Final Technical Report (FTR)

Cover Page

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f. *Principal Investigator (PI)*	Name: Zahra Thani Title: Research Project Manager Email address: thanizahra@gmail.com Phone number: 925-330-9368	
g. *Business Contact (BC)*	Name: Yesenia Rivera Title: Executive Director Email address: yrivera@energy-allies.org Phone number: 301-744-8346	
h. *Certifying Official (if different from the PI or BC)*	Name Title Email address Phone number	

Signature of Certifying Official *07/30/24* *Date*

By signing this report, I certify to the best of my knowledge and belief that the report is true, complete, and accurate. I am aware that any false, fictitious, or fraudulent information, misrepresentations, half-truths, or the omission of any material fact, may subject me to criminal, civil or administrative penalties for fraud, false statements, false claims or otherwise. (U.S. Code Title 18, Section 1001, Section 287 and Title 31, Sections 3729-3730). I further understand and agree that the information contained in this report are material to Federal agency's funding decisions and I have any ongoing responsibility to promptly update the report within the time frames stated in the terms and conditions of the above referenced Award, to ensure that my responses remain accurate and complete.

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3. **Executive Summary:**

This study aims to comprehensively analyze community solar project preferences for consumers and suppliers by conducting three distinct analyses. First we analyze the predictors of community solar contract adoption to understand how individual priorities affect the probability of adoption. Using an original data set of survey responses from potential community solar customers, we analyzed the predictors of contract adoption by employing a weighted logit model. We find that individuals who were previously familiar with community solar projects were significantly more likely to adopt than those who were not familiar. Secondly, a survey of community solar developers and financiers identified industry perceived barriers to community solar access and inclusion. Thirdly, we gathered payment performance information from community solar initiatives to measure how financial risks are perceived and how they interact with customer demographics. Our study is beneficial to the public by providing insights into the drivers and barriers of community solar adoption and sheds light on the importance of understanding individual priorities in designing effective community solar policies.

The community solar industry has changed significantly since the beginning of this project. The industry continues to grow at a rapid rate, with an additional 7 gigawatts expected to come online between 2022 and 2027. With federal pressure to meet climate goals, as the harms of climate change continue to impact everybody, legislators are looking to community solar as a method to achieving their states energy policy goals. These new policies that push for low-to-moderate inclusion, coupled with the increase in community solar capacity illustrate a new era for the community solar industry. A number of policies have arisen in the last few months that push for more inclusive practices including the groundbreaking Solar for All program run by the EPA.

The research created a “best practice” contract that can then be used, in conjunction with the manuscript and validated study, to pitch the industry on a more inclusive community solar product.

4. Table of Contents:

5. Background:

In 2020, the United States solar industry installed a record 19.2 gigawatts of solar capacity, representing a 43% increase compared to the previous year [1]. As solar expands at a rapid pace, concerns arise about the fairness and inclusivity of renewable energy access. Often, there are disparities in who receives benefits from renewable energy [2]. For example, the conventional method of installing solar panels on rooftops of homes limits the benefits to individuals who have homes with rooftop conditions that can support panels, limiting access for renters or households with insufficient direct sunlight [3].

Community shared solar (CSS) presents a solution to increase the distribution of the benefits of renewable energy. Previous research found CSS increases the market size for customers and shares costs, alleviating financial and locational barriers to solar participation [3, 4]. Because community solar projects are typically at an off-site array, they do not require individuals to own a home with a specific type of roof. Instead, individuals who are renters, lack appropriate roof conditions, or are unable to finance a solar installation, can subscribe to or buy into a portion of the community solar program.

Community solar ownership models including special purpose entities (SPE), utility-sponsored, and nonprofits, offer opportunities to expand renewable energy benefits [8]. In the SPE model, a separate legal entity outside of the utility is created to develop and manage the community solar project, while utility-sponsored models involve the utility itself initiating and managing the project. The non-profit models are driven by community organizations operating for the public benefit. Future adoption

of the respective model depends on factors like policy support and regulatory restrictions. To date, twenty-one states support CSS through legislation, with states like New York and Colorado embracing various ownership models, with SPE and utility-sponsored being most prominent [9].

CSS participants receive a credit on their utility bill, resulting in a discount on their total energy cost, and communities that participate may receive other benefits including workforce development, investment into community infrastructure, and a reduction of fossil fuels. As a result, CSS offers a potential avenue for more low-to-moderate income (LMI) individuals, also known as income-qualified individuals, to access clean energy. A National Renewable Energy Laboratory (NREL) report estimates that as of the end of 2020 only 65 MW, or 2%, of that total CSS is dedicated to income-qualified subscribers [5].

Existing research in CSS ownership models and customer preferences notes the lack of a comprehensive analysis of preferences for both consumers and suppliers, particularly for disadvantaged populations [10]. To address this gap, this study aims to fill the research void by conducting three distinct analyses. Firstly, it examines the sensitivity of potential customers to CSS contract attributes and develops quantitative measurements to gauge individual priorities. Secondly, it surveys CSS developers and financiers to qualitatively identify the most significant factors that limit the offering of CSS to income-qualified customer bases. Finally, the study analyzes the monthly payment performance data of two operating community solar farms to determine the demographic or socioeconomic factors that are correlated with the likelihood of churn. By integrating the findings of these analyses, the study aims to provide a more comprehensive understanding of CSS preferences for consumers and suppliers, as well as identify ways to increase adoption and analyze churn rates among income-qualified individuals.

6. Project Objectives:

The goals of this project are to determine low-to-moderate income (LMI) customer community solar contract preferences, to assess the price sensitivity for offering inclusive contract terms for financiers, and to analyze community solar program churn and default data as they vary by participant demographic. The primary outcome of this research will be a “best practice” contract that can then be used, in conjunction with the manuscript and validated study, to pitch the industry on a more inclusive community solar product.

Project Objectives by Budget Period

Budget Period 1 (BP1): In the first Budget Period, Solstice will complete the study design for the primary contract innovation research. Completion of study design includes validation of methodological strategy by third party reviewers. Additionally, Solstice will develop all forms, questionnaires, and materials necessary to execute data collection in the next budget period. This includes the main contracts that Solstice will be using to test

the effect of contract terms and contract language on subscriber enrollment. To further prepare for data collection in BP2, Solstice will obtain two signed Memorandums of Understanding with developers that secure churn-and-default data on subscribers over at least 4 MW of project capacity.

