conservation and reliability in generating and delivering electricity, including renewable energy. PURPA imposed an obligation on local utilities to purchase power from qualifying facilities (QFs) in an effort to promote competition and achieve other policy goals embodied in the federal law.

Renewable Energy Credits (RECs): Also known as Renewable Energy Certificates, RECs are tradable commodities that put a value to the environmental benefits of renewable electricity. One REC represents 1 megawatt Hours (MWH) of electricity from renewable sources. RECs are valuable to utilities because they can act as proof of compliance to renewable portfolio standards. A SREC is a Solar Renewable Energy Credit.

Renewable Portfolio Standards (RPS): Also known as a Renewable Energy Standard, is a policy that requires electric utilities to supply a specified amount of power from renewable sources by a certain date.

Resistance: Resistance is measured in ohms. Resistance makes transmission wires hot and is a major source of transmission loss. Losses scale with the square of a wire's current. That square factor means a tiny jump in current can cause a big bump in losses. Like fossil fuel powered electricity, solar electricity must overcome the same types of resistance associated with all electrical wires, connectors and devices.

Silicon (Si): Is the raw material for making solar photovoltaic cells. Silicon is super-abundant and the second-most common element in the Earth's crust.

Soft Costs: Are costs of installing a renewable energy system that are not considered Hard Costs, such as permitting, financing, and installation.

Solar Farm: Is a solar installation on an area of land in which a very large number of solar panels are installed to generate electricity. Solar Farms can comprise hundreds of acres.

Solar Photovoltaic System: The total components that generate electricity from a solar energy system.

Standby Charge: Is a fee that is charged for the availability of a service, even if the service is not used. This fee is often based on the size of the property and is charged regardless of whether or not the service is actually utilized.

Stranded Costs: Are financing, operations and decommission-related costs that remain after an electricity generation facility has been shut down that rate-payers continue to pay for. Such costs are usually claimed by investor-owned utilities that have been compelled to shut down coal generation facilities, prior to their expected decommissioning date.

Sustainable Energy Utility (SEU): Is a publicly owned municipal electricity utility that generates and delivers clean energy to residential, commercial and industrial electricity users in the community. (See: www.a2gov.org/a2MSEU). The SEU operates as an additional provider and would supplement the local utility electricity service with clean electricity generated from solar. Both the District of Columbia and Delaware currently operate SEU's.

Third Party Developers and Owners: Third Party Developers are businesses that put together solar projects including community solar systems. Third Party Owners are generally referred to as investors who finance solar energy projects, receiving a return on

investment from federal tax credits and the sale of the electricity generated by the solar array.

Time-of-Use or Time of Day Rates: Is a utility billing system in which the price of electricity depends upon the hour of day at which it is used. Rates are higher during the afternoon when electric demand is at its peak. Rates are lower during the night when electric demand is off peak.

Voltage: Voltage is pressure measured in volts (V). Different electrical devices require higher voltage depending on how much electrical power is needed to operate. For example, small appliances and light bulbs operate on 110 Volts while an electric dryer will require 220 Volts and a larger motor will require 440 Volts. Electricity generated from the solar array is converted by an inverter to 110 volts, compatible with residential electrical needs.

Zoning Ordinance: A document adopted by a local government that establishes local land use regulations, found in the Michigan Zoning Enabling Act (P.A. 110 of 2006).

Appendix II
Renewable Energy Policy Framework

'Policies and Regulatory Commissions that Govern the Deployment of Solar'

The purpose of this Appendix is to provide a general overview of the key State, Federal, and Regulatory Commission policies that guide or oversee renewable energy in Michigan.

Michigan Renewable Energy Policy

Michigan Public Act 295

In 2008, the Michigan Legislature passed Public Act 295 whose purpose is to promote the development of renewable energy, and energy optimization through the implementation of cost effective, clean, renewable, and efficiently used energy. Public Act 295 established a Renewable Portfolio Standard (RPS) that required the regulated utilities in Michigan to ramp up their generation or purchase of renewable energy in order to obtain 10% of their electricity generation from renewable resources by 2015.[108]

In 2016, the Michigan Legislature enacted Public Acts 341 and 342 that increased the Renewable Portfolio Standard (RPS) from 10% to 15% that had to be achieved by 2021, changed the Net Metering Program (that had been enacted as part of Public Act 295) to the Distributed Generation Program, and established a new policy that the regulated utilities had to develop and submit Integrated Resource Plans (IRP's) to the Michigan Public Service Commission for approval, on how the utility would generate energy in the future, including renewable energy.

