FINAL TECHNICAL REPORT

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Disclaimer

Executive Summary

Grid-tied solar photovoltaic (PV) development began gradually in Montana, initially taking root in the early 2000s, largely in the form of small residential systems, rarely larger than two kilowatts. Utility support for solar technology through public benefit funding triggered the installation of the state's first solar PV installations on community-owned facilities including schools, libraries, fire stations and local government buildings in the mid-2000s. By 2016, solar PV installations totaled approximately 28 megawatts of installed capacity, generating less than 0.05% of electricity sold in Montana. Montana's solar fleet in 2016 included 17 megawatts of utility-scale solar farms, and three shared solar projects developed by rural electric cooperatives that ranged from 25 to 50 kilowatts in size. However, with only 3,000 households utilizing solar PV, either through an on-site installation or participation in a shared solar project, the potential benefits and reach of solar technology was limited.

The Montana Solar Community Project (MSCP) was developed by the Montana Energy Office (MEO) at the Department of Environmental Quality in order to implement a "community-scale" solar energy strategy for the state that would cost-effectively expand Montanans' access to solar PV. This project defines three types of community-scale solar projects: shared solar, community-sited solar, and group purchasing programs. The MSCP project conducted research and stakeholder engagement that helped to inform and develop model community-scale initiatives and an overarching community-scale solar strategy for Montana.

Specifically, the project included a solar market assessment, stakeholder meetings across Montana, development of a menu of community-scale solar options, a study of solar potential on schools, community solar market research, and community-scale project implementation support. MSCP activities were successful in implementing solar projects and supporting solar development in communities across Montana. Project activities realized 280 kW of newly installed solar from two solarize programs, a shared solar array at a rural electric cooperative, and a solar array atop a Bozeman high school. The community-scale project implementation support and Solar on Schools components of the project resulted directly in the analysis and design of nearly 2 MW of distributed solar systems across the state. The Solar on Schools analysis alone produced solar designs for 25 schools, representing 920.8 kW of solar potential.

Many of the deliverables from this project provide guidance on future development of community-scale solar in Montana, and resulted in a number of important conclusions about community-scale solar in Montana. There is strong interest in community-scale solar in Montana, as noted during stakeholder meetings, in response to solar market research surveys, and as seen by applications for implementation support grants provided by MEO. Project activities also suggest that Montanans demonstrated a desire and need for more information about solar energy technology, solar financing options, and the state's policy and regulatory framework. Additionally, the project found that

schools will be key partners for future community-scale solar programs. In addition to being excellent hosts for solar arrays, schools have the opportunity to use the installation of a solar array to develop educational materials and curricula to educate Montana's future leaders about these technologies, which can be shared and replicated across the state.

Project activities laid a clear path forward for solar energy in Montana. Certain activities have concrete next steps. For example, numerous solar arrays were designed for schools and other public buildings around the state. Many of those designs will be used as soon as funding becomes available. Other activities have less developed next steps, though lay the foundation for future work. The solar market assessment, solar market research, and community stakeholder meetings are good examples. These documents can be used as stepping stones to increase renewable energy education, increase stakeholder outreach, and support communities as they seek to develop community-scale solar projects.

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1. Background

A. Montana's Solar Landscape

To date, most solar development in Montana has been a combination of rooftop and ground-mounted distributed generation systems, generally not exceeding 50 kW in generating capacity. Solar has been installed in Montana for decades, but development began to pick up speed after the Montana Legislature passed net metering legislation in 1999. Since then, growth in both the number of systems and the number of businesses in the market has significantly increased. By 2016, approximately 11 MW of solar generating systems had been installed on homes, small businesses and community facilities. Still, Montana remains an emerging market, with less than 300 solar jobs in the state spread across 42 solar companies[1]. According to the Solar Foundation[2], the state ranks 49th in solar jobs nationally, and 47th in solar jobs per capita.

In 2016, Montana saw the arrival of utility-scale solar. Montana is home to six utility-scale solar projects that are 2 MW or 3 MW in size, totaling 17 MWs. These projects were developed as qualifying facilities (QFs)[3] under the Public Utilities Regulatory Policies Act. In this single year, Montana tripled the amount of solar capacity installed in the state. Still, QF development has been contentious. Developers of qualifying facilities and utilities are in long-standing disputes over the proper contract terms and contract lengths for QF projects. The Montana Public Service Commission (MPSC) has been more involved in these decisions, as QF developers seek arbitration when they are unable to reach an agreement with the utility on contract terms and rates. This litigative atmosphere, along with multiple attempts by the Montana Legislature to set QF terms through legislation, have created uncertainty and hesitation in the market.

"Community-scale" solar development in Montana prior to this project was limited. For the purposes of this project, "community-scale" solar development was defined to include: 1) shared solar projects, in which multiple utility customers purchase or subscribe to a portion of the output from a large solar array; and 2) community-sited solar, including solar projects located on community-owned facilities such as schools and local government buildings; and group purchasing programs, also known as "solarize" programs, in which a community organization coordinates residential solar installations through pre-selected installer(s) at an agreed-upon price. Libraries and schools have been the primary hosts for community-scale distributed solar projects. A single "solarize" campaign was organized in Missoula prior to the project. In addition, rural electric cooperatives in the state had begun installing shared solar arrays prior to the projects. By the end of 2017, four different cooperatives developed shared solar

[1] The Solar Foundation, 2018 Montana Solar Jobs Census. https://www.thesolarfoundation.org/solar-jobs-census/factsheet-2018-MT/
[2] Id.
[3] https://www.ferc.gov/industries/electric/gen-info/qual-fac/what-is.asp

offerings for their members, totaling 351 kW, but no shared solar projects had been developed by investor-owned utilities.

B. Challenges and Barriers

Montana experiences a number of challenges and barriers affecting solar development in the state. The primary barriers that this project addressed were a lack of awareness by Montanans about solar energy technology and options for developing and financing community-scale solar energy in the state. In addition, certain state statutes and regulations, as well as the low cost of energy, create challenges that this project did not address.

At the outset of this project, examples of all three of the community-scale solar projects that this project aimed to expand (shared solar, community-sited projects, and group purchasing programs), had been developed in the state, but to a limited extent. There were three shared solar projects, but all were in the western part of the state in territory served by rural electric cooperatives. A single solarize campaign had been conducted in Missoula. Community-sited solar installations were more widely dispersed across the state, but the concentration of solar installation businesses in three of Montana's larger towns (Bozeman, Missoula, and Helena) focused solar development in those areas. Furthermore, as a large state with a dispersed population, community-scale solar strategies were not well known or understood outside of the communities that had made those investments.

Financing options for community-scale solar systems in Montana are also limited. Montana statute offers several tax credits, of which the most commonly used is an individual credit of $500 (up to $1,000 per household) available for installing an alternative energy system. Montanans can also claim the Federal Investment Tax Credit, which began a multi-year step down at the end of 2019. Public entities like libraries, schools, and government agencies, which have different tax liabilities, cannot take advantage of tax incentives and are left with few options for project financing. To date, third-party financing of solar and renewable energy projects has not been utilized in Montana, in part due to lack of regulatory clarity.

Certain Montana policies and regulations limit community-scale solar in the state. For example, the state's net metering law has been interpreted to restrict investor-owned utilities from developing shared solar arrays, because a net metered system is defined to be "located on the customer-generator's premises…"[4] When a shared solar array is not located on the customer's premises, an offsite subscriber is unable to participate in a shared solar program. Electric rural cooperatives are not subject to these sections of the statute and have developed and offered shared solar arrays for their members. In addition, net metering is restricted by statute to 50 kW[5] systems for NorthWestern

[5] Mont. Code Ann. § 69-8-103(19)

Energy (NWE) customers. For Montana's other investor-owned utility (Montana Dakota Utilities, MDU), the 50 kW standard is in place through a MPSC approved tariff. Electric cooperatives in the state, whose net metering policies are not governed by statute, voluntarily offer programs. Their net metering caps range from 10 kW to 50 kW, depending on the cooperative.

Finally, the low cost of energy makes the economics of solar more challenging than in many other markets. Montana's average cost of electricity is approximately $0.09/kWh, which ranks 38th in the nation[6]. Payback times for most residential systems are approximately 10-15 years under current rate design and federal tax incentives. Montana's investor-owned utilities must offer retail-rate net metering, and most cooperatives do. However, several cooperatives have lowered the value of the credits they are providing for energy sent back to the grid.

C. Opportunities and Recent Developments

Despite the challenges and barriers that Montana faces, the state has excellent solar resources. A 2016 study conducted by the National Renewable Energy Laboratory suggests that rooftop solar alone could provide 28% of Montana's electricity needs[7]. Further, Montanans have demonstrated that they have a willingness and eagerness to participate in community-scale solar programs. One example is the Solarize Missoula program. Conducted over the winter of 2015 and through the summer of 2016, this program was the first of its kind in Montana. The program brought 300 community members to two different educational workshops and resulted in 150 site assessments and 45 new systems in the Missoula Community.

There are two other recent developments that affect community-scale solar development. First, the MPSC's 2018 update to its interconnection processes and procedures adjusts the rating used to determine interconnection eligibility from DC to AC. This allows for slightly larger community-scale projects. The second development is an approved settlement among parties intervening in NorthWestern Energy's recent rate case docket on a review of NWE's E+Green program. The stipulating parties, including NWE and the Montana Department of Environmental Quality (DEQ), agreed to review NWE's current green tariff programs and offerings.

Financing is a key factor to any solar installation. The falling cost of solar has not escaped Montana's market. The cost of solar has dropped more than 70% over the past ten years[8] and is driving increased investment in solar. Further, several funding options are available in Montana. While community-scale solar projects typically cannot take

[6] Energy Information Administration. https://www.eia.gov/electricity/state/montana/
[7] Gagnon et al. "Rooftop Solar Photovoltaic Technical Potential in the United States: A Detailed Assessment." National Renewable Energy Laboratory. 2016. https://www.nrel.gov/docs/fy16osti/65298.pdf
[8] Solar Energy Industries Association. https://www.seia.org/solar-industry-research-data

advantage of tax incentives as discussed above, grants and low-interest loans are available on a limited basis. Montana's Universal Systems Benefits (USB) program is one such program. Utilities in the state administer their own programs, with some self-directing funds and others using an oversight committee to make suggestions. USB funds have been a common source of funding to date for public entities in Montana, such as schools and libraries, however applications for USB grants regularly exceed available funds. Grants are also available from the Bonneville Environmental Foundation (BEF). However, these grants are only available to customers of the Bonneville Power Administration (BPA) and thus are practically available only to entities served by rural electric cooperatives in western Montana. Lastly, Montana DEQ administers the state's Alternative Energy Revolving Loan Program, which offers low interest loans for renewable energy projects across the state.