Budget Period 2 (BP2): During the second budget period, Solstice will carry out data collection activities for the contract innovation study. By the end of the budget period, Solstice should have collected 750 reservation forms from potential subscribers using the four contract prototypes developed in BP1. Additionally, Solstice should have received and conducted preliminary analysis on the subscriber churn-and-default data from developers that signed MOUs in BP1, as well as surveyed the project financiers to understand their needs. Solstice will be supplementing these data with subscriber contract data collected from the EnergyScore pilot research from their previous Solar Energy Evolution and Diffusion Studies-2 (SEEDS-2) award, DE-EE0007659. In order to highlight the importance of this research Solstice will prepare a white paper and have the analysis and results published in at least one industry or trade outlet. In a similar vein, Solstice will begin to prepare for the dissemination of the contract innovation research by scoping webinar hosting opportunities and identifying national or regional level partners interested in co-hosting webinar(s). Finally, Solstice will conduct outreach and scoping around a possible guarantee fund. BP2 will culminate in a decision around whether or not to pursue setting up a guarantee fund in BP3.

Budget Period 3 (BP3): During the last budget period, Solstice will finalize the contract innovation research through the completion of a manuscript to be submitted to one academic outlet. Finalization of the research also includes producing a best practice contract that will be used to pitch developers on a more inclusive community solar product. These pitch meetings will culminate in the signing of two MOUs with developers that plan to offer Solstice's best practice contract. Finally, over the course of the budget period, Solstice will submit three abstracts to conferences that are targeted towards topics involving low-income inclusion in renewable energy systems.

Technical Scope Summary

BP1: In the process of designing a contract innovation study and producing contract prototypes, Solstice will need to conduct preliminary research on the current contracts available in the American community solar market. Additionally, Solstice will ensure the prototypes produced are externally validated and commercially viable. Solstice will also conduct a number of outreach, scoping, and networking tasks in order to obtain the necessary MOUs.

BP2: Solstice will engage in a number of tasks dedicated to executing the data collection and analysis necessary for the contract innovation study. This involves collecting reservation forms, questionnaire responses from financiers, and churn-and-default data from developers. Solstice will also prepare the SEEDS-2 Follow-On Subscriber Payment Performance study that will supplement subscriber payment history data obtained from developers. To prepare for sharing this research in BP3, Solstice will begin scoping

partners for co-hosted webinar(s). Finally, several tasks are dedicated to beginning the process of reaching out to investors and social enterprises about their experience and/or interest in setting up a guarantee fund for community solar.

BP3: During the last budget period, Solstice will conclude the contract innovation research and prepare for future efforts to share this research at conferences and other gatherings dedicated to innovation in community solar. Additionally, Solstice will prepare a best practice contract for use in pitch meetings with developers. Lastly, should Solstice decide to pursue a guarantee fund in BP2, a legal structure for the fund will be devised.

Tasks To Be Performed

Budget Period 1

Task 1.0: Contract Development
Task Summary: Solstice will develop four prototype contracts which will be used in the contract innovation study, with binary variation of inclusive contract terms (no cancellation fee, shorter contract length) and contract language (reduction of legalese, simpler language).

Subtask 1.1: Contract Research
Subtask Summary: To develop an informed contract, Solstice will conduct preliminary research on current community shared solar contracts offered by prominent developers in the market. This research will draw on many different sources of information, including other researchers, academic articles, white papers, and industry experts. Research should identify what has been done in this arena, what contract features have been validated (if any), and what features are appropriate to test in our study. Research may take note of whether the impact of state incentives/studies on contract terms has been studied. It will also inform literature review of final publication.

Subtask 1.2: Write Contracts
Subtask Summary: Write prototypes using market research and knowledge of best practices. Prototypes will be used in both financier and subscriber-facing research in order to test their commercial viability. Variation of friendlier contract terms and simpler contract language will allow Solstice to isolate how important each aspect of the contract is to subscribers.

Subtask 1.3: Validate Contracts Externally
Subtask Summary: Contracts are sent out to the mutually agreed-upon experts from Subtask 3.1. After contracts go through process of review and improvement, a small write-up will be completed on the main feedback and how it was incorporated/addressed.

Task 2.0: Develop and Verify Contract Innovation Study Methodology
Task Summary: Comprehensive methodology overviewing data collection methods, risk mitigation, compliance measures (i.e. Human Subjects Training for all involved

staff), and analysis plan for the contract innovation study. The study is comprised of three different data sets: reservation forms from subscribers being enrolled using the validated contracts, questionnaire responses from financiers, and subscriber churn-and-default data secured through developers. Report sent out for external review by academic researchers working with utility performance data and community solar industry experts.

Subtask 2.1: Research on Methodology
Subtask Summary: Preliminary research done on popular methodological strategies in contract research. Research will review literature on subscriber behavior with regards to contract variation. This subtask will also help Solstice identify if additional software will be necessary to complete this project.

Subtask 2.2: Complete the Mandatory Online Certification for Researchers
Subtask Summary: Submit the certification for all researchers/data collectors involved in the project. Solstice will have to identify all employees that may be involved in any step of the process.

Subtask 2.3: Develop Reservation Forms
Subtask Summary: Solstice will need to develop reservation forms to collect subscriber preference data on contract terms and language. A reservation form is used to collect details on subscribers being pitched on a product. In this case, the forms will be used to collect details on subscriber income status, interest in hypothetical solar garden projects, and ability to sign on based on contract terms and language. Reservation forms will be modelled off of previous forms and methods that Solstice has employed in research settings. Reservation forms will vary based on the contract prototype on which they are collecting information.

Subtask 2.4: Write and Pilot Financiers Questionnaires
Subtask Summary: Solstice is planning to collect data from financiers on the price sensitivity for offering a contract with inclusive terms and language. Solstice will do this in the form of a questionnaire to collect both quantitative and qualitative data. The questionnaire will also poll financiers on the ability of a guarantee fund in the absence of robust contract terms data and the necessary ratio of guarantee fund to leveraged capital from investors.

Subtask 2.5: Prepare Informed Consent Documents
Subtask Summary: This document will be modeled on similar documents used to obtain consent from subscribers participating in EnergyScore. This will require incorporating new research procedures, updated questions for subscribers, and any benefits or risks associated with participating.

Subtask 2.6: Prepare IRB Research Project Application
Subtask Summary: IRB approval is necessary to collect data from subscriber reservation forms and financier questionnaires. The IRB Project Application consists of quite a few different forms and should be started well in advance of submission.