Michigan Clean Energy Future Plan 2023 - see page 16 for summary.

Renewable Portfolio Standard

A Renewable Portfolio Standard (RPS) is a policy mechanism that mandates electric utilities to supply a specified amount of power from renewable or alternative sources by a certain target date.[109] Michigan set the RPS in 2008 at 10% and expanded it to 15% in 2016 to be achieved by 2021.

Michigan's *Healthy Climate Plan* calls for Michigan to adopt a renewable energy standard of 50% by 2030, either through legislation or formal commitments in proceedings before the Michigan Public Service Commission. The 2023 enactment of Public Act 235 increased the RPS from 15% to 50% and the utilities must meet this new standard by 2030 and then to 60% by 2035 and each year thereafter.

108 MCL 460.1001
109 http://www.seia.org/policy/renewable-energy-deployment/renewable-energy-standards

Net Metering

Net Metering is a policy that encourages the growth of small-scale solar on residential homes and businesses by requiring the utilities to compensate homeowners for the extra solar electricity they can't use immediately and send back to the grid to be reused by the utilities. Net metering allows solar owners to bank this excess electric generation on the grid, in the form of kilowatt-hour (kWh) credits during a billing period.

In 2009, Michigan's Net Metering program began with the enactment of Public Act 295.[110] The Michigan Public Service Commission established the rules for this Program. The compensation rate for the solar electricity that was exported back to the grid was set at the retail rate that utilities charged residential customers.

Distributed Generation Program

As a result of the enactment of Public Act 341 and 342 in 2016, the Michigan Public Service Commission (MPSC) was required to phase out the Net Metering Program and create the new Distributed Generation program for solar owners. The MPSC adopted a Distributed Generation tariff based upon the Inflow/Outflow billing mechanism. The 'Inflow' is the electricity the customer purchases from the utility. The 'Outflow' is the electricity generated by the customer's solar system that is not used immediately on-site and is instead exported back to the electric grid. This mechanism measures the solar owners' incoming and outgoing electricity flows separately. Solar owners are compensated for the extra electricity they send back to the grid at approximately 50% of the utility retail rate.

Public Act 235, passed in 2023, increased the distributive generation cap from 1% to 10% of a utility's average in-state peak load for the proceeding five calendar years. The 10% Cap is allocated with 50% of the Cap for customers with a solar system generating 20 kilowatts or less and 50% for customers generating more than 20 kilowatts but not more than 550 kilowatts. A customer can also install a solar energy system with a generation capacity of 110% of the customer's electricity consumption for the previous 12 months.

Integrated Resource Plan

In 2016, the updated Michigan Energy Law initiated long-term energy planning by requiring utilities like Consumers Energy and DTE to develop Integrated Resource Plans (IRP). These plans provide a blueprint on how the utilities plan on generating reliable, affordable and clean electric service to its customers[111] over the next 5, 10 and 15 years. These plans must be submitted to the Michigan Public Service Commission to be reviewed and either approved or denied.[112]

Public Act 231, enacted in 2023, expands the Michigan Public Service Commission's authority to evaluate Integrated Resource Plans that are submitted by the utilities. The Commission can now take into consideration new factors, including the impact on green-house gas emissions, environmental justice concerns, impact on human health and the affordability of energy. Integrated Resource Plans must now promote environmental quality and public health and reasonably mitigate adverse effects on human health due to power generation, with a priority on mitigating impacts and prioritizing benefits to communities disproportionately impacted by pollution and other environmental harms.