Montana has experienced a steady increase in solar development over the past two decades. This development provides successful examples and case studies of programs and projects that can be replicated across the state. Still, further education and support for project development is needed to help overcome the barriers and challenges solar faces.

2. Introduction

The overall goal of the Montana Community-Scale Solar Strategy Project (shortened to Montana Solar Community Project, MSCP) is to develop a community-scale solar energy strategy for the state that will cost-effectively expand Montanans' access to solar PV. The Montana Energy Office (MEO) at the DEQ split project activities across two budget periods. Activities for the first period included conducting stakeholder engagement in order to form a strong partnership with other interested parties in Montana to learn from recent progress in developing community-scale solar projects. These engagements helped inform and develop model community-scale initiatives and an overarching community-scale solar strategy for Montana. The objective for the second period was to market the model initiatives developed in Period 1 across Montana in a manner that will meet both the needs of interested consumers and communities and their electric utility or cooperative. The tasks associated with MSCP are shown in the table below, along with the anticipated execution timeline.

Table 1 – Summary of Project Tasks and Key Milestones

Task #	Task or Subtask (if applicable) Title	Milestone Description (Go/No-Go Decision Criteria)	Anticipated Date (Months from Start of the Project)	Anticipated Quarter (Quarters from Start of the Project)
1	Solar Market Assessment	Final report from contractor	7	3

2	Solar Strategy Stakeholder Involvement	Conduct stakeholder meetings in 8 Montana communities to present market assessment findings and receive community feedback on how initiatives can be shaped to meet their needs	8-12	4
2	Solar Strategy Stakeholder Involvement	Final report from first series of meetings, incorporating comments from draft review	13	5
3	Solarize Montana Pilot Projects	Solarize tasks moved to Task 9		
4	Community-Scale Solar Development Menu of Options	Finalize Community-Scale Solar Development Menu of Options Report, provide to all stakeholders, and make available to the general public through MTSEP website	15	5
5	Community Solar Website Development	Deploy first community-scale solar website for the state of Montana from Energize Montana domain and track unique visitors the website on a quarterly basis	12	4
5	Community Solar Website Development	Update website with final Budget Period 1 reports and other relevant information	15	5
GO/NO-GO DECISION POINT: Identify at least 10 Montana communities and relevant community stakeholders willing to commit to pursuing a community-scale solar project in their community, including agreeing to hold a community planning meeting, as part of Budget Period 2 implementation initiative			15	5
6	Solar Summit	Hold Summit to market community-scale solar opportunities in order to kick start local community-scale solar development efforts and connect community stakeholders with technical and project development resources	18	6
7	Community-Scale Solar Market Research	Complete summary report of market research findings and provide to Montana electricity providers	35	12
8	Community Solar Website Updating	Final web update to make available overall program impact report	36	12
9	Community Project Development	Contract with individual communities to provide $60,000-80,000 in matching dollars to assist with project design or identify project deployment requirements	19-35	11-12

9	Community Project Development	Collect status and final reports from each community project to determine the overall success of each project, lessons learned, and future development goals and next steps	30-35	10-12
10	Solar on Schools Assessment	Complete assessment reports and make available to participating schools and school districts	35	12
11	Final program impact report	Complete final project report and provide to team members, stakeholders, Governor's Office, and DOE and make available on the community-scale solar website	36	12

A. Project Team

MEO's application for funding was supported by a team of key stakeholders representing investor-owned utilities that serve Montana customers, rural electric cooperatives engaged with the development of community-scale solar, and the principle solar education and advocacy organization in the state. The team included NorthWestern Energy, Montana-Dakota Utilities, Montana Electric Cooperatives Association, Flathead Electric Cooperative, the National Renewable Energy Laboratory, Missoula Electric Cooperative, and the Montana Renewable Energy Association. MEO provided this group with updates over the course of the project, and directly engaged these organizations on specific tasks. For example, NREL provided solar resource mapping analysis (see Task 5), MEO staff presented to members of the Montana Electric Cooperatives Association at their annual meeting in 2018 and shared information about a funding opportunity through their monthly newsletter; Flathead Electric staff presented at the Summit hosted by MEO (see Task 6); and, MEO engaged NWE and MDU for review of the market study before interviews were conducted (see Task 7). The Montana Renewable Energy Association was hired through competitive solicitations as a contractor for Tasks 2 and 11, and sent notices of stakeholder outreach meetings and funding opportunities to its membership of solar installation businesses and solar supporters state-wide.

3. Project Results and Discussion

The results associated with the eleven different project tasks are discussed below. They are broken out by task. Many include key outcomes and takeaways, although higher level outcomes and impacts are addressed in later sections.

A. Task 1.0: Montana Solar Market Assessment

The objective of the Solar Market Assessment ("Assessment"; available here: http://mtsolarcommunity.mt.gov/Resources) was to assess the current status of solar penetration in Montana communities, including system production data, utility and cooperative load shapes, permitting and social climates, utility grid impacts, installation infrastructure, and other components that encourage or limit substantial increases in

distributed solar capacity. Further, it assessed the potential for solar energy development in various Montana communities. These analyses were compiled into a report evaluating the existing and potential impacts of solar development on the Montana electricity grid overall and its component sub-regions, as well as identifying optimal locations for increased solar energy development. The Montana Energy Office contracted with Clean Power Research and Synapse Energy Economics, Inc. to conduct the research and produce the report. The Assessment was organized into three areas:

- Montana Solar Energy Market Penetration
- Community-Scale Solar Policies
- Montana Community-Scale Solar Developments

Key takeaways and lessons learned from each area are summarized below.

i. Montana Solar Energy Market Penetration

The market penetration portion of the Assessment investigated installed solar capacity, as well as the availability of solar resources in Montana. It models solar production, including a comparison to peak loads for several Montana energy providers. The Assessment finds that Montana has a good solar resource, comparable to other large markets in the country, as seen in Figure 1. Further, the solar resource in Montana does not significantly vary across the state, suggesting potential market development for any part of the state. The Assessment modeled the impact of weather patterns in Montana on solar output across the state. It found that annual solar production does not vary significantly across the state. Figure 1 compares the variation of 10-year average production among representative Montana cities and other cities across the U.S. The Assessment further found that annual variations over the past 10 years are insignificant. The Assessment notes, “This means that producers (whether utility scale or customers) would not see significant variations in revenues from year to year if pricing did not vary on an hourly basis.”[9]

Montana, however, has low solar penetration currently. As of 2015, total installed solar capacity in Montana was approximately 28 MW, representing 0.04% of retail electricity sales and 0.64% of peak load. Among its neighbors, Montana lags behind only Idaho in installed solar capacity, which has nearly 13 times the solar capacity (359 MW) of Montana.

[9] Norris et al. “Montana Solar Market Assessment.” Prepared for Montana DEQ. January 8, 2018.

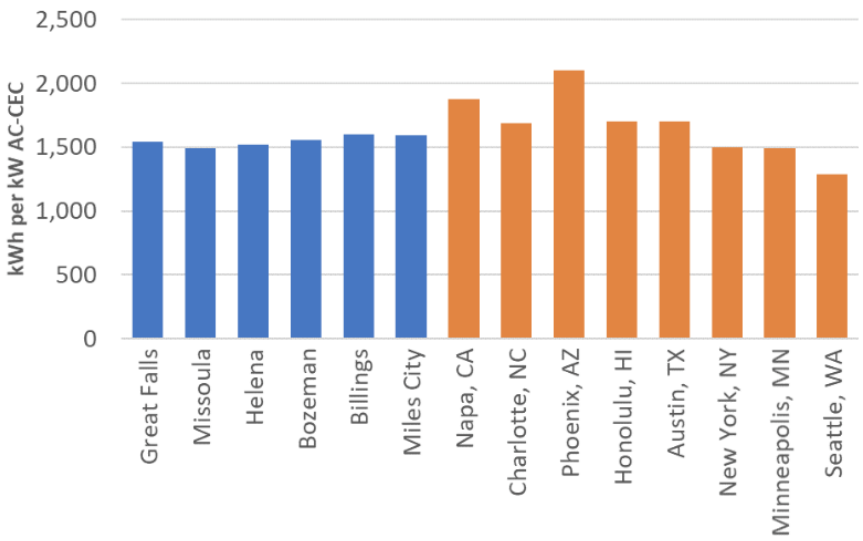


Figure 1 – Variation in 10-year average production among selected U.S. cities

ii. Community Scale Solar Policies

The Assessment looked at Montana state policies that affect community-scale solar development. It notes, "Montana does not have any policies that directly promote community solar, but does have a few policies that help promote solar in general." The policies that it identifies as helping to promote solar include: the universal systems benefits (USB) grant program administered by NorthWestern Energy, state net metering policies, and state tax incentives. The Assessment notes that statute is currently interpreted to restrict virtual net metering by investor-owned utilities, which is a barrier to shared solar development. The state's rural electric cooperatives (Co-ops) are not subject to the same statutes as the investor owned utilities in the state. Most cooperatives offer voluntary net metering policies, and several have developed virtual net metering projects.

The Assessment provides examples of state policies that have affected community solar development in other select states, most of which are in the western United States (Arizona, California, Colorado, Hawaii, Minnesota, New Mexico, Oregon, and Washington), such as specific virtual solar program requirements; expanded net metering programs; tax incentives; and renewable portfolio standards. The Assessment also noted several policies that negatively affect solar development, such as mandatory demand charges for net metering customers.

iii. Montana Community-Scale Solar Developments

The third and final portion of the Assessment provides case studies of four shared solar (e.g., virtual net metering) projects installed by Co-ops in Montana. The Assessment notes that shared solar can provide renters, homeowners with shaded roofs, or those who cannot finance a large array with an ability to "harness the benefits associated with solar panels without needing to install panels onsite at their home." The Assessment discusses case studies of other community-scale solar developments, such as

installations on public buildings like libraries and parking garages. These projects provide community benefits by reducing operating expenses for publicly owned entities and buildings, providing opportunity to reduce tax expenditures and shift them to other public uses. The Assessment points out that public buildings are often excellent candidates for solar installations because they typically have large, flat, and un-shaded roofs. The inability for public entities to take advantage of tax breaks makes financing projects more difficult.