Subtask 2.7: Study Protocol Sent to Third Party Reviewers
Subtask Summary: Reviewers will be chosen in Subtask 2.2 and will submit feedback for Solstice to turn around a revised copy by end of BP1.

Subtask 2.8: Determine Minimum LMI Threshold
Subtask Summary: After identifying an initial list of developers that Solstice is likely to work with, Solstice will gather information on aggregate state or regional demographics to determine a minimum threshold for low- to moderate- subscriber data. This research will consist of pulling population statistics and estimating a number or range that describes what percent of the churn and default data will be from LMI subscribers. Additionally, Solstice will conduct research into the options for assessing LMI status, as this can be a complicated and protracted process. Solstice may work with a third-party company that specializes in LMI status verification so as not to take on additional liability for sensitive customer data.

Task 3.0: Stakeholder Outreach
Task Summary: Solstice will be reaching out to a number of stakeholders for multiple aspects of this project, including developers, financiers, and other researchers doing similar work. Solstice already has a wide network of preexisting contacts and will likely start the process. However, Solstice may also reach out to new contacts through phone calls or emails. Solstice may also travel to community solar conferences or other venues to network with financiers and developers. Solstice will obtain Memoranda of Understanding (MOUs) with developers over multiple, established projects. The MOUs will establish the transfer of churn and default data from developers to Solstice.

Subtask 3.1: Identify and Engage Experts
Produce spreadsheet of academic and industry experts who Solstice will reach out to for contract validation and study methodology validation services. Experts may include academics, legal experts, or industry experts.

Subtask 3.2: Developer and Financier Scoping/Networking
Task Summary: Solstice will identify developers and financiers that may want to participate in the contract research study. Solstice will begin by reaching out to our preexisting network of developer partners. However, additional scoping may be necessary and will include activities such as online research, project prospecting, and potentially joining a solar developer network access database (which can sometimes incur fees). Networking may also include travel to conferences in order to meet industry and academic experts and develop contacts.

Budget Period 1 Go/No-Go (GNG) Decision Point(s): Please refer to the Milestone Summary Table below for the Budget Period 1 GNG criteria.

Budget Period 2

Task 4.0: Research Execution for Contract Innovation Study

Task Summary: During this period, Solstice will be conducting a number of data collection activities for the contract innovation study, leveraging software as needed. Participants are randomly allocated to one combination of the contract conditions out of the four possible combinations developed in BP1. Study analysis, writing, and publishing will continue into BP3.

Subtask 4.1: Subscriber Outreach
Task Summary: Solstice's outreach team will be using tactics to enroll subscribers into the study using reservation forms that include, but are not limited to, online and offline advertising, in-person outreach, and community-based organizing. Solstice may slightly vary from our standard subscriber acquisition strategies in order to control for possible study bias, but may largely be similar in order to recreate real-world enrollment conditions. In the case of leads that choose to not sign a reservation form with Solstice, a light-touch, optional exit survey will be administered either over the phone or over the internet. The survey will be a multiple choice question inquiring as to why the potential customer opted out of the subscription.

Subtask 4.2: Financiers Questionnaires
Subtask Summary: A piloted-questionnaire will be sent out to solar project financiers to determine price sensitivity for offering inclusive terms, language. The questionnaire will also poll financiers on desirability of a guarantee fund in the absence of robust contract terms data and the necessary ratio of guarantee fund to leveraged capital from investors. Solstice will aggregate questionnaire results and analyze for trends.

Subtask 4.3: Reservation Forms
Subtask Summary: Solstice will be employing a number of outreach tactics to collect reservation forms from potential subscribers including (but not limited to) newspaper advertisements, online advertisements, flyer distribution, engagement through educational events, and liaising with established community leaders. LMI-specific strategies will be used in order to contact and enroll LMI subscribers. Additionally, Solstice will have a procedure in place to assess LMI-status of subscribers.]]

Subtask 4.4: Developer Churn and Default Data Analysis
Task Summary: This analysis will produce a report on the churn and default data that Solstice obtains from developers with active projects. The report will identify trends in subscriber default and delinquency as they vary by income, payment history, and other variables Solstice determines to be statistically significant. By analyzing churn-and-default data by LMI status, Solstice can demonstrate that there is a much weaker correlation between low-income status and default rates than previously thought by the community solar industry. Solstice will design a plan for analysis of these churn-and-default data acquired through developer partnerships.
To ensure compliance with human behavior research standards, Solstice will obtain IRB approval. Additional review and validation of study design will come from an academic or professional consultancy third-party that Solstice identifies in conjunction with DOE.

Task 5.0: SEEDS-2 Subscriber Performance Research

Task Summary: This research will be a follow-on study from the Solar Energy Evolution and Diffusion Studies-2 (SEEDS-2) award DE-EE0007659 and will tie into final research article. Under SEEDS-2 grant, Solstice collected data on utility payment history and developed a machine learning algorithm that has the ability to accurately predict default and delinquency rates among subscribers, while inclusively qualifying populations typically rejected by traditional credit scoring mechanisms. Solstice then went on to pilot the EnergyScore in a real-world case study. Payment data from the case study, as well as contract data, will be analyzed and presented in this follow-on study.

Subtask 5.1: Data Methodology and Research Design
Subtask Summary: Solstice will develop a robust study design that analyzes subscriber payment performance data as it varies by the type of contract signed by subscribers during the SEEDS-2 grant period.

Subtask 5.2: Data Analysis and Presentation
Subtask Summary: Solstice will use this period to carry out the research plan laid out in Subtask 8.1 and then will summarize the anonymized data received from SEEDS-2 study participants gathered from subscribers enrolled under SEEDS-2 grant and participating in EnergyScore projects in a report for DOE.

Subtask 5.3: Study Dissemination
Subtask Summary: Solstice will identify outlets in which SEEDS-2 EnergyScore research can be published and arrange agreements to ensure the report will be accepted into the outlet. Solstice will author one report/white paper on the SEEDS-2 grant research and have it published in the industry outlet determined.

Task 6.0: Research on Guarantee Fund Activities
Task Summary: Solstice will investigate the necessity of a guarantee fund in the community solar arena through research and outreach. This research will be used to determine the necessity of a Solstice-established guarantee fund. In Solstice's experience, more often than not, guarantee funds do not make developers more or less amenable to more inclusive practices. Solstice will research the use of guarantee funds in the solar market by speaking with both financiers and developers to quantify the size of a guarantee fund necessary to mitigate the risk of an investment. This task will be capped by a decision on whether to pursue further guarantee fund activities in BP3.