110 Michigan Public Service Commission "Net Metering Program". Michigan Public Service Commission. Retrieved January 31, 2017

111 For example, see: (a) DTE Electric Company's Integrated Resource Plan (U-20471) - https://www.cubofmichigan.org/dte_electric_company_s_irp, and, (b) Consumer Energy Clean Energy Plan - https://www.consumersenergy.com/-/media/CE/Documents/company/IRP-2021.ashx.

112 https://www.nrdc.org/experts/ariana-gonzalez/michigan-integrated-resource-plan-primer

Michigan Healthy Climate Plan

Established by Governor Whitmer in 2022, the *Michigan Healthy Climate Plan* strives to reduce green-house gas emissions (GHG) from 2005 levels by 28% in 2025, 52% by 2030, achieve carbon neutrality by 2050, and maintain net negative GHG emissions thereafter. Meeting the 2050 goal will require a switch to 100% clean, renewable electricity paired with robust energy storage and reducing other sources of green-house gas emissions.

The energy specific parts of the Healthy Climate Plan include the following:

- **Energy Production:** Implement a series of measures towards more holistic and integrated energy system planning in Michigan. This should include rate design, traditional resource planning, long-range transmission planning, distribution planning, storage planning, consideration of new and emerging resources, planning around areas of interdependence between the electric and natural gas systems, and consideration of community and health impacts.
- **Clean Energy Resources:** Adopt a renewable energy standard of 50% by 2030, either through legislation or formal commitments in proceedings before the Michigan Public Service Commission. In addition, Michigan should commit to end its use of coal-fired power electricity production by no later than 2035.
- **State Electricity Use:** State-owned facilities will utilize 100% in-state renewable energy by 2025 and reduce energy intensity in state facilities 40% by 2040. The state will also implement a plan to site solar on state-owned lands and properties to help deploy solar across the state as quickly as possible. The state will complement this work by assisting local units of government in adopting best practices for siting renewable energy systems within their communities.

As a result of the 2023 Michigan Clean Energy Future Plan laws, the Michigan Healthy Climate plan may become achievable for Michigan.

Michigan Public Service Commission

The Michigan Public Service Commission (MPSC) is a regulatory agency which regulates the utilities in Michigan, including electric power, telecommunications and natural gas services. The mission of the MPSC is to "serve the public by ensuring safe, reliable and accessible energy and telecommunications services at reasonable rates."[113]

The MPSC is composed of three members appointed by the Governor with the advice and consent of the State Senate. Commissioners are appointed to serve staggered six-year terms. No more than two Commissioners may represent the same political party. One commissioner is designated as chairman by the Governor.

Federal Renewable Energy Policy

Public Utility Regulatory Policies Act

Public Utility Regulatory Policies Act (PURPA) was enacted in 1978[114] as part of the National Energy Act to encourage competition, conservation, reliability and efficiency in generating and delivering electricity (including renewable energy). One of the ways PURPA was set up to accomplish its goals was by establishing a new class of power generation facilities, known as Qualifying Facilities (QFs). PURPA imposed an obligation on local utilities to purchase power from QFs in an effort to

113 https://www.michigan.gov/mpsc
114 Pub. L. 95–617, 92 Stat. 3117, 11/9/1978)

promote competition and achieve the other policy goals embodied in the federal law. The enactment of PURPA triggered the beginning of renewable energy with the construction of wind turbines and early solar that generated electric power that the utilities had to purchase.

This federal law was set up to be implemented by state public service commissions for rate-regulated electric utilities. Federal rules require state public service commissions to set rates for the utility to buy power from a Qualifying Facility. The MPSC issued its second *Report on the Implementation of the Public Utility Regulatory Policies Act of 1978* on April 20, 2020.[115]

Bipartisan Infrastructure Law

In November 2021, the Biden Administration enacted the Bipartisan Infrastructure Law (BIL).[116] This seeks to modernize America's infrastructure through updates to roads and bridges, and increase clean drinking water through the replacement of lead pipes.[117] It also allocates funds to expand passenger and freight rail, electric vehicle infrastructure, the electric grid and airports.[118]

Through the BIL, the Department of Energy is administering the Grid Resilience and Innovation Partnership Program to make the electrical grid more resilient and flexible.[119] This Program provides billions of dollars in competitive grants for clean energy projects, including solar.[120]