The Assessment summarized common themes found among the case studies that may provide insights into how to support further development of similar projects in the future. Ownership structure provided an important insight. For example, by structuring the shared solar program so that subscribers are owners of the panels, then the customers are able to take advantage of federal tax incentives. If customers are eligible to claim the federal tax credit, this option significantly reduces the cost to the customer and makes it easier for the Co-op to recover the costs of the project. Other themes discussed include outside project funding (e.g., grants), the impact of low electricity rates on payback times, on-bill payment options, transferability of ownership to other customers, and project siting. The Assessment also notes that using existing land or buildings helps minimize project costs from land acquisition.

The Assessment ultimately provided a snapshot of Montana's current solar market and future potential, key considerations to include in project development, and best practices from successful policies and projects in Montana and in other states.

B. Task 2.0: Solar Strategy Stakeholder Meetings

MEO contracted with the Montana Renewable Energy Association (MREA) to facilitate and convene stakeholder meetings across Montana to discuss the solar market assessment report, hear from technical experts on community-scale solar, and discuss community needs and goals. The objective of the meetings was to educate interested community members about solar energy opportunities while also receiving feedback from stakeholders about community priorities for the menu of community-scale solar development options being considered.

MEO worked with MREA to identify eight communities across Montana to host meetings. Meeting locations were chosen based on geographic distribution, population size, demographics, income levels, presence of tribal populations, diversity of electricity provider types, and solar market penetration level. The communities chosen were Billings, Bozeman, Butte, Great Falls, Malta, Miles City, Missoula, and Polson. Meetings were hosted over a two-month period from September through October 2017. Meetings were held in public, community spaces and were advertised on local radio, in local papers, and through word of mouth. More than 130 individuals attended the meetings. Attendance ranged from 10 in smaller communities up to 40 in larger communities. The summary report ("Report"; available here: http://mtsolarcommunity.mt.gov/Resources) of the meetings finds that there was "good representation from a cross section of

community members, including: community development organizers, city staff, business owners, state and local elected officials, solar installers, electricity providers, and the general public."

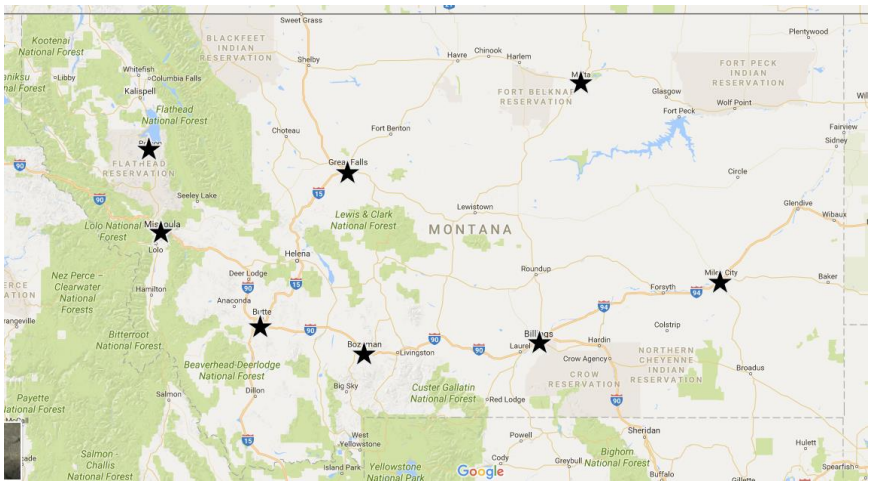


Figure 2 – Community-Scale Solar Community Outreach Meeting Locations

The meetings began with a short presentation on community-scale solar and focused largely on engagement with the audience. The questions posed to attendees included:

- Which of the types of community-scale solar projects presented were of most interest? Are there other types of projects that are interesting to you?
- What is your 'solar vision' for your community? Where do you see solar fitting in?
- Who should the Montana Energy Office be working with on these issues? This could be focused on your community, or could be more general.
- What role can the Montana Energy Office play to better support development of community-scale solar (or solar in general) in your community, and in Montana?

i. Discussion Themes and Outcomes

There were a number of common themes and outcomes from the discussion questions noted above.

The Report notes that shared solar was by far the most popular community-scale project identified by attendees across all of the meetings. Montanans found shared-solar to be more accessible, specifically due to the lower financial commitment. Attendees saw benefits from the economies of scale and siting advantages that shared-solar offers. Several communities discussed group-purchase programs as a means to provide an incentive and demonstrate community interest to the installer, which could help overcome distance and population density issues that attendees identified as barriers to incentivizing installers to visit the community. Few communities identified installing solar on community buildings as a popular option. However, in certain communities with little to no solar development, a solar installation on a community

building was identified as way to demonstrate the technology to the community and spur discussions and education among community members.

Meeting attendees were asked to provide their vision of how solar could fit into their community with the goal of understanding the community's wants and needs. Several common themes emerged among the meetings. One was the role of storage and solar, especially to provide backup power for emergency services and during outages. Communities also saw solar as a way to complement electric vehicle charging infrastructure, both for personal vehicles and for public transit. Attendees saw a key role for renewable energy in farming and ranching applications.

Attendees identified stakeholders that should be involved in solar development going forward. The most common responses across the meetings included planning staff and officials. This branched beyond local or state agents (e.g. urban planners, zoning officials) to include architects, developers, and energy providers. Community members also saw essential services and emergency services as important stakeholders to engage. This included hospitals, fire departments, and more. The most common stakeholder identified was energy providers, as well as decision makers and regulators (i.e., elected officials).

Finally, attendees were asked to share their vision for how the Montana Energy Office could play a role in advancing community-scale projects in the state. The Report notes that education and project facilitation were dominant themes brought up in each of the meetings, including educating students and teachers in grade school through the university system, as well as decision makers, specifically state-level elected officials. The discussion also addressed community education programs, similar to the workshops themselves.

There were additional themes were discussed at the meetings, as the conversation broadened beyond the prompt questions. Financing and economics, policy and policy barriers, and geographical barriers for rural communities were all discussion points that were brought up in multiple meetings. In several meetings, electricity providers noted their position that the regulatory structure for net metering does not allow for adequate recovery of fixed operating costs from net metering customers.

C. Task 3.0: Solarize Montana Pilot Projects

Technical assistance partners were scheduled to coordinate Solarize projects in select MT communities to assess the market potential and test replicability and financial sustainability models for coordinating and managing these projects in Montana.
Four Montana communities (Great Falls, Big Sky, Billings, and Miles City/Glendive) were identified as suitable for hosts to pilot Solarize projects during the 2017/2018 time period. These communities were selected because of their diversity of geographic, socio-economic, and population attributes so that MEO could better understand how Solarize-type projects can best operate in different types of Montana communities. MEO

initiated a request for proposal process in September 2017 for a project coordinator for the four pilot projects, but only received one complete proposal. Upon review, the one proposal was assessed to be inadequate. In response to the failed request for proposals, MEO staff requested that the project funding be moved into Budget Period Two's Task 9 Community-Scale Project Implementation Support, which provided grants to communities to conduct feasibility studies of community-sited and shared solar projects, and implement group purchasing programs. More discussion of the solarize program implementation efforts are discussed later in this report, under Task 9.0.

D. Task 4.0: Community-Scale Solar Development Menu of Options

MEO contracted with Cascadia Consulting group to produce a report detailing the solar energy development options communities can implement to expand their access to solar energy. The Menu of Options Report ("MOR"; available here: http://mtsolarcommunity.mt.gov/Resources) was made available to all Montana communities via the Community-Scale Solar Website (discussed under Task 5 below; available here: http://mtsolarcommunity.mt.gov/). The information presented in the MOR was largely shaped by the solar market assessment report (see Task 1) and the outcomes of the community stakeholder meetings (see Task 2).

The flow of the document is intended to guide communities through the process of deciding what type of community-scale solar projects may be the best fit to achieve the goals of their community. The MOR presents different questions and considerations about how community-scale solar may impact a community, and then suggests various courses of action the community could take using a decision diagram, seen in Figure 3 below. This diagram is included in a section of the MOR describing three different types of community-scale solar projects, and the key elements of each type of program.

In addition to proposing preliminary questions to consider in tandem with the decision diagram, the MOR provides high-level considerations on implementing projects that apply to all project types. These include descriptions of key state and federal policies, a discussion of financing and incentives, and technical considerations (e.g. string inverters vs. micro-inverters).

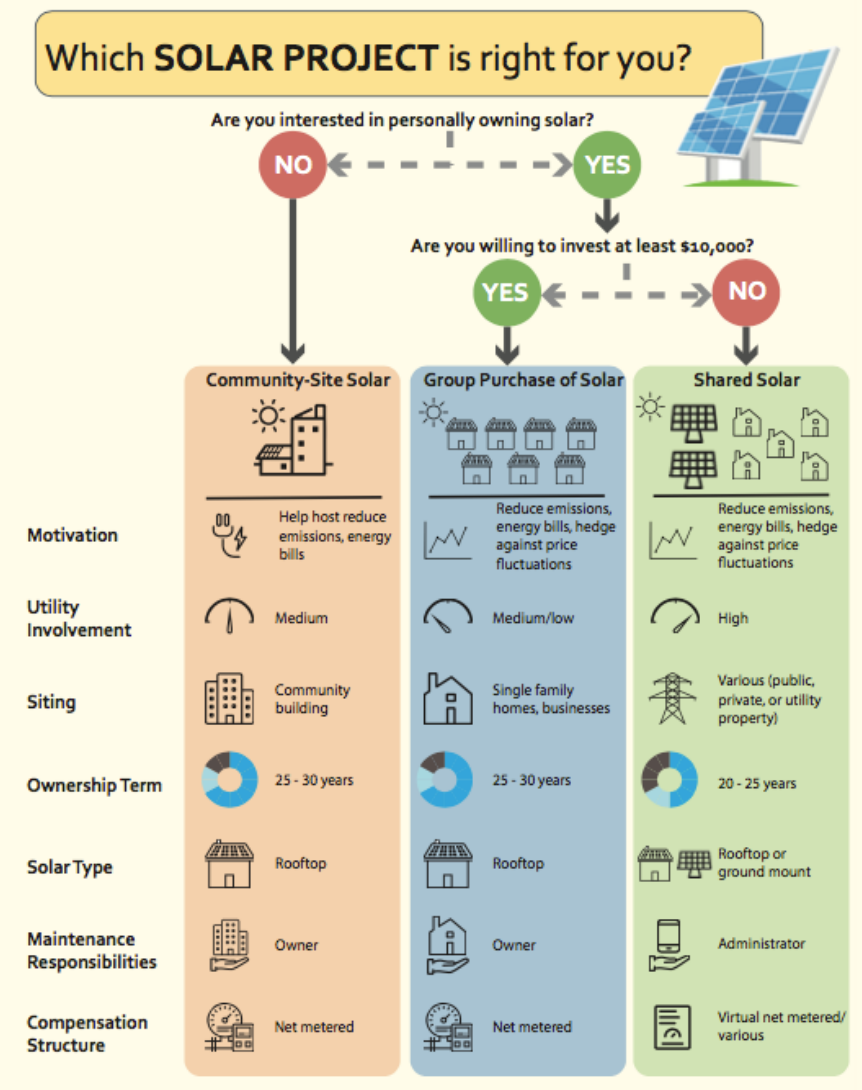


Figure 3 – Decision Diagram for Communities interested in Community-Scale Solar Projects