Subtask 6.1: Preliminary Research
Subtask Summary: Research will identify existing guarantee funds in the renewable energy sector, as well as identify existing gaps in coverage of LMI projects. Research may include outreach, networking, and travel to conferences convening around financial innovation of loan-loss reserve funds and philanthropy. This research will also involve gathering data to help Solstice make a decision about whether or not to pursue a guarantee fund in BP3.

Subtask 6.2: Guarantee Fund Work Plan

Subtask Summary: Solstice will write a work plan that lays out the necessary steps for forming a guarantee fund in order to understand the full scope of activities required. Solstice will conduct outreach, holding meetings and conversations, and ask established foundations for advice on how best to mitigate developer risk. This work plan will contribute towards deciding if the guarantee fund tasks in BP3 should be pursued.
Subtask 6.3: Guarantee Fund Meetings
Subtask Summary: Solstice will meet with organizations to discuss the formation of a guarantee fund. Solstice may draw on previous guarantee fund research and conversations to set up these meetings. These meetings will contribute towards deciding if the guarantee fund tasks in BP3 should be pursued.

Task 7: Study Dissemination
Task Summary: Solstice will work to have the contract innovation research distributed through a webinar in an effort to benefit community-based organizations, low-income organizers, grassroots organizers, and otherwise marginalized populations that would not otherwise be able to attend or travel to conventional conferences.

Subtask 7.1: Webinar Partnership Scoping
Subtask Summary: Solstice will conduct outreach in order to identify interested partners for hosting a webinar around LMI inclusion in community solar and product innovation. Both regional and national organizations will be considered. Solstice will contact at least three specific organizations.

Budget Period 2 Go/No-Go (GNG) Decision Point(s): Please refer to the Milestone Summary Table below for the Budget Period 2 GNG criteria.

Budget Period 3

Task 8.0: Contract Innovation Study Finalization and Dissemination
Task Summary: Solstice will pursue a number of activities to write and publish the results of the study and create a tangible impact on the solar market through agreements to use best practice contracts.

Subtask 8.1: Analyze Data and Write White Paper
Subtask Summary: Solstice will analyze the qualitative and quantitative data collected in BP 1 through the financier and developer surveys, churn and default data purchase, and reservation form subscriptions. Solstice will use statistical analysis and data modelling software to analyze trends in the data, and then present these trends in a white paper/article.

Subtask 8.2: Finalized Event Details
Subtask Summary: Solstice should identify a hosting platform, advertising strategies to ensure participation by target audiences, identify a day and time, a plan for recording and distributing the webinar, and possible speakers/presenters. Webinar will be hosted and completed as Subtask 11.2.

Subtask 8.3: Host Webinar
Subtask Summary: Solstice will host an online webinar with the goal of reaching community organizers, low-income inclusion advocates, community organizations that work with LMI populations, and other actors in this policy space of community solar. The webinar will be recorded and distributed through Solstice's media center and other advocacy partners interested in sharing the webinar.

Subtask 8.4: Contract Innovation Study Dissemination
Subtask Summary: Solstice will submit abstracts through a rolling process of scoping and applying to conferences, workshops, summits, and other kinds of events as opportunities arise. Additionally, Solstice will publish developer, financier, and subscriber facing articles based on findings contained in manuscript in national and industry news outlets such as Greentech Media, Grist, and Solar Power World.

Subtask 8.5: Best Practice Contract Prototype
Subtask Summary: The most tangible result of these grant activities is a best practice contract prototype which can then be used, in conjunction with the manuscript and validated study, to pitch developers an inclusive and equitable, yet still low risk, method of including LMI subscribers in community solar projects.

Task 9.0: Set-Up for Contract Pilots
Task Summary: Following this research, Solstice hopes to use the finalized contract and the findings of the study to garner interest from developers in using a best-practice contract.
This may include Solstice representatives pitching to developers, presenting at developer conferences and events, and hosting meetings with individual developers, with the objective of securing MOUs to pilot the contracts.

Task 10.0: Legal structure of Guarantee Fund
Task Summary: Should Solstice decide to pursue the creation of a Guarantee Fund (Task 6.0), Solstice will work with legal counsel and fund experts in order to structure a guarantee fund that is both financially and legally sound. This will involve drawing on the previous contacts made through previous guarantee fund activities, and potentially reaching out to a few more specialists in this field.

7. Project Results and Discussion:

Task 1.0: Contract Development, **M1-M12**

Task Summary: Solstice will develop four prototype contracts which will be used in the contract innovation study, with binary variation of inclusive contract terms (no cancellation fee, shorter contract length) and contract language (reduction of legalese, simpler language).
Subtask 1.1: Contract Research **M1-M3**

Subtask Summary: To develop an informed contract, Solstice will conduct preliminary research on current community shared solar contracts offered by prominent developers in the market. This research will draw on many different sources of information, including other researchers, academic articles, white papers, and industry experts. Research should identify what has been done in this arena, what contract features have been validated (if any), and what features are appropriate to test in our study. Research may take note of whether the impact of state incentives/studies on contract terms has been studied. It will also inform literature review of the final publication.

Subtask 1.2: Contract Research, **M4-M12**

Subtask Summary: Write prototypes using market research and knowledge of best practices. Prototypes will be used in both financier and subscriber-facing research in order to test their commercial viability. Variation of friendlier contract terms and simpler contract language will allow Solstice to isolate how important each aspect of the contract is to subscribers.

Subtask 1.3: Validate Contracts Externally, **M11-M12**

Subtask Summary: Contracts are sent out to the mutually agreed-upon experts from Subtask 3.1. After contracts go through a process of review and improvement, a small write-up will be completed on the main feedback and how it was incorporated/addressed.

Milestone 1.1: Contract Research - **Completed**

Milestone 1.2: Contract Language - **Completed**

Milestone 1.3: Contract Validation Expert Identification - **Completed**

Milestone 1.6: List of Variables - **Completed**

GNG-1A: Contract Validation, **M12 - Completed**

Task 1 Final Report:

Solstice began this project phase by conducting a literature review to better understand the community solar space and low-income contract experience. This process provided a strong baseline understanding of what work has been done in this field prior to the execution of this research. Through reviewing reports, scholarly literature, and legislation focused on these issues, Solstice has ensured that this research is designed to build upon the existing knowledge of LMI community solar and address key gaps.