Inflation Reduction Act

The Federal Inflation Reduction Act (IRA) was passed in 2022 to accelerate innovation in clean energy, lower consumer healthcare costs, and increase tax revenues.[121] The IRA provided funding toward climate technologies such as carbon capture and sequestration and clean hydrogen, and allocated money toward environmental justice efforts. The IRA designated just under $400 billion toward clean energy in the form of tax incentives, grants, and loans.[122] The funding is targeted toward clean electricity and transmission, followed by clean transportation.[123]

The IRA also allocates $43 billion toward consumer incentives. Tax credits include: $2,000/year to purchase heat pumps, water heaters, biomass stoves, and boilers and $4,000 for electric vehicles.[124]

For solar, the IRA reinstated the Solar Investment Tax Credit (ITC) which was being phased out prior to the Act.[125] The updated

115 https://www.michigan.gov/mpsc/-/media/Project/Websites/mpsc/regulatory/reports/Legislature-Other/2020_PURPA_Report.pdf?rev=3e4f-8378970848fbabac60fec9f41c5f&hash=134427B8B0BC19F4C09FFF60BD012F88. as required by Section 6v of PA 341 of 2016. This report describes the status of qualifying facilities (QFs) in the state, the current status of power purchase agreements (PPAs) for each QF, and the Commission's efforts to comply with the requirements of PURPA.

116 Badlam, Justin, Tony D'Emidio, Rob Dunn, Adi Kumar, and Sara O'Rourke. "The US Bipartisan Infrastructure Law: Breaking It down | McKinsey." McKinsey and Company, November 12, 2021. https://www.mckinsey.com/industries/public-sector/our-insights/the-us-bipartisan-infrastructure-law-breaking-it-down.

117 *Id.*

118 *Id.*

119 "The Bipartisan Infrastructure Law | Enel North America." Accessed June 23, 2023. https://www.enelnorthamerica.com/the-bipartisan-infrastructure-law.

120 Energy.gov. "Grid Resilience and Innovation Partnerships (GRIP) Program." Accessed June 23, 2023. https://www.energy.gov/gdo/grid-resilience-and-innovation-partnerships-grip-program.

121 Badlam, Justin, Jared Cox, Adi Kumar, Nehal Mehta, Sara O'Rourke, and Julia Silvis. "What's in the Inflation Reduction Act (IRA) of 2022 | McKinsey." McKinsey & Company, October 2022. https://www.mckinsey.com/industries/public-and-social-sector/our-insights/the-inflation-reduction-act-heres-whats-in-it.

122 *Id.*

123 *Id.*

124 *Id.*

125 Pivot Energy. "The IRA's Impact on Solar Incentives: What You Need To Know." *Pivot Energy* (blog). Accessed June 6, 2023. https://www.pivotener-

ITC gives homeowners that install solar panels between January 1, 2022 to the end of 2032 a 30% tax credit of the cost of their renewable energy that can reduce their federal income taxes by that same amount.[126] The tax credit can be paired with other incentives, increasing the amount of tax credits that will reduce the cost of the energy system. For example, if a solar or wind facility is located in a low-income community, an additional 10-20% tax credit can be claimed.[127]

The IRA tax credits are more complex for larger utility-scale projects than residential projects, so the amount of tax credits available may be more complex than a straight 30% rate.[128]

Furthermore, the Inflation Reduction Act developed a credit system for organizations that are exempt from federal taxes, including non-profit organizations, places of worship, and Native American Tribal Governments. This credit system is called a 'direct pay' option, and it allows these entities to receive payment for installing renewable energy systems in lieu of tax credits. [129]

The Inflation Reduction Act also created a new Production Tax Credit (PTC) for domestic solar manufacturers.[130] Eligible solar components include "thin film photovoltaic cell or crystalline photovoltaic cells, photovoltaic wafers, solar grade polysilicon, polymeric backsheet, and solar modules," and the credit amount is determined per watt. [131]

Federal Energy Regulatory Commission

The Federal Energy Regulatory Commission (FERC) is a United States agency that regulates the transmission and wholesale sale of electricity and natural gas in interstate commerce. FERC is an independent federal agency even though it is part of the United States Department of Energy. FERC is composed of five commissioners who are nominated by the President and confirmed by the United States Senate. There may be no more than three commissioners of one political party serving on the commission at any given time.