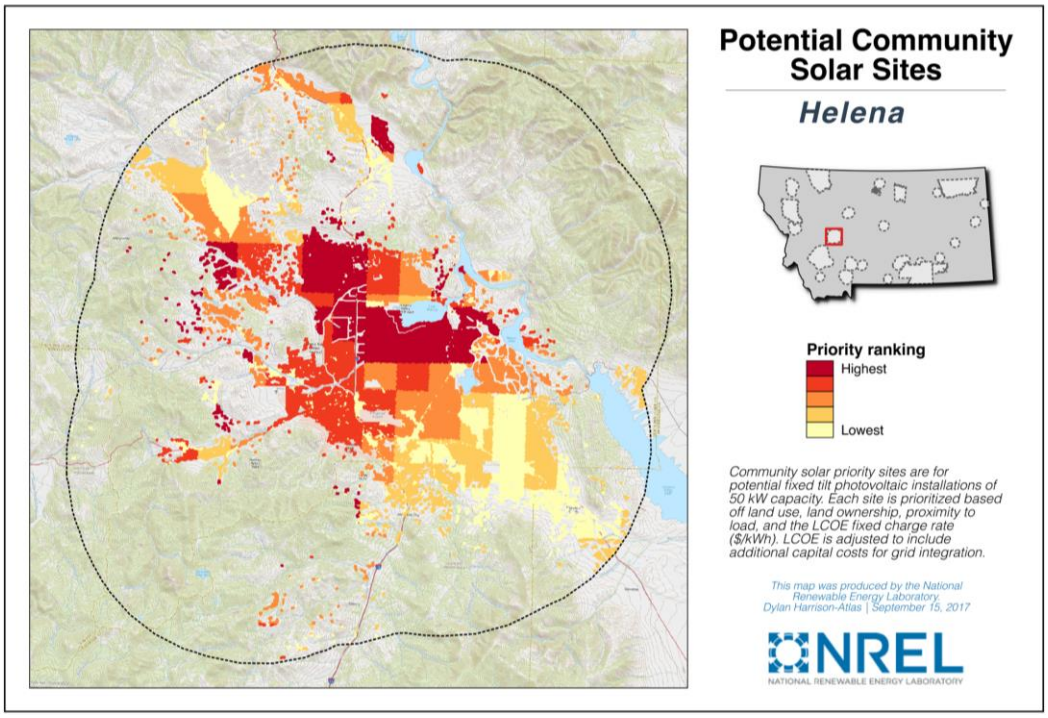
After these introductory sections, the document takes a deeper dive into three types of community-scale solar projects: shared solar, community-sited solar, and group purchasing programs. The sections include greater detail on each type of project to help the community move forward. Each section describes the project type, shares some of the trade-offs associated with the project, and then walks the community member through how to implement a project of this type through a “Project Pathway”. Each section ends with a case study and with a list of resources where the reader can find more information.

The MOR is a critical and impactful deliverable of Montana Community-Scale Solar Strategy Project, because it is a one-stop information source for any community member investigating solar opportunities for their community.

E. Task 5.0: Community-Scale Solar Website Development

MEO developed a Montana Community-Scale Solar website to provide information about the project, including case studies of successful Montana projects, stakeholder activities, upcoming meetings, and links to additional informational resources about solar energy. The website is: http://mtsolarcommunity.mt.gov/.

The resources section is a key educational tool for site visitors. Included on that page are other deliverables from this project, such as the Solar Market Assessment, the Community Stakeholder Meetings Summary Report, and the Menu of Options Report. The Resources page also hosts solar resource maps for 25 different cities and reservations in Montana. These spatial analyses were performed by the National Renewable Energy Laboratory as part of this project. They detail the solar resource in various communities around the state (see example in Figure 4 below). The maps show the levelized cost of energy (LCOE) in dollars-per-kilowatt hour ($/kWh) for 50 kW, ground-mounted, fixed-tilt solar arrays on half-acre plots of land (each dot in the maps represents one half-acre parcel). The cost estimates are based on a variety of factors including local solar resource potential, estimated solar array installation costs, land ownership, proximity to utility transmission and distribution lines, etc.[10] These maps provide a visual representation of a community's highest valued locations for developing community-scale solar projects.



[10] MT Solar Community Project. http://mtsolarcommunity.mt.gov/Resources.

Figure 4 – Spatial Analysis showing Potential Community Solar Sites in the Helena area

In addition to hosting informational resources, the website acted as the landing page and contact gateway for grant award information associated with Task 9.0: Community-Scale Project Implementation Support. This is discussed in the Task 9 section, later in this document.

Unfortunately, the website was not added to MEO's site analytics tracking list until December 10, 2019. Data below is demonstrative of the impact the site has had, even in the short time that the analytics have been available. The dataset is from the period beginning December 10, 2019, and ending January 10, 2020. Tables 2 and 3 below show site visitation information, as well as resource downloads. The Resources page and the Solar Grants page were two of the most popular. The most popular resource download was the Solar Market Assessment.

Table 2 – Montana Solar Community Project Website Visitation Statistics, 12/10/19-1/10/20

Webpage	Home	Resources	About	Solar Grant	Events	Comments
Unique Visits	297	72	73	69	51	45

Table 3 – Montana Solar Community Project Website Resource Download Statistics, 12/10/19-1/10/20

Resource	**Downloads**
Solar Market Assessment	45
MSCP Request for Application – Round 3	29
Montana Solar Menu of Options Report	25
MSCP Presentation (from Community Outreach meetings)	24
MSCP Request for Application Model Contract	23
Community Meetings Summary Report	21
MSCP Request for Application – Round 2	2

F. Go/No-Go Decision Point

The Project had a single go/no-go decision point, which was to identify at least 10 Montana communities and relevant community stakeholders willing to commit to pursuing a community-scale solar project in their community, including agreeing to hold a community planning meeting, as part of the Budget Period 2 implementation initiative. The community stakeholder meetings conducted for Task 2 were used to help MEO staff identify communities that may be interested in pursuing projects during Budget Period 2. Meeting attendees shared information on community-scale projects that were in planning stages and also identified several electric cooperatives that were considering project development. This helped MEO populate a list of potential project

partners and outreach targets. MEO developed a set of parameters for a Request for Application before contacting communities about participating with MEO in project support.

G. Task 6.0: Montana Solar Energy Summit

MEO hosted a solar energy summit to kick off the Budget Period 2 initiative to boost solar energy development across Montana. The goal was to bring in stakeholders and community members from across the state to attend the summit and have technical experts present at the meeting on Budget Period 1 findings, as well as regional and national market trends.

MEO held the summit on June 28, 2018. The summit was titled, "How to Develop Community-Scale Solar" and speakers included representatives from Sage Mountain Center, the City of Missoula, Flathead Electric Cooperative, Homeword Inc., Lewis and Clark Library, and the U.S. Department of Agriculture. MEO hosted the summit at their offices in Helena, but made virtual-attendance available via a live webinar of the meeting.

The meeting was attended by 26 individuals, 7 of which attended in person and 19 of which attended in the live webinar. The meeting was recorded, so that the presentations and sessions could be viewed afterwards for those who could not attend. Topics covered at the summit included an overview of solar energy and technology, case studies of projects across Montana, and financial resources available to communities. This last presentation included the Community-Scale Solar Grant Program that was made available through this project. Those grants and projects are discussed further in Task 9 below.

MEO uploaded the recordings to YouTube and posted them to the MSCP website in July 2018. MEO contacted summit attendees, project partners, Montana electric cooperatives, and other stakeholders to notify them of the recordings. Table 4 below summarizes the number of views to date of the recordings. The viewing statistics suggest that the topics of most interest were the MSCP project and upcoming grant opportunity, and not necessarily the background information on solar and financing options.

Table 4 – How to Develop Community-Scale Solar Summit Presentation Recording Views

Presentation Title	**Views[11]**
Introduction to How to Develop Community-Scale Solar and the MSCP	45
Solar PV 101	5
Success Stories in Developing Community-Scale Solar in Montana	29
Solar and Affordable Housing	8

[11] YouTube views as of December 17, 2019

H. Task 7.0: Community Solar Market Research

The goal of the community solar market research was to develop, conduct, and summarize market research of Montana electricity customers to determine their interest in participating in a community solar program provided by their electricity provider, their motivation for participating in a community solar program, and their preferences for how a community solar program would be structured. Findings from the research have been shared with the participating investor owned utilities (NWE and Montana-Dakota Utilities (MDU)), and are available to the public via the project's website.

MEO contracted with Johnson Consulting Group (JCG) to interview customers within NWE and MDU's service territories. The findings in the report are from interviews with 168 residential customers and 164 small commercial customers in Montana. JCG's research objectives for the surveys are summarized in Table 5 below, taken from the survey summary report. The questions were designed to address the concepts of customer interests, motivations, and attitudes.