Table 1: Industry experts interviewed during the "Contract Research" phase of Task 1.

Name	Position	Organization	Area of Expertise
Gabe Chan	Assistant Professor	University of Minnesota	Community Solar Researcher

Joseph Pereira	Regulatory Director	Citizens Utility Board MN	LMI Community Solar Advocate
Jenny Heeter	Senior Energy Analyst	NREL	LMI Community Solar Researcher
Odette Mucha	Regulatory Director of SE Region	VoteSolar	LMI Community Solar Expert
Kelsey Read	Program Manager	MA CEC	LMI Solar Financing
Emily Artale	Principal Engineer and Co-owner	Lotus Engineering	Community Solar Researcher
Timothy DenHerder-Thomas	General Manager	Cooperative Energy Futures	LMI Community Solar Expert
Casey Canfield	Assistant Professor in Engineering Management & Systems Engineering	Missouri University of Science & Technology	Community Solar Researcher
Kerry O'Neill	Chief Executive Officer	Inclusive Prosperity Capital	Community Solar Financier

To complete this task, Solstice consulted nine expert stakeholders. Those interviewed included academics, community solar program managers, financiers, and LMI advocates. These conversations were used to collect input on the direction and structure of this research and to build a network of potential advisors to collaborate with throughout the entirety of this project. Through these interviews, Solstice was able to increase our understanding of what contract terms are considered most and least impactful on both a LMI participant's interest in a program and the financial viability of these programs for financiers. Gabe Chan, Assistant Professor from the University of Minnesota and PI for the Chan Lab, suggested Solstice use an experimental design for this project. This approach will allow Solstice to isolate the impact of a specific term on a participant's willingness to sign up for a program. Solstice intends to continue to partner with Chan and the other experts interviewed during this stage to gain input on how best to convey this study's findings for maximizing their impact on the industry. This relationship-building is paramount to the success of our research; therefore, the

success of this stage bodes well for the potential value and impact of this project moving forward.

Building off of progress made in Subtask 1.1, where Solstice engaged in preliminary research on consistencies, differences, and opportunities within community solar customer contracts, Solstice drafted prototype contracts that will be the primary vehicle for data collection during this study. Based on feedback gathered from researchers in the energy equity field, Solstice has chosen a factorial design for this study, which has informed the selection of the contract variables included within this study and the overall design of the prototype contracts.

Prototype contracts were drafted based on industry contracts previously used to enroll customers in existing community solar programs. By basing test contracts on real examples, Solstice ensures that the test contracts are representative of industry-approved contracts. Contract elements were collected directly from developer partners, the publicly-available NY Department of Public Service Database, and secret shopping with developers across the United States. These contracts were reviewed to inform the test variables selected for test contracts and to outline the overall composition of the contracts.

Solstice will use these prototype contracts to evaluate the impact of four contract elements commonly used in subscription contracts for privately-owned, pay-as-you-go community solar projects: 1) starting rate or discount; 2) term length; 3) early termination clause; 4) contract length (pages) (Table 2). These specific contract elements were selected based on preliminary research conducted by Solstice that suggested that these elements are more likely to be impactful on a customer's likelihood to sign-up for a program.

Table 2: Displays the contract variables Solstice will incorporate into the prototype contracts developed for this study.

	Variable 1	Variable 2	Variable 3
Starting Rate or Discount (%)	5%	10%	20%
Term Length (years)	1	25	*n/a*
Contract Length (pages)	10	21	*n/a*
Early Termination Fee	None	Conditional	*n/a*

Starting rate or discount directly impacts the financial benefits customers can incur from a program and has been suggested to be a highly influential factor on an LMI household's willingness to participate in a program. Term length describes how long a participant is subscribed to a program. Programs that run for the life of a PV solar system, up to 25 or 30 years, have been suggested to restrict LMI participation, as LMI people are often renters and may not be likely to occupy the same dwelling for this amount of time. Early termination clauses describe the procedures program participants are required to follow to exit a program prematurely, which often require departing participants to pay a fee or be liable for ongoing program payments, even if they are no longer receiving bill credits. The impact of this term represents the combined effect of concerns around financial value and flexibility, and is also suggested to influence program participation.

Our research pointed to a large disparity in the length and formatting of commonly used community solar subscriber contracts. Trust is often cited as an influential factor on a person's decision to sign up for a community solar program, and longer contracts with excessive legalese can be seen as an attempt to obscure terms that are potentially unfavorable for a customer. Thus, Solstice has chosen to develop two contract templates to test the impact of contract length on program interest: one 21-page contract and one 10-page contract. These contract templates include sections where Solstice will input the contract variables that will be researched through this project. Aside from these variable sections, the contracts were designed to be approximately equal in the terms offered, with the 21-page contract including a higher level of detail and substantial amounts of legalese. Due to this being a factorial study, this project will deploy twenty-four contracts — one for each possible combination of the test variables.

Outside of these test elements, Solstice has identified additional facets of these contracts that are potentially impactful on a customer's willingness to sign up for a program. Example elements include, but are not limited to, upfront cost, transferability of a subscription, allowable payment method, definition of/termination based on default events, and payment schedule. In an attempt to prevent these variables from impacting the results, Solstice has standardized these contract elements based on the most customer-friendly samples collected. Contract language and procedures outside of potentially impactful terms were pulled directly from actual contracts that were redacted to remove any mention of their attached program.

While the intention of these prototype contracts is to solely assess the impact of the four variable categories on contract uptake, it is important to recognize that this data represents a small fraction of the data that will be collected from potential subscribers and developers/financiers. Solstice has designed its prototype contracts to isolate the impact of the specified variables on uptake and will use surveying to gauge perspectives on other topics surrounding the expansion of community solar. The survey

forms that are administered to potential subscribers and to developers/financiers are written to explore both groups' priorities related to community solar. Topics explored will give insight into how, outside of improvements to contracts, community solar can provide more value to communities and what developers see as the most prominent obstacles limiting their ability to engage in LMI community solar.

Our final test contracts have undergone redline revisions from experts in the solar financing, contract law, and community organizing fields (Table 3). These experts represent key stakeholders in determining the ultimate success of the "better practice" contracts that emerge from this research, as Solstice will need each group's compliance with these contracts to make sure they are used in actual inclusive community solar projects following the culmination of this research. These experts were identified for participation based on their knowledge and expertise within their respective fields. Several changes were made to both of the contract templates due to feedback received during these reviews. These changes are summarized in the GNG 1A report, and include changes to the contract language to improve consumer protection standards across both contracts, removing duplicative language, and improving the readability of each contract though the addition of a summary sheet. With these revisions incorporated, Solstice can be confident that the contract prototypes will be seen as legitimate by members of the stakeholder groups that form the primary audiences of this research.