Electrification Transformation

In addition to the State and Federal regulatory policy framework, there are two broad trends that are driving the transition to renewable energy: Electrification Transformation and the Competitiveness of Solar Energy.

Electrification is defined as "the substitution of electricity for the use of non-electricity-based fuels (e.g. gasoline and natural gas) used to provide similar services." The National Renewable Energy Laboratory study, *Electrification Futures Study: Scenarios of Electric Technology Adoption and Power Consumption for the United States*, found that, "electrification has the potential to significantly increase overall demand for electricity," but this increased use of electricity must be generated by renewable energy sources.[132] [133]

Another key development is the electrification of the automobile sector. The logic behind

gy.net/blog/the-iras-impact-on-solar-incentives.

126 Dech, Zachary. "IRA Updates to the Solar Investment Tax Credit (ITC)." UC News, January 18, 2023. https://www.uc.edu/news/articles/2023/01/gc-ira-updates-to-the-solar-investment-tax-credit-itc.html.

127 https://home.treasury.gov/news/press-releases/jy1830

128 https://www.seia.org/sites/default/files/Inflation%20Reduction%20Act%20Summary%20PDF.pdf

129 *Id.*

130 *Id.*

131 *Id.* at 5

132 National Renewable Energy Laboratory (NREL), *Electrification Futures Study: Scenarios of Electric Technology Adoption and Power Consumption for the United States* - https://www.nrel.gov/docs/fy18osti/71500.pdf

133 See: NREL, DOE for the most up-to-date info on EVs, EV charging by solar, carbon reductions, long-term costs/paybacks: (1) https://www.ren21.net/oil-and-gas-companies-renewable-energy-transition/; and (2)https://drawdown.org/sites/default/files/pdfs/Drawdown_Graphic_Framework01.pdf

electrification is that as utility generated electricity becomes cleaner through the transition from fossil fuel power plants to electricity generated by wind and solar, the expanded use of that electricity can reduce carbon emissions associated with diesel or gasoline powered cars and trucks, and buildings heated by natural gas.

The Competitiveness of Solar Energy

Globally, solar energy has grown at about 30% per year over the past 15 years. According to the 2002 Department of Energy's Quarterly Solar Industry Update, solar represented approximately 46% of all new U.S. electric generation capacity, compared to 4% in 2010.[134]

The solar industry has been creating jobs 10 times faster than the economy as a whole. Now employing 200,000 workers, the solar sector is bigger than the coal sector and accounts for more jobs than oil and gas extraction combined. According to Mark Jacobson and Mark Delucchi, in their work titled, *A Path to Sustainable Energy by 2030,* Global Energy Demand by 2030 will reach 11.5 trillion Watts (TW).[135] The authors cite estimates that 40% of this amount can be supplied by solar.[136]

Because most energy delivered to buildings comes from regulated investor-owned utilities, governments continue to play a critical regulatory role in the ability of individuals to purchase and use solar electricity for their homes or office buildings. Public utilities in Michigan have shown a strong reluctance to open their territories to non-utility owned electric generation, opposing attempts to enable privately owned distributed generation, community solar and micro-grids.

Local and State Government policies relating to building codes, zoning rules, permitting processes, local property taxes, distributed solar public policy and financial incentives all impact the installed cost of solar energy for individuals and businesses. Efforts to lower the installed cost of solar, including local Solarize Group-Buy programs and Community Solar, are critically important to the future of solar energy deployment and carbon reduction in Michigan.

134 https://www.energy.gov/eere/solar/quarterly-solar-industry-update

135 Mark Jacobson & Mark Delucchi, A *Path to Sustainable Energy by 2030*, in Scientific American, November, 2009)

136 1.7 Billion Rooftop PV Systems (sized for a moderate house or commercial roof; 49,000 Concentrated Solar Power Plants (300 MW); and, 40,000 PV Power Plants (300 MW).