Table 5 – Summary of Key Research Objectives

Research Area	Key Research Questions
Customer Awareness	Are customers aware of the solar technologies? Are customers aware of community – scale solar projects? If so, how did they learn about them?
Customer Attitudes	How do these customers view community-scale solar projects? What do they think others think their family/friends/ work colleagues think of community-scale solar projects? How important is it to rely on solar energy for electric usage?
Customer Interests	How important is using renewable technologies to the customer? How important are renewable technologies to your community?
Previous Experience (Motivations)	What types of experiences have customers had with solar PV technologies? What has been their assessment? What do they like? What don't they like?
Barriers to Community Solar Participation	How are the major barriers to preventing them from participating in community solar projects? Are the costs too high? Are contractors available? Is the offering well understood?
Willingness to Pay (Preferences)	What financing options are most attractive to customers by class? What financing offerings are they familiar with: on-bill, solar leasing, community gardens, contractor financing, conventional loans? What is the ideal monthly cost for a subscription-based program? What is the ideal monthly cost for a solar lease?

Research Area	Key Research Questions
Key Customer Demographics	What is the customer breakdown within small commercial groups? What is the average household income among the residential customers? How many own homes vs. rent; how many own buildings vs. lease?

i. Residential Research

JCG found that 99% of residential respondents were aware of rooftop solar technology, and 83% were aware of ground-mount and large scale solar. However, only 32% of respondents knew about shared solar programs managed by energy providers and a mere 13% were aware of solar gardens. This suggests that community-scale programs are a less understood, or at least less identifiable, version of solar development.

Of the residential customers that stated why they had not invested in solar, the most common answer by far was that it was too expensive. Other barriers to on-site solar that are solved by a shared solar project (such as home ownership, shading, associated home improvement costs) were small in comparison to costs. This could suggest that other benefits of shared solar are not as impactful as a potential lower-cost of participation.

JCG found that 60% of respondents expected bills to decrease by participating in shared solar. However, 37% expected either an increase or no change at all. This points to a need for education and resources on the financial impacts of solar, especially resources that are specific to the customer's energy provider.

ii. Commercial Research

Similar to residential respondents, JCG found that 92% of commercial respondents (i.e., local business owners) were aware of solar technology, and 37% were unaware of any of the community solar projects referenced in the survey. This points to the need for additional education and marketing programs among commercial customers and business.

Approximately one third of commercial respondents agreed that their employees would approve of participation in a community solar project; that their customers would also approve; and that they want their business to be proactive about where their energy comes from. JCG suggests that this shows that community solar would be well received by commercial customers.

Questions that had the highest level of disagreement from respondents are listed in Figure 5 below, taken from the summary report, and demonstrate a need for additional education and marketing of projects and programs to commercial customers.

The research found that commercial customers want to be proactive about where their energy comes from (3.54/5) and are interested in learning more about community solar (3.49/5).

Neither residential nor commercial customers had a significant locational preference for where the community solar project may be sited. For those that did find it important, they wanted to see a project located in Montana, and there was a strong preference for their own county and community.

Of the commercial customers that stated why they had not invested in solar, cost was by far the most common response, which is consistent with the residential response. 62% of respondents said they were interested in participating in a community solar project.

Similar to the residential respondents, 59% of commercial respondents expected their bills to go down after participating in a community solar project, while 36% expected an increase or no change. This again points to the need for education and resources on the financial impacts of solar, especially resources that are specific to the customer's energy provider.

The report shows that 42% of respondents stated willingness to pay $50 or more than their current bills for per month to participate in a shared solar project, and another 8% stated willingness to pay $40 or more than their current bills. These percentages are higher than those for residential customers, which may be influenced by the fact that commercial customers may have larger energy bills and may be willing to pay more. Again, this is an interesting result that should form the basis of further investigation.

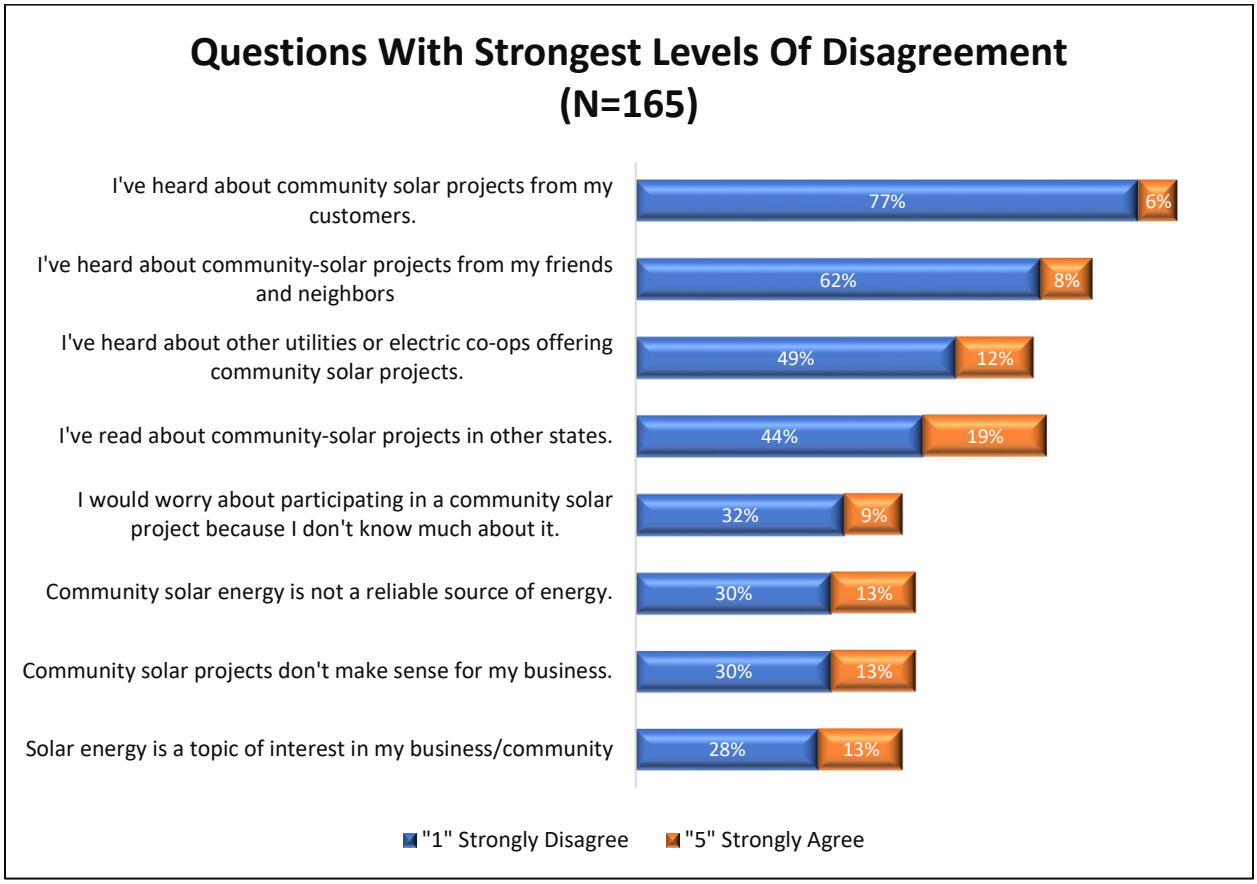


Figure 5 – Questions with Strongest Levels of Disagreement from Commercial Respondents of the Market Research Survey. "N" is the number of survey respondents (165 for these questions). Only the questions with the strongest level of disagreement are shown.

The report states its key findings. Many are summarized above, but the list also includes:

- The residential interviews revealed that customers who are most interested participating in a community solar project are NorthWestern Energy customers, those who live in multifamily homes, and those with a graduate degree.
- Statements that generated the strongest levels of agreement among residential customers included those that focused on reducing the environmental impact and protecting their families from rising energy prices.
- MDU customers were not willing to pay as much to participate in community solar projects and were less concerned with environmental implications of their investment.
- There were no significant differences among the commercial customers to identify any particular target groups. Overall, these customers are interested in participating in a community solar project; however, they are unfamiliar with specific details about these projects.

- A significant number of customers who do not already own a solar PV system stated that investing in solar PV was neither practical nor feasible for their current home or business.

The summary report provides the following recommendations for future work:

- Community solar projects would require significant levels of residential and commercial education to convince customers to participate. Furthermore, community solar projects would require significant customer education to allay concerns about the reliability and practicality of the community solar project.
- Customer groups did not show a strong preference for the location of a community solar project when given the options of having it located in their town, their county, or somewhere else in the state.
- Community solar projects would be favorably received among both commercial and residential customers. However, customer expectations regarding anticipated monthly savings need to be clear to minimize any potential customer confusion or negative feedback.

I. Task 8.0: Community-Scale Solar Website Development

MEO was tasked with launching the Montana Solar Community Project (MSCP) website as part of Task 5 in Budget Period 1. Budget Period 2 included continual updates to the website based on new developments and progress within the scope of the project. Budget Period 2 began in April 2018 and ran through the end of the project in December 2019. Key updates made to the website during Budget Period 2 are listed below:

- June 2018. Updated to announce How to Develop Community-Scale Solar summit, including online registration form. This same month, launched a new page announcing the Request for Applications for project funding support, describing the program, and providing instructions on how to apply. Answers to solicitor questions were posted to the site in mid-July.
- July 12, 2018. Recordings of the presentations from the Summit were posted to the website. (More details on these recordings are provided under Task 6 above)
- October 12, 2018. Website was updated with information on Round 2 of the solar grant support program. This included an updated Request for Applications. Answers to solicitor questions were posted to the site in late October.
- November 30, 2018. Website updated with information on Round 3 of the solar grant support program. This again included an updated Request for Applications.

Site visitation statistics are included under Task 5, above.

J. Task 9.0: Community-Scale Project Implementation Support

Task 9 was one of the key activities associated with this project. MEO supported project implementation in communities throughout the state by providing technical assistance, and grants of $5,000 to $15,000 for pre-construction community-scale solar project development costs, including feasibility analysis, education, and organizational costs. In developing the grant program, MEO decided a formal request for application and application review process was the best option for distributing grant funds. Grants were dispersed quarterly, allowing for multiple rounds of applications. Not only could new projects to seek funding, but projects that were not funded in a previous round could revisit their application and reapply for funding.