Table 3: A list of industry experts that reviewed the prototype customer contracts. This list applies to Subtask 1.3 and Subtask 3.1.

Name	Position	Organization	Project Role
Ben Healey	EVP of Corporate Development and Finance	Posigen	Project Financier
William Peters	Partner	Gibson, Dunn & Crutcher LLP	Contract Law Expert
Megan Amsler & Lindsey Close	Executive Director; Associate Director of Workforce Training and Operations	Self-Reliance	Community Group Leader

The pre-development process has incorporated perspectives from each of the stakeholders involved in this research and has led to an expansive, yet focused, study

plan that effectively assesses what product innovations will be necessary for the expansion of community solar.

Task 2.0: Develop and Verify Contract Innovation Study Methodology, **M1-M12**

Task Summary: Comprehensive methodology overviewing data collection methods, risk mitigation, compliance measures (i.e. Human Subjects Training for all involved staff), and analysis plan for the contract innovation study. The study is comprised of three different data sets: reservation forms from subscribers being enrolled using the validated contracts, questionnaire responses from financiers, and subscriber churn-and-default data secured through developers. Report sent out for external review by academic researchers working with utility performance data and community solar industry experts.

Subtask 2.2: Complete the Mandatory Online Certification for Researchers, **M6**

Subtask Summary: Submit the certification for all researchers/data collectors involved in the project. Solstice will have to identify all employees that may be involved in any step of the process.

Subtask 2.3: Develop Reservation Forms, **M7-M10**

Subtask Summary: Solstice will need to develop reservation forms to collect subscriber preference data on contract terms and language. A reservation form is used to collect details on subscribers being pitched on a product. In this case, the forms will be used to collect details on subscriber income status, interest in hypothetical solar garden projects, and ability to sign on based on contract terms and language. Reservation forms will be modelled off of previous forms and methods that Solstice has employed in research settings. Reservation forms will vary based on the contract prototype on which they are collecting information.

Subtask 2.4: Write and Pilot Financiers Questionnaires, **M7-M10**

Subtask Summary: Solstice is planning to collect data from financiers on the price sensitivity for offering a contract with inclusive terms and language. Solstice will do this in the form of a questionnaire to collect both quantitative and qualitative data. The questionnaire will also poll financiers on the ability of a guarantee fund in the absence of robust contract terms data and the necessary ratio of guarantee fund to leveraged capital from investors.

Subtask 2.5: Prepare Informed Consent Documents, **M8-M10**

Subtask Summary: This document will be modeled on similar documents used to obtain consent from subscribers participating in EnergyScore. This will require incorporating new research procedures, updated questions for subscribers, and any benefits or risks associated with participating.

Milestone 1.4: Study Design and Protocol – **Completed**

Milestone 1.5: IRB Approval for Study **- Completed**

GNG-1C: Verified Study Design and Protocol, **M12 - Completed**

Task 2 Final Report:

On October 6th, 2020, Solstice Initiative submitted GNG 1C, a report detailing a study design and protocol for the execution of this research. Included within this report were the following distinct project components that make up the study design: data analysis plan, data collection plan, Solstice staff CITI completion documents, informed consent forms, research materials, and an IRB exemption certificate from Ethical and Independent Review Service. The data analysis plan details the central researchable questions, hypotheses, and analytical strategies that will be used to explore the product priorities of households and project developers and financiers across the eight states involved in this research. The data collection plan outlines a protocol that the Solstice team will follow to effectively compile the data required to facilitate the analyses described in the data analysis plan. The Solstice staff CITI completion documents include records of Human Subjects Research training certification for all core project personnel. The informed consent forms include drafts of the Community Solar Priorities in-person survey, Community Solar Priorities online survey, and Developer and Financier informed consent documents that will be provided to respondents prior to their participation in this research. Finally, research materials include the Community Solar Priorities survey form, Developer and Financier survey form, and focus group discussion outline. In combination, this report compiles the central components necessary for the successful execution of this study.

The data analysis plan lays out a plan for testing the data collected through each of this project's three distinct components: the Community Solar Priorities research, Developer & Financier survey, and churn & default analysis. Included in this plan are the researchable questions, hypotheses, population, sample size target, and schedule necessary for completing each component of this research.

Table 4: The questions each section of this study will focus to best explore each component of the community solar product from the perspective of multiple stakeholders.

Research Component	Researchable Questions
Community Solar Priorities Research	1. How does (1) subscriber contract page length, (2) savings rate included in a subscriber agreement, (3) term length attached to a subscriber agreement, or (4) cancellation fee attached to a subscriber agreement influence adoption rates for community shared solar?
	2. How does contract adoption rate differ between contract variables across term categories?

	3. How do varying demographics respond differently to contract variables included in community shared solar subscriber contracts?
	4. Outside of customer contract priorities, what other preferences do individuals have for the design of community solar programs?
Developer and Financier Research	Average program terms 1. Is there a significant difference in the savings rate offered by developers and financiers within their community solar programs? 2. Is there a significant difference in the term length offered by developers and financiers within their community solar programs? 3. Is there a significant difference in the cancellation clauses offered by developers and financiers within their community solar programs? 4. Is there a significant difference in subscriber contract page length offered by developers and financiers within their community solar programs?
	Do economic-financing factors influence the approach developers and financiers take to structuring community solar subscriber contracts?
	Under what conditions are developers willing to adjust their programmatic terms to include LMI populations in their programs?
Churn and Default Research	1. What are average churn and default rates experienced by solar developers?
	2. In what ways do churn and default rates differ across income groups?
	3. In what ways do churn and default rates differ across homeownership status?
	4. In what ways do churn and default rates differ across races?
	5. Within a project lifecycle, when are subscribers more likely to churn and default?

	6. In what ways do contract variables influence churn and default rates?

Community Solar Priorities Research

Our Community Solar Priorities survey is focused on understanding the priorities of various communities for the design of community solar products. The data collected through this facet of the research and the perspectives centered within this research will inform the short and long-term innovation of community solar products.