Appendix III
Supporting Michigan Business

Most people would agree that supporting Michigan businesses when purchasing and installing renewable energy makes sense for creating jobs and supporting economic development in this State. This can be done with the use of preferences, incentives and sometimes requirements. The standard procurement process uses the standard low bid criteria to award project contracts, but it is also possible for local units of government to create a selection process that uses multiple factors when awarding a contract, including contractor qualifications and experience, project cost and 'buy local' criteria.

For example, a selection process could award points as follows:

Project Cost	40%
Contractor Qualifications	30%
Buy Local Criteria	30%

A Buy Local criteria could also provide a number of selection points if:

- The contractor is physically located in Michigan.
- The contractor uses Michigan labor.
- The contractor will provide equipment made in Michigan.
- The contractor uses a standardized method for calculating the cost of energy per watt of renewable energy installed.
- The contractor sells low-embodied carbon solar modules or other renewable energy products and balance of system components.

The Made in Michigan program and the 2022 Inflation Reduction Act contain domestic content requirements and incentives for renewable energy products. These programs use a 'proportional basis' or 'minimum threshold' to determine eligibility. For example, the dollar value of Michigan components as a percentage of total system costs could be used on a proportional basis or 'Michigan Made' could be defined as 50% or more of total cost coming from Michigan components.

Using Buy Local criteria in the purchasing process has the advantage of favoring local businesses, while not excluding other non-local bidders that may have quality or price advantages. The appropriate weight to give to Buy Local criteria could vary depending on project sponsor preferences or policies. *The Solar and Wind Energy Supply Chain in Michigan* study by the Environmental Law & Policy Center in December 2019 found 249 Michigan businesses in the solar industry and Buy Local criteria in purchasing provides an excellent opportunity to support the growth of Michigan companies.[137]

The Great Lakes Renewable Energy Association (GLREA) has a business directory that can assist purchasers in identifying solar products and solar installers. Approximately half of the GLREA business member's sell, install or distribute solar products or provide consulting services to assist businesses or institutions interested in buying renewable energy systems. Renewable energy products sold and installed in Michigan by GLREA members include solar panels, inverters, racks and tracking systems, and

137 https://elpc.org/resources/michigan-clean-energy-supply-chain-report/

wind energy systems and towers. The business directory can be found at www.glrea.org.

Beyond Michigan Renewable Energy Credit incentives, State Government financial incentives for Michigan solar projects do not exist at the time of this publication. Content requirements by State and Local government agencies may run up against the Commerce Clause of the U.S. Constitution or International Trade Agreements. The addition of Buy Local criteria in addition to the other criteria could be used by Local Government to favor Michigan businesses while providing some flexibility in the selection process for public funded solar projects and for Community Solar projects that involve a mix of public and private dollars. Community Solar projects can dramatically expand the market for solar in Michigan, helping the industry to grow and prosper.

There are domestic content concerns where renewable energy products are manufactured. Buy Michigan Preferences provide preferential treatment for Michigan labor or equipment components made in Michigan as a form of domestic content. Michigan is a world-class durable goods manufacturing center which includes a significant and growing innovative and entrepreneurial solar industry.

Buy Local Preferences - Existing Buy Michigan Preference

Some Buy Michigan Preferences are already in place in Michigan for the purchase and installation of renewable energy systems. Michigan Public Act 295 from 2008 only allows utilities operating in Michigan to use renewable energy certificates from renewable energy systems located within this State or outside of the State in the service territory of a Michigan utility, to meet the mandated Renewable Portfolio Standard (RPS) of 10% renewables by 2015 and 15% by 2021. While some parts of service territories are in other states, most are in Michigan and other out-of-state renewables cannot be counted toward the Michigan RPS requirement.

Public Act 295 also provides a Renewable Energy Certificate (REC) incentive for Michigan-made equipment and Michigan labor. If a renewable energy system is constructed using Michigan labor, a 1/10th incentive credit for Michigan Labor is granted for the first three years. Renewable energy that is generated from a system that was constructed using Michigan-made equipment qualifies for Michigan incentive renewable energy credits equal to 1/10th REC per MWh for the first three years (subject to a calculation that takes into account all components of the renewable energy system).