This opportunity was presented during the Summit on June 28, 2019, described above under Task 6. MEO sent program information directly to the list of community stakeholders and other interested parties in the project, and also posted information to its Facebook page.

Round 1 grant application reviews were finalized in August 2018, and awardees were notified on September 5, 2018. Round 1 awardees included:

- Beartooth Electric Cooperative for Shares du Soleil Community Solar Project
- Bozeman Public Schools for 50 kW Solar Array on School Support Building
- City of Red Lodge for Solarize Red Lodge Project

MEO received three applications during Round 2. One of these was received late, and deemed ineligible for funding. The two others were reviewed, but were deemed insufficient for funding.

Due to the lack of funded projects during Round 2, MEO altered the Round 3 grant application process. A rolling deadline was implemented and funding was awarded on a first-come first-serve basis. Five projects in Round 3 were awarded, including:

- Yellowstone Bend Citizens Council for its Solarize Livingston Project
- Climate Smart Missoula for developing a feasibility study of installing a solar PV system at the University of Montana
- Helena Public Schools for developing solar PV system plans at three new elementary schools
- City of Whitefish for developing feasibility studies for solar PV systems at two sites in Whitefish
- Livingston Education Foundation for assessing the feasibility and designing a solar PV system to be installed at Park High School in Livingston

Eight grants were awarded across six different communities. A total of 280 kW of new solar systems were installed as a result of these associated projects. An additional 824 kW of potential solar was designed by studies conducted through these grants.

Table 6 – Summary of Total Solar Installed and Designed through Project Implementation Support Grants

Project	Grant Amount	Capacity (kW AC)	Status
Beartooth Electric Cooperative shared solar	$15,000	50.14 kW	installed
Bozeman Public Schools solar array	$8,660	50 kW	Installed
Solarize Red Lodge program *(22 systems)*	$4,350	108 kW	Installed
Solarize Livingston program *(15 systems)*	$8,982	72 kW	Installed
University of Montana solar study	$15,000	200 kW	Designed
Helena Public Schools solar study *(3 systems)*	$9,336	150 kW	Designed
City of Whitefish solar study *(2 systems)*	$12,000	423.8 kW	Designed
Park High School (Livingston) solar study/design	$6,200	50 kW	Designed

Information on individual projects and high-level outcomes are described below.

i. Beartooth Electric Cooperative: Shares du Soleil Community Solar Project

Beartooth Electric Cooperative (BEC) serves several counties in south-central Montana, including large portions of Carbon and Stillwater Counties, as well as Sweetgrass County. BEC applied for a Montana Solar Community Project grant to support design and engineering costs for a shared solar array, as well as communications to potential subscribers. In 2017, BEC conducted a member survey to investigate the opportunity for developing a shared-solar project offering for its members. After a positive response, BEC decided to move forward with the project.

Initial designs were for a 28 kW ground-mounted system. BEC determined a ground-mounted system was cost prohibitive and revisited the design. The second, and final, design was for a 50.14 kW roof-mounted solar array at the Co-op's headquarters in Red Lodge. The installation was performed by Sundance Solar, a Red Lodge-based solar installation business. In addition to the MSCP grant, the Co-op was awarded a U.S. Department of Agriculture Renewable Energy for American Program (REAP) grant of $15,764.

The first portion of 60 panels were offered to members in July 2018 and sold out in November 2018. A second phase of 20 additional panels sold out by year's end. Due to increased interest, another 33 panels were added to the project when Phase II went to

bid the following July (2019). The project payback for the Co-op is 13.1 years. For a member subscriber, the project has a simple payback of 10.2 years on the investment. BEC offered subscriptions to members at $750 per panel. The Co-op maintains ownership of the panels, which allowed them to apply for the REAP grant and lower the overall cost for subscriptions. The Co-op notes that 7 shares of Phase II were purchased by businesses that donated their share of energy production to Operation Round Up (ORU), an independent charitable foundation sponsored by the Co-op that provides financial assistance to families going through financial hardship. The system was commissioned and energized on October 15, 2019, and BEC held a ribbon cutting ceremony on November 7.

Image 1: Beartooth Electric Cooperative Shares du Soleil shared solar array

ii. Bozeman Public Schools: 50 kW Solar Array on School Support Building

Bozeman School District received a grant from MSCP to support research and design of a 50kW system on its support services building in Bozeman, MT. The goal of the analysis was to identify the most cost-effective way to install a 50kW system and to produce a report for the school that could be used if and when funds were allocated to finance the installation. The school district contracted electricians, electrical engineers, and structural engineers to support the design, including advising on how to preserve structural integrity of the building, where to place system components, and how to integrate the system in to existing structural and electrical connections. These analyses resulted in design documents that can be used for any installation on a standing seam metal roof, allowing the design to reduce costs for future projects. Bozeman Public Schools funded the project. The photo below (Image 2) is of the installed solar array.

Image 2 – 50 kW solar array at the Bozeman School District's support services building

iii. City of Red Lodge: Solarize Red Lodge Project

The City of Red Lodge applied for an MSCP grant to support the design and execution of a Solarize program in Red Lodge, MT called “Solarize 59068.” According to organizers, the goal of the program was “to lower the cost of solar installations, increase the adoption of solar on homes and businesses, and expand the community’s knowledge of solar energy.” The City spearheaded the effort, but a coalition of partners was involved in the design and general support of the program. The coalition set a goal of 15 new installations from the program. The active program ran from April 2019 through August 2019, but planning began in October 2018. The coordinators contracted with a local solar installer, Sundance Solar, to facilitate the program. Sundance was responsible for site assessments as well as installation.

The program coordinators organized a launch party to announce the program. In addition, the group set up a website for the program with a form for interested households to sign up for a site assessment. The Launch Event was held on April 3, with 76 people attending. Coordinators also tabled at local Earth Day block party event, the Farmers Markets, and coordinated two Installation Open Houses at newly installed systems in town. In August, the team held a Library SunPower Celebration. The Library had recently installed solar (not through the solar program) and the team held an informational event about solar and the Solarize program. Approximately 20 people attended. Lastly, the team organized a Solarize Slow Roll. The group led a tour of five homes that had participated in the Solarize program to show off their new solar arrays and educate attendees about solar and about the program.

The program coordinators noted one of the challenges encountered that the utility was not keeping up with demand. The coordinators also noted a concern about the utility’s proposed changes to net metering rate structure and rates. The program ended before the Montana Public Service Commission ruled on the issue, which ensured that participants remained unaffected.

Through the Solarize 59068 program, 123 households signed up for site assessments of which 22 installed a solar system. Three of those systems included battery storage.

This exceeded the goal of 15 new installations. The City of Red Lodge also noted several beneficial financial impacts from the program. These include:

- $2,200 in permitting fees paid to the Building Department
- The program created two new short-term jobs for the local installation business, which paid approximately $20,000 in wages to the two individuals.
- Local electricians were subcontracted by the installation business to complete electrical work on the projects, earning approximately $17,600.

iv. Yellowstone Bend Citizens Council: Solarize Livingston Project

The Yellowstone Bend Citizens Council (YBCC) received an MSCP grant to organize and facilitate a Solarize program in Livingston. The goal of the program was to increase adoptions of solar in the community, with a target of 30 new installations.

YBCC launched a website for the program, where interested community members could sign up for the program. They held two community outreach meetings in January, both of which were attended by approximately 50 individuals and were covered by the local paper. YBCC utilized its own community mailing list educate the community about the program. Further, YBCC noted that word of mouth, especially in a small town like Livingston, was very impactful. YBCC also placed “Solarize Livingston” banners at participating households to increase awareness of the program around town.

Forty site assessments were performed by a local solar expert, Jim Baerg, Montana Energy+Design of which 15 moved forward with an installation. In total 72 kW of new solar systems were installed as a result of this program. The program used a multi-installer model, signing up three different solar installers, which helped avoid waiting periods for installation.

The Solarize Livingston organizers are planning to host another campaign in January 2020. Now that the Montana Public Service Commission has rejected the utility’s proposed changes, part of the target audience will be Round 1 participants who were waiting for the outcome of the rate case. In addition to the physical solar installations, program coordinators believe that the awareness and education opportunities provided by the campaign are growing momentum for more solar installations in Livingston.

v. Climate Smart Missoula: Feasibility study of installing a solar PV system at the University of Montana

Climate Smart Missoula (CSM) received a grant from MSCP to conduct a feasibility study and analysis for the installation of a solar array on top of the Mansfield Library at the main campus of the University of Montana’s (UM) in Missoula. CSM contracted with OnSite Energy to conduct the feasibility analysis and design for maximum capacity based on available roof space. The original proposal for system design was for a pole-mounted system on top of the university parking garage. However, initial research showed that costs would be higher than a rooftop system, specifically due to additional

structural engineering and infrastructure. CSM worked with OnSite and the UM facilities department to determine that the Library would be a better fit.

OnSite determined that the Library could host approximately 200 kW (250 kW-dc) of solar. OnSite found that no significant electrical or structural barriers existed for the proposed system and that the metering configuration for the university presented a unique opportunity. All of the university's electrical services go through a single metering point with NorthWestern Energy. Due to the size of the university's load (avg. 3 MW, with a typical low point of ~2 MW), the solar array atop the Library would never export energy. Since the system will not be net metered, the system design was not restricted by the statutory 50 kW cap for net metering systems. OnSite estimates that the total system cost would be about $368,000. The system should produce about 309 MWh per year, resulting in a 15.2-year simple payback time and a 25-year savings of $727,379 (average annual ~$29,000).

Climate Smart Missoula also conducted an analysis of financing options that the university could use for the solar array. As a public entity, the university cannot take advantage of certain tax incentives that many households and businesses use to reduce payback times. In their final report to MEO, CSM found that, "options to fund this renewable energy system include a cash purchase of the system by the University, utilizing innovative financing arrangements with investors, companies or financial institutions, and/or pursuing donations to offset some or all of the upfront cost."