The short-term focus will test customer enthusiasm for specific subscriber agreement terms by asking participants to indicate whether or not they would be interested in participating in a program based on their review of the prototype contracts described earlier in this report. This adoption/non-adoption data represents a primary outcome for this research. This data will be supplemented with data collected on the complexity and organization of these contracts. Respondents will be asked to independently review two contracts to support this study's robust data collection goals. Solstice will use a regression analysis to assess which variables are most significant in determining whether or not a respondent would consider signing up for a program. This analysis will highlight the tradeoffs customers make between programmatic terms and how priorities differ across demographics, providing developers and financiers with valuable information on how they can adjust their products to best incentivize participation in the communities they're working in. For the short-term focus of this research, Solstice will be most interested in surveying respondents that are aware of community solar and represent the populations most likely to adopt community solar in the near future, namely high- and moderate-income homeowners.

The long-term focus of this research is focused on assessing customer priorities for a range of components outside of customer agreements that still constitute the community solar "product". This includes surveying respondents on topics including, but not limited to, project siting, single-billing, ownership, and workforce development. Solstice considers this section of this research to be future-focused because many of these product components might require policy changes to be deployed on a meaningful scale, whereas the contract research offers data on programmatic changes that have a greater likelihood of immediate implementation and impact. As this research is focused on the long-term design of community solar, Solstice aims to include the perspectives of populations that are not currently effectively reached by community solar, including those that weren't previously aware of community solar and those that may not see the current market's offerings as accessible. This is likely to include low- to moderate-income and BIPOC communities, whose preferences are crucial for informing the equitable expansion of community solar. By oversampling low-income and BIPOC

communities, both focus' on both time horizons will be embedded in understanding these communities' priorities. Data will be presented in order to show how priorities might change based on changes in demographics.

Revisions of the Community Solar Priorities survey form have been incorporated from representatives from All In Energy, Rising Sun Center for Opportunity, the Bonneville Environmental Foundation, members of the Green Justice Coalition, and Shalanda Baker, a professor of law and public policy at Northeastern University. All of these reviewers are representatives from nonprofit organizations that work on environmental justice issues facing LMI and BIPOC communities. Solstice has invited input on this survey from numerous experts in the field of environmental justice to ensure that this study benefits the populations it intends to research — low- to moderate-income populations. This feedback has led to the development of a survey that maintains the ability to inform program design through testing the appeal of subscriber agreements while better centering community voice on their priorities regarding community solar program design moving forward. By consistently engaging community advocates on this research, and structuring the survey to work on multiple scales, Solstice aims to collect a comprehensive community perspective on the most inclusive form of this product.

To ensure this research captures a nuanced understanding of the priorities of the communities included in this research, we're planning to hold focus group discussions with a diverse group of respondents focused on understanding the underlying context for community preferences. These focus group discussions will be aimed to explore aspects of community solar like trust, wealth-building, and environmental agency. These focus group discussions will be co-designed in partnership with community organizations and a focus group discussion moderator.

In August, this survey experience was piloted with a select number of respondents, recruited for this survey through All In Energy and Union Capital Boston, a community group with members in the Roxbury/Dorchester/Mattapan area of Boston. For this pilot survey, four prototype contracts were randomly assigned to respondents (table 6). Contracts 1 and 3 represent the assumed-most restrictive and inclusive contract options included within this research. The goal of this pilot survey was to assess the validity of the survey experience by testing whether adoption rates significantly differed depending on the product terms embedded within the prototype contracts, the primary hypothesis involved in the Community Solar Priorities Survey. The pilot survey delivered this expected result, as adoption rates were significantly different between contracts 1, 3 and 4.

Table 5: The four prototype contracts tested within this research varied in their embedded terms, capturing a range of the contracts that will be tested within this research.
***+denote significance at the p=.05 level.**

	Savings	Term Length	Contract length	Termination fee	Adoption Rate
Contract 1	5%	25 years	23 pages	yes	23.08%*+
Contract 2	10%	1 year	23 pages	yes	37.25%
Contract 3	20%	1 year	9 pages	no	45.10%*
Contract 4	10%	25 years	9 pages	no	45.83%+

While the main goal of this pilot was to test this hypothesis, this process also provided valuable insights regarding the design and future deployment of this survey. For instance, the likelihood to participate in a program with a termination fee of $251 or more was greatly reduced compared to programs with a minimal or no termination fee. This suggests a $250 termination fee might be a breaking point for potential community solar participants. In the full survey, Solstice will seek to expand on this initial insight and assess the impact of this product term on program participation.

Through collaboration with energy equity leaders and researchers, Solstice has come up with a research plan and associated materials that will collect a comprehensive community-centered perspective on the future of community solar. By centering the community perspective within this research, this study aims to improve the industry's understanding of how community solar can better meet the needs of LMI and BIPOC communities while emphasizing the importance of designing LMI community solar programs around the specific needs of the community a developer is working in.

Developer and Financier Survey

Solstice will launch a second survey in conjunction with its Community Solar Priorities survey. This second survey will be distributed to community solar developers and financiers. The survey has been written to, in part, mirror aspects included in the Community Solar Priorities survey. As a result, Solstice staff will address the stated research questions in a way that is comprehensive and includes multiple perspectives.

To accomplish this task, Solstice has framed the Developer and Financier survey around five key objectives. These objectives are copied below:

Table 6: Developer and Financier survey objectives

Community Solar Developer and Financier Survey Objectives
Capture state-specific community solar programs' impact on project development
Capture developers' experience working with low to moderate income subscribers
Capture average product terms offered by developers
Capture developers' leniency and restrictiveness around contract terms assumed to be more inclusive
Quantify rates of churn and default for average projects to understand if developers have a sense of when churn or default is likely to happen

The objectives allowed Solstice to frame survey questions in a way that ensures survey responses will give strong insight into how developers and financiers choose to structure community solar programs. The first objective, which focuses on policy, recognizes that a community solar project is largely dictated by the state regulations specific to where the given project is located. By asking where developers are operating projects and where they intend to operate in the future, this study will strengthen the industry's understanding of what does and does not constitute operable policy for developers considering entering new markets. First, this research will review trends of where the majority of projects are operating. Solstice will then review these policies for language specific to equity and inclusion in community solar. While policy is not the primary focus of this research, policy decisions do play a pivotal role in community solar and project findings would be flawed if they did not account for policy-driven impacts. Solstice will use findings here to begin crafting policy recommendations that might allow developers and financiers to offer more inclusive contract terms.