There are other programs that can assist renewable energy developers to support local business. The Pure Michigan Business Connect (PMBC) program is a public-private initiative developed by the Michigan Economic Development Corporation that helps Michigan companies identify local suppliers. The PMBC system provides posting of procurement opportunities, collaboration needs, and unique offers available to Michigan businesses. Companies in the system can be both buyers and sellers. DTE Energy and Consumers Energy have made major commitments to increase their purchases of Michigan products and services. More specifics on this program can be found at: http://www.michiganadvantage.org/Business-Connect/

Appendix IV

Community Solar Resources

Catalyzing Community Solar: A Handbook for Municipalities. Donna Attanasio, John Forrer, Amit Ronen, and Scott Sklar. (2017). Washington, DC: The George Washington University, GW Sustainability Collaborative. https://www.ourenergypolicy.org/resources/catalyzing-community-solar-a-handbook-for-municipalities/

Cherryland Electric Cooperative. *Active Community Solar Program*. https://cherrylandelectric.coop/renewable-energy-programs/

Clean Energy States Alliance. *Consumer Protection for Community Solar: A Guide for States.* https://www.cesa.org/resource-library/resource/consumer-protection-for-community-solar-a-guide-for-states/ and the *National Database of Community and Renewable Energy Organizations*. https://www.cesa.org/resource-library/resource/national-database-of-community-and-renewable-energy-organizations/

Community Power Network. *Aggregated Buying*. This provides examples for community scale projects across the United States. The site includes a wiki to learn and share from other projects. http://communitypowernetwork.com.

Community Solar Gardens Institute. Helping organize communities to pool their resources and go solar. http://www.solargardens.org.

Database of State Incentives for Renewables and Efficiency (DSIRE). Is a comprehensive source of information on state, local, utility, and federal incentives that promote renewable energy and energy efficiency https://www.dsireusa.org/

Great Lakes Renewable Energy Association (GLREA). Provides research, publication, education on Community Solar in Michigan. www.GLREA.org.

GLREA Business Directory. https://www.2glrea.org/business-directory

Coalition for Community Solar Access. http://www.communitysolaraccess.org/

Community Solar Value Project. https://www.communitysolarvalueproject.com/

Interstate Renewable Energy Council.

- *"Model Rules for Shared Renewable Energy Programs"* provides guiding principles important when designing Community Solar projects. It can be downloaded from: https://irecusa.org/resources/model-rules-for-shared-renewable-energy-programs/
- *A Checklist for Voluntary Utility-Led Community Solar Programs*. 2018

  https://irecusa.org/resources/checklist-for-voluntary-utility-led-community-solar-programs/
- *Shared Renewable Energy for Low-to Moderate-Income Consumers: Policy Guidelines and Model Provisions*. https://irecusa.org/resources/shared-renewable-energy-for-low-to-moderate-income-consumers-policy-guidelines-and-model-provisions/

Institute for Local Self-Reliance. Working towards the democratization of the electric grid, a network of independently-owned and widely dispersed renewable energy generators, dispersing economic benefits as broadly as electricity generation. http://www.ilsr.org/initiatives/energy/.

Interfaith Power and Light. Works with faith-based communities on energy conservation and renewable energy. Published *Solar Resource Guide – An Overview for Congregations* providing general info about solar, costs and financing, and several testimonials about congregations in California who have gone solar. https://www.interfaithpower.org/resources/solar-resource-guide/

Michigan Environment Great Lakes Energy (EGLE). Readying Michigan to Make Good Energy Decisions – Renewable Energy - http://www.michigan.gov/energy.

Solar Energy Industries Association. Community Solar. https://www.seia.org/initiatives/community-solar

Traverse City Light and Power. Active Community Solar Program. https://www.tclp.org/renewable-energy/

U.S. Department of Energy.