Climate Smart Missoula also compiled an education and outreach plan associated with the installation. According to CSM's final report, the goals of the plan are to "raise awareness about the value of solar and renewable energy for UM, the opportunities this particular solar PV system provides UM, and how this system supports larger sustainability efforts on campus." CSM, in collaboration with UM's sustainability office and several other departments and student groups, plans to develop and distribute educational resources both online and in print format. The groups want to ensure the solar array is "visible" to the public, even if hidden from view. The groups plan to integrate interactive, visual displays throughout the Library and on university websites that allow students and the general public to access array production statistics. A media event will be planned for the announcement of the installation (once confirmed) as well as when the system is commissioned.

vi. Helena Public Schools: Developing solar PV system plans at three new elementary schools

Helena Public Schools applied for a MSCP grant to support technical system design plan and bidding documents for three different solar PV systems. The systems were to be placed on the three new elementary schools that will be opening in 2019. The three new schools are Bryant, Central, and Jim Darcy elementary schools. The grant was estimated to cover 60% of the design costs, with Helena Public Schools (HPS) matching the remaining 40%.

HPS contracted with SMA Architects to conduct the analysis and design. SMA subcontracted the local solar installation firm Bozeman Green Build to support their work. HPS intends to install a 50 kW system at all three schools. HPS plans on funding the installation through a mixture of funding sources. During the grant period, HPS was awarded two grants from the state's Universal Systems Benefits (USB) program, which is administered by NorthWestern Energy. In addition, HPS will be the beneficiary of the annual Helena Sun Run, organized by Sleeping Giant Citizens Council and Helena Vigilante Runners. The proceeds from the fundraising race event will help fund all three systems.

Over the summer, HPS worked with science educators and consultants to develop learning targets and objectives associated with renewable energy and the solar arrays for grades 3-5 at Bryant elementary. These curricula can be shared with other elementary schools as those schools complete their solar installations and as the curricula is fine tuned.

vii. City of Whitefish: Feasibility studies for solar PV systems at two sites in Whitefish

The City of Whitefish received a grant from MSCP to support design and analysis of two different sites in Whitefish – the municipal wastewater treatment plant (WWTP) and a low-income housing project developed by Homeword, called Alpenglow Apartments. Both analyses were completed, though funding remains an issue for development of the solar arrays. The City contracted with OnSite Energy, a Bozeman-based solar design and installation firm, to conduct the analyses.

Wastewater Treatment Plant. The City asked OnSite to conduct an analysis for a ground-mounted system next to the WWTP, which is under renovation. OnSite focused its analysis on two principle issues: available and suitable ground space, and integration into the facility's electrical distribution system. OnSite found there was plenty of space (8 acres) and no issues with the siting or integration into the facility. Thus, the design was guided by optimization of loads and finances. In its report, OnSite notes:

> "During the beginning stages of the feasibility analysis, net-metered and power purchase agreement (PPA) options were also assessed. Due to Flathead Electric Cooperative's 50 kW system capacity cap, it was determined that a net metered system was not a good option to achieve the goal of substantially offsetting the facility's energy consumption. On the other hand, while a power purchase agreement through Flathead Electric Cooperative would allow for the highest system capacity potential, the anticipated kWh rate structure (avoided cost) would be far from economically viable. For these reasons, the non-export system configuration was a middle-ground compromise between maximizing system capacity and focusing on overall economic viability."

OnSite recommended a non-exporting system with a 375 kW (492.5 kW-DC) capacity. The system would have an average annual production of approx. 600 MWh/year and a simple payback time of 27.7 years. Importantly, OnSite notes that the interconnection procedures and policies for the local energy provider, Flathead Electric Cooperative (FEC), do not specifically mention non-exporting systems. Since Flathead is not governed by the same sections of statue as investor-owned utilities, it has more flexibility in what it allows on its system. The design plans were sent to FEC's staff and Board of Directors for review.

Alpenglow Housing Project. The City, in partnership with Homeword[12], asked OnSite to conduct an analysis of rooftop solar for the Alpenglow Housing project in Whitefish, MT. This is a new development, so building energy use data was not available. OnSite used comparative data from other multi-family housing projects built by Homeword, as well as a "combination of an individual load analysis for each house panel." Homeword confirmed the buildings were designed and built as solar-ready, meaning solar integration should be efficient and should not require any structural changes.

The requested design was to offset 100% of the estimated annual loads for each of the three individual buildings. OnSite recommended three net-metered systems with a total capacity of 48.8 kW (49.5 kW-DC). The individual systems are 10 kW, 28.8 kW, and 10 kW. The systems are to be net metered, under FEC's net metering program. The systems will have an average annual production of approximately 50 MWh/year and a simple payback time of 28 years.

Next steps for both projects will be identifying funding sources. The bid for the new WWTP came in $3 million higher than expected. The City has no financing at this time to support development of the solar array. The City has noted that there are several opportunities for collaboration and learning with other municipalities and non-profit groups who are seeking funding for similar projects. One example is Climate Smart Missoula, who is collaborating on a similar project for the University of Montana (see their project in the above section).

viii. Livingston Education Foundation: Feasibility and Design of a solar PV system at Park High School in Livingston

The Livingston Education Foundation received a MSCP grant to support project feasibility study, project system design, and project fundraising efforts for a 50 kW system at the Park High School in Livingston, MT. The effort was fiscally sponsored by the Foundation, but activities were coordinated by the school's Green Initiative. The Park High Green Initiative ("Green Initiative") is a student-led volunteer group at Park High School dedicated to promoting environmentally-friendly practices. Specifically, two teacher-advisors and several students spearheaded the research and outreach efforts. The Green Initiative group worked with a Bozeman-based solar contractor, Sustulis

[12] http://www.homeword.org/about-us/mission-and-history/

Energy LLC, as well as other local energy consultants to complete the feasibility study and project system design.

The final design is for a roof-mounted, 50 kW system located on the northwest portion of the roof, which provides visibility from two main roads passing the school, enabling students, parents, and the public to see the array while driving near the school. The design estimates that the school will save $7,000 on energy costs each year, with a simple payback of 14 years.

The Green Initiative, and specifically the two teacher Advisors, have already incorporated renewable energy lessons into their curriculum and plan to add additional modules to the curriculum once the installation moves forward. The real-time monitoring of the system and the data provided will allow for hands-on learning experiences for the students.

In addition to the system design, the Green Initiative members dedicated time to community education and outreach opportunities. The total system cost was estimated at approximately $117,000. By the end of the MSCP grant period, the group had raised $65,000 with a pending Universal Systems Benefits grant of $70,000. The group has also applied for several additional grants from local, state, and national organizations and foundations.

K. Task 10.0: Solar on Schools Assessment

The Solar on Schools Assessment (Assessment) was an analysis of the potential to develop rooftop and ground-mounted solar PV projects at participating schools throughout Montana. The resulting reports determine the potential size, locational suitability, and simple payback period for each school assessed. MEO contracted with paleBLUEdot (PBD) to complete the Assessment, which encompassed 25 schools throughout Montana. The Assessment included 8 different energy providers, including 2 investor owned utilities, 5 rural electric cooperatives, and 1 muni. The final reports result in a total of 920.8 kW (1180 kW-DC) of designed solar.

In addition to the individual reports for the schools, PBD also provided a slide deck for the schools. The slide deck walks the viewer through the report format, giving them insights into how to read the document, what information is included, and how to use it. MEO also developed a Solar Owner Worksheet Tool that was provided to the schools. The user of the worksheet inputs design parameters that are typically provided from a solar contractor’s bid, and the worksheet will calculate the 30-year simplified cash flow projection. This information can help the school understand the financial implications of a bid, as well as compare bids from multiple contractors.

In order to assemble each report, PBD collected basic information about each site, including building size, student population, building age, roof age and condition, building expansion plans, etc. Using one full year’s worth of electric bills, PBD compiled annual electric consumption, annual demand and electrical costs for each site. Using all of this information, PBD was able to compile an “electric consumption peer group comparison.”

The comparison, seen in Figure 6, shows the electrical consumption per square foot of building and per student, allowing schools to compare themselves to others around the state. In their reports, PBD also provided information on net metering policies for the electric utility serving that school.

PBD used satellite data and street view photographs to assess the site characteristics, such as shading and obstructions, building configuration, orientation, and roof design, which informed where the array would be located. PBD used local NOAA weather stations to inform site-specific climate conditions, like average hours of sunlight, rain, snow, cloud cover, and more.

Once all of this data was collected and analyzed, PBD was able to design the array and provide a performance analysis that demonstrates monthly electrical production, annual production, systems metrics (size, capacity, etc.), and sources of system losses (shading, reflection, temperature, etc.). After the performance analysis, PBD completed cost analysis to inform a project budget organized into four categories: administration, installation, developer/professional fees, and contingency. Lastly, the reports provide a 30-year lifespan financial performance, which shows the costs and savings over the 30-year lifetime of the system and includes the energy generation schedule, potential revenue value, and a simplified cash-flow projection (similar to the Solar Owner Worksheet Tool).

Peer Electric Consumption Comparisons

School	kWh/SF	Percentile	kWh/Pop	Percentile	Demand %	Percentile
Belt School	5.73	40	1,612.83	68	27.5%	68
Libby Elementary School	13.71	96	1,691.79	76	46.6%	92
Libby Middle/High Schoc	6.51	52	1,205.28	44	14.8%	16
Plevna School	6.32	44	2,439.23	84	47.1%	96
Polson High School	13.06	92	2,920.00	96	17.3%	24
Polson Middle School	6.71	64	905.29	28	21.5%	40
Linderman Elementary	13.93	100	1,381.52	60	22.6%	44
W.F. Morrison Elementar	7.04	72	1,169.20	40	27.3%	64
Troy High School	7.06	76	2,011.20	80	24.7%	52
West Yellowstone Schoo	4.09	12	1,294.00	52	29.4%	76
Park City School	4.46	16	639.94	12	47.2%	100
East Glacier Park Grade S	8.32	80	1,346.32	56	37.7%	84
Chester-Joplin-Inverness	2.73	4	1,048.17	32	30.8%	80
Moore School	8.38	88	2,525.18	88	28.0%	72
Reed Point High School	4.95	32	3,563.20	100	21.4%	36
Reed Point Elementary	3.08	8	379.67	4	13.6%	12
Meadow Hill Middle Schc	6.91	68	1,056.10	36	16.5%	20
C.S. Porter Middle Schoo	4.83	24	713.51	20	27.0%	60
Chief Charlo Elementary	4.93	28	699.95	16	25.8%	56
Hawthorne Elementary S	6.51	48	761.03	24	21.2%	32
Lewis and Clark Element	4.53	20	561.97	8	18.4%	28
Sentinel HS	5.50	36	1,265.25	48	22.7%	48
Shelby Elementary Schoc	8.37	84	1,412.24	64	0.0%	4
Shelby Junior & High Sch	6.54	56	1,670.89	72	0.0%	4
Ryegate School	6.68	60	2,620.39	92	40.1%	88

Figure 6 – Electric Consumption Peer Group Comparison

The reports also provide information on solar basics, solar photovoltaic technology, and net metering. They close with recommended next steps for the school. These studies will form the foundation of future work for each school.

i. Takeaways

The reports demonstrate that schools are excellent candidates for solar arrays. Design and next steps for individual schools vary, but not significantly. For example, very few reports recommend ground-mounted arrays, and most schools were designed to maximize the system size to the allowable net metering limit.

The data from the reports suggest that the net metering limitation is a significant factor affecting the feasibility of projects. The reports show that these schools can offset an average of 27.3% of their annual energy use, but the offset values range widely from 1.2% and 100% of a school's annual energy use. Libby Elementary's electric consumption is the highest among schools (13.71 kWh/SF), as seen in the Peer Group Comparison in Figure 6 above. It is subject to a 50 kW net metering cap and can offset up to 8% of its energy use with the designed array. Polson's electric consumption is

lower (13.06 kWh/SF), but is subject to a 10 kW cap, and thus can only offset 1.2% of its electric energy use with solar.

The data from the reports also suggest that financing options play a key role in project feasibility. Payback times across the 25 schools range from 14.3 years to 36.0 years, with a mean of 25.2. None of the reports include grants, rebates, or other funding sources in the financial analysis, though the reports do provide information on several options that are available. Funding will be an issue for schools, since they cannot take advantage of tax credits. Montana's Universal Systems Benefits (USB) program can provide up to 90% of project funding available through the E+ Renewable Energy Program for renewable energy installations on non-profit or government/public buildings that are NorthWestern Energy customers. Bonneville Environmental Foundation funding is available, but only for co-ops served by BPA. The schools that are in included in these Co-ops include Libby (Flathead Electric), Polson (Mission Valley Power), East Glacier Park School (Glacier Electric), and Troy (Troy Electric). These funding sources will have large impacts on project financing, payback times, and – thus – feasibility.

L. Task 11.0: Program Impact Report

The final task associated with the project is to produce a final report overviewing the impacts of the project on Montana's solar energy market, key successes, and lessons learned. This document serves as that report. MEO contracted the Montana Renewable Energy Association to draft the impact report.

4. Outcomes and Conclusions

The Montana Solar Community Project was a three-year effort conducted by the Montana Energy Office at the Montana Department of Environmental Quality to develop a community-scale solar energy strategy for the state that will cost-effectively expand Montanans' access to solar PV. The Project focused on 11 individual tasks to support that goal. All tasks were completed, though Task 3 was merged with Task 9.

The project had several important outcomes and impacts.

Project activities resulted in new solar development across the state. Through the project support provided by MSCP, stakeholders in communities across the state implemented different types of community-scale solar projects that resulted in 280 kW of newly installed solar, including two solarize programs, a shared solar array for a cooperative, and a solar array atop a Bozeman high school.

Contractor diversity supported the development of the Montana solar market. MSCP activities were conducted in communities around the state and used various contractors active in the renewable energy market, including solar installation businesses, architects, engineering firms, electricians, and more.

MSCP activities built momentum towards an increase in solar development throughout the state. Many of the deliverables from this project provide guidance on future development of community-scale solar in Montana. For example, the stakeholder meetings and customer research provided important information for future solar development. Further, resources like the Menu of Options Report is one of many educational resources that can be used to fill information gaps identified during the stakeholder meetings. More directly, the community-scale solar implementation support and the Solar on Schools report resulted directly in the analysis and design of 1,745 kW of solar across the state. Lastly, the two Solarize programs conducted in Livingston and Red Lodge have built community momentum towards increased solar deployment, in addition to the physical installations. In particular, the Livingston project references a second solarize program, noting: “we will keep building on the momentum we have!”

MSCP activities provide several conclusions about community-scale solar in Montana.

There is strong interest in community-scale solar in Montana. Feedback from community stakeholder meetings and the solar market research, as well as by the response to the project implementation grants provided by MEO, indicated a strong interest in solar in Montana. In particular, respondents to the market research survey demonstrated a desire, and need, for additional educational materials and resources on community-scale solar projects and programs. Further, the interest in community-scale solar could provide an opportunity for development of new products offered by utilities, such as green tariffs.

Montanans demonstrated a desire and need for more information about renewable energy. One of the most common themes across all project activities was the desire and/or need for additional education about solar, ranging from information about the technology and financing options, to policy and regulatory updates. Several entities, including MEO, provide such information. MEO and other entities that provide renewable energy education should consider how to reach wider audiences and communities that are not currently finding the information they seek.

Montana’s policies and regulatory framework are limiting community-scale solar. As noted in the reports produced by MSCP activities, several key policies and regulatory frameworks are restricting community-scale solar projects. For example, the Solar on Schools assessment clearly demonstrates that limitations on the capacity of net metering projects is preventing schools across the state from being able to more significantly reduce their operating costs using distributed solar generation.

Schools will be key partners for community-scale solar efforts. The Solar on Schools reports clearly demonstrates the potential for schools across the state to take advantage of distributed solar to reduce operating costs and save money. Further, the project implementation grants and feasibility studies that were completed show how schools can harness the existing solar array to develop educational materials and

curricula to educate Montana's future leaders about these technologies. The success of these programs is tied closely to the educational gaps identified in the Solar Market Research activities. Lastly, community members in rural communities that lack significant solar development are seeking ways to stoke conversations around renewable energy in their community.

5. Budget and Schedule

The Project Period for this award was January 1, 2017 through December 31, 2019, consisting of the following Budget Periods:

- Budget Period 1: 01/01/2017 to 03/31/2018
- Budget Period 2: 04/01/2018 to 12/31/2019

Budget Period 1 included Tasks 1 through 5 as described in section 3 above. Budget Period 2 covered Tasks 6 through 11.

Six modifications were approved over the course of the project as follows.

- Modification 0001:
  - Extended the project end date from 03/31/2018 to 09/30/2019.
- Modification 0002:
  - Approved the continuation application, allowing the Recipient to move from Budget Period 1 to Budget Period 2.
- Modification 0003:
  - Updated DOE contacts.
- Modification 0004:
  - Extended Budget Period from:
    - 04/01/2018 to 09/30/2019 to
    - 04/01/2018 to 12/31/2019.
- Modification 0005:
  - Deleted and replaced the Statement of Project Objectives;
    - Remove Task 3, Montana Solarize Pilot Projects, and reschedule for solarize projects in Task 10;
    - Change Task 7 from developing solar policy recommendations to conducting community solar market research; and,
    - Change Task 10 from conducting a solarize assessment and creating a solarize handbook, to conducting solar feasibility assessments for public schools.
  - Deleted and replaced the Budget Information in accordance with changes to the SOPO;
  - Updated the Recipient Business Officer contact information for Laura Rennick, and Principal Investigator from Garrett Martin to Dan Lloyd; and,
  - Deleted and replaced the Special Terms and Conditions in order to delete and replace Term 13, "Publications."

- Modification 0006:
    - Updated the Principal Investigator from Dan Lloyd to Ben Brouwer.

The project budget is noted below in Table 7, including actual expenses, adjustments, DOE share, and MEO cost share.

Table 7 – Project Budget, Actual Expenses, and Adjustments

Budget Categories	Project Budget	Actual Expenses	Adjustments
a. Personnel	$94,118	$94,720	$601
b. Fringe Benefits	$32,941	$32,836	$(106)
c. Travel	$11,870	$3,587	$(8,283)
d. Equipment	$0	$0	$0
e. Supplies	$0	$86	$86
f. Contractual	$291,000	$247,700	$(43,300)
g. Construction	$0	$0	$0
h. Other	$3,430	$537	$(2,893)
i. Total Direct Charges	$433,360	$379,465	$(53,894)
j. Indirect Charges	$41,640	$40,201	$(1,439)
k. Total Charges	$475,000	$419,666	$(55,334)
DOE Share	$380,000	$335,682	$(44,317)
Cost Share	$95,000	$83,954	$(11,046)
Cost Share Percentage	20.0%	20.0%	

The unspent project budget amount, totaling $55,334, was largely due to lower than expected contracting and travel costs.

6. Path Forward

As discussed in the Outcomes and Conclusions section above, a number of the project deliverables are specifically designed for future development, or identified tangible next steps. This includes the numerous site assessments that were conducted throughout the project period. The Solar on Schools assessment is the most obvious example. These analyses provide the information each of these schools will need to efficiently move forward with a solar project. Another example is the analysis conducted through the project implementation grants provided by MEO, such as for the University of Montana, Whitefish Wastewater Treatment Plant, and Helena Public Schools. These are actionable deliverables that these entities can put to use when funding or other necessary project catalysts become available. In particular, Helena Public Schools is actively bidding projects to install solar arrays based on the analysis provided by this project. A final example is the Solarize Livingston program, which program coordinators note will see a second round in the 2019/2020 timeline.

Other deliverables lay the foundation for future work, even if no activities are scheduled at this time. The solar market assessment, solar market research, and community stakeholder meetings are good examples. These documents are designed to inform future education and outreach programs. By providing these documents to the public and marketing them through Montana, MEO can continue to increase solar education throughout the state. It is also noteworthy that some of the information discussed in those documents was surprising to stakeholders, including MEO. For example, the solar customer research report suggested that Montanans across the state may be willing to pay tens of dollars more per month to participate in a community solar project. This conclusion challenges conventional wisdom and experience in Montana and should be the focus of continued research.

Generally, this project has identified challenges, barriers, and needs for community-scale solar development in Montana. Limited public awareness of community-scale solar options continues to be a significant barrier to more widespread adoption of these strategies, however the outcomes of the MSCP have begun to erode that obstacle. The resources and model community-scale solar projects developed with the support of the MSCP, and the continued implementation of projects initiated by the MSCP, will only erode that barrier further.

This project provided MEO an opportunity to bring its own staff, as well as other stakeholders, into communities around the state that have had limited, if any, discussion of community-scale solar. This has created new relationships, new lists of stakeholders and interested parties, and new opportunities for expanding solar development and the solar market throughout Montana.