- **Energy Efficiency and Renewable Energy.** Clearinghouse page for all DOE solar resources and programs. www.eere.energy.gov/topics/solar.html.
- **Energy Efficiency and Renewable Energy. *'Solar America Communities'*** Learn from the efforts of the DOE's 25 designated Solar America Cities. https://www.energy.gov/eere/solar/articles/solar-powering-your-community-guide-local-governments-book-energy-efficiency
- **Energy Saver Guide: Tips on Saving Money and Energy at Home.** https://www.energy.gov/energysaver/energy-saver-guide-tips-saving-money-and-energy-home
- **National Renewable Energy Laboratory (NREL)**. *A Guide to Community Shared Solar.* A comprehensive guide for those who want to develop community solar projects, from community organizers or solar energy advocates to government officials or utility managers. http://www.nrel.gov/docs/fy12osti/54570.pdf
- **National Renewable Energy Laboratory (NREL)**. Community Solar https://www.nrel.gov/state-local-tribal/community-solar.html
- **National Renewable Energy Laboratory (NREL).** Community Solar Analysis Tool- This excel spreadsheet tool was custom designed by NREL for use in analyzing the financing involved in Community Solar projects. The LCOE generated in the SAM model is used in this tool to model various Community Solar configurations. This tool allows analysis for a variety of the following variables: Levelized Cost of Energy, System size, System costs, Project lifetime. Project shares or number of participants, and Value of solar energy generated. Click on the Community Solar Resource Data link to access the database. https://data.nrel.gov/submissions/201
- **National Renewable Energy Laboratory (NREL). The *Open PV Project*.** Interactive database providing real-time statistics on the status of solar energy in the U.S. https://www.nrel.gov/docs/fy12osti/52971.pdf

- **National Renewable Energy Laboratory (NREL).** *Systems Analysis Model (SAM),* a tool created at NREL to analyze the financial properties of renewable energy system investment over the lifetime of the system. The most important output used from this SAM modeling software is the "Levelized Cost of Energy" (LCOE). LCOE is the price at which electricity must be generated to break even over the lifetime of the project. It is an economic assessment of the cost of the energy-generating system, including all the costs over its lifetime including: initial investment, operations and maintenance, cost of fuel and cost of capital. GLREA worked with NREL and MPSC staff to utilize the Systems Analysis Model to compute the LCOE for many of the models analyzed. https://sam.nrel.gov/
- **National Renewable Energy Laboratory (NREL).** *PVWatts™* calculator determines the energy production and cost savings of grid-connected photovoltaic (PV) energy systems throughout the world. It allows homeowners, installers, manufacturers, and researchers to easily develop estimates of the performance of hypothetical PV installations. http://www.nrel.gov/rredc/pvwatts/.
- **National Renewable Energy Laboratory (NREL)**. *Shared Solar, Current Landscape, Market Potential, and the Impact of Federal Securities Regulation.* https://www.nrel.gov/docs/fy15osti/63892.pdf
- **National Renewable Energy Laboratory (NREL)**. *Focusing the Sun: State Considerations for Designing Community Solar Policy*. https://www.nrel.gov/docs/fy18osti/70663.pdf
- **National Renewable Energy Laboratory (NREL)**. *Design and Implementation of Community Solar Programs for Low-and Moderate-Income Customers*. https://www.nrel.gov/docs/fy19osti/71652.pdf
- ***Solar America Board for Codes and Standards.*** Provides technical information on best-practice code requirements for solar energy systems. www.solarabcs.org/
- **Solar Energy Technologies Office**. *Community and Shared Solar.* https://www.energy.gov/eere/solar/community-and-shared-solar.
- **Solar Research.** Information on NREL programs focusing on photovoltaics and solar heating systems. www.nrel.gov/solar/.
- **SunShot Initiative.** DOE's SunShot Initiative focuses on making large-scale solar energy systems cost-competitive without subsidies by the end of the decade. www1.eere.energy.gov/solar/sunshot/.
- **Wood Mackenzie and GTM Research**. (2018). *The Vision for U.S. Community Solar: A Roadmap to 2030 and Beyond, Report for Vote Solar*. https://tinyurl.com/2s6kkk2r

Thank you for reading!