The following section of questions are structured around gaining insight into developers' prior experience working with low income communities. This section will also capture the average product terms that developers offer in their average projects. Here, Solstice aims to develop an understanding of the degree to which developers prioritize working with low income and BIPOC communities and the terms offered to these communities. The following survey objectives, capture average product terms offered by developers, capture developers' leniency and restrictiveness around contract terms assumed to be more inclusive, and quantify rates of churn and default for average projects to understand if developers have a sense of when churn or default is likely to happen, are structured to capture the factors that contribute to developers' decisions to write subscriber agreements that use more or less inclusive terms and to quantify expected rates of churn and default. These questions ask for respondents to answer whether or not projects experience higher rates of churn and default for low-income and non-low-

income communities. These survey responses will then be compared with the historical churn and default project data to be collected as a later component of this research.

A series of general questions are included at the end of the survey. In this section, Solstice will survey developers to understand how COVID-19 has impacted their current development projects. Questions are also framed to ask whether or not developers approach outreach to LMI communities differently than they might to market rate customers. The final question of the survey will ask respondents if they would be willing to participate in a follow-up conversation with Solstice staff. This semi-structured interview will allow for deeper discussion on the issues presented in the survey, allowing for more nuanced understanding of driving forces behind project development. During these conversations Solstice will seek to pull direct quotes that might be used in the final whitepaper that is written as a deliverable for this project. In total there are slightly more than 30 questions.

In preparation for distributing the survey, Solstice has shared the document in draft form with several key parties. Solstice's own Business Development team, which interacts regularly with solar developers, has assessed the survey for answerability and to gauge its effectiveness in meeting stated goals. Subsequently, Solstice has shared this survey with external reviewers operating in key roles in advancing community solar. Staff with the Coalition for Community Solar Access have reviewed the survey and made similar recommendations to improve question phrasing and answerability. The Coalition for Community Solar Access is a national Coalition of businesses and nonprofits working to expand customer choice and access to solar for all American households and businesses through community solar.

The Community Solar Priorities survey as well as the Developer and Financier survey have been loaded into Qualtrics, the online survey platform selected for this research. Consequently, Solstice staff have worked to format and arrange questions so that they flow and are presented clearly.

Task 3.0: Stakeholder Outreach, **M5-M12**

Task Summary: Solstice will be reaching out to a number of stakeholders for multiple aspects of this project, including developers, financiers, and other researchers doing similar work. Solstice already has a wide network of preexisting contacts and will likely start the process. However, Solstice may also reach out to new contacts through phone calls or emails. Solstice may also travel to community solar conferences or other venues to network with financiers and developers. Solstice will obtain Memoranda of Understanding (MOUs) with developers over multiple, established projects. The MOUs will establish the transfer of churn and default data from developers to Solstice.

Subtask 3.1: Identify and Engage Experts, **M6-M7**

Subtask Summary: Produce spreadsheet of academic and industry experts who Solstice will reach out to for contract validation and study methodology validation services. Experts may include academics, legal experts, or industry experts.
Subtask 3.2: Developer and Financier Scoping/Networking, **M5-M12**

Subtask Summary: Solstice will identify developers and financiers that may want to participate in the contract research study. Solstice will begin by reaching out to our preexisting network of developer partners. However, additional scoping may be necessary and will include activities such as online research, project prospecting, and potentially joining a solar developer network access database (which can sometimes incur fees). Networking may also include travel to conferences in order to meet industry and academic experts and develop contacts.
GNG-1B: Memorandum of Understanding, **M12 – Completed**

Task 3 Final Report:

Solstice has conducted extensive outreach to stakeholders to incorporate feedback and to better understand motivations and limiting factors that limit adoption of more equitable community solar programs. Conversations with experts pointed to a need to better define the geographic scope of this study. By adjusting the research's scale, Solstice is able to go deep in several specific areas without losing a level of detail, granularity, or straining research capacity. These conversations led to a decision to limit the scope to cover eight distinct states: Massachusetts, New York, California, Oregon, Illinois, Maryland, Colorado, and Minnesota. These states were selected based on several factors including the presence of community solar enabling legislations and maturity of the program. In selecting these states Solstice sought to maintain a breadth of geographies in this research, while still being able to define a manageable scale. Solstice has conducted community research in these states and developed a list of close to 150 community-based organizations within the defined study area. In the coming months, Solstice will build partnerships with a number of these organizations in order to best coordinate survey distribution. Continued outreach to these groups will ensure equitable representation across the study area. By basing the geographic-scope of this study at the state level, Solstice will be able to develop case studies that explore detailed aspects of each state's success in rolling out community solar programs, while maintaining an ability to make state-specific recommendations based on research findings.

Additional outreach has been conducted to fulfill subtask 3.1. Academic experts, community solar industry stakeholders, and community organizations working in the community solar space have played integral roles in this research to date. Over the past few project months, Solstice has invited collaboration from community solar experts, researchers, and community-based organizations on multiple components related to the design of this study. Solstice has developed its data analysis and collection plans in

partnership with NMR Group Inc., a research consulting firm specializing in program evaluation and research in the energy-efficiency and renewable energy fields. This partnership is geared at ensuring each facet of the study design and protocol is operational and statistically valid. Two external study design reviewers, Gilbert Michaud, Ph.D. and Casey Canfield, Ph.D., have completed reviews of the study design and protocol developed by Solstice and NMR Group Inc. Solstice has incorporated detailed feedback from these three parties to reach the final, Validated Study Design and Protocol submitted to meet the requirements of GNG-1C.

Table 7: A list of academic, legal, industry, and community organizing experts that contributed to this study through reviewing the study design or prototype contracts.

Name	Position	Organization	Project Role
Ben Healey	EVP of Corporate Development and Finance	Posigen	Contract Review - Project Financier
William Peters	Partner	Gibson, Dunn & Crutcher LLP	Contract Review - Contract Law Expert
Megan Amsler	Executive Director	Self-Reliance	Contract Review - Community Group Leader
Lindsey Close	Associate Director of Workforce Training and Operations	Self-Reliance	Contract Review - Community Group Leader
Casey Canfield, PhD.	Assistant Professor in Engineering Management & Systems Engineering	Missouri University of Science & Technology	Study Design Review - Community Solar Researcher
Gilbert Michaud, PhD.	Assistant Professor	Ohio University	Study Design Review - Community Solar Researcher

Greg Clendenning, PhD.	Director	NMR Group	Study Design Review - Renewable Energy Researcher
Chris Russell, PhD.	Senior Quantitative Analyst	NMR Group	Study Design Review - Renewable Energy Researcher

Solstice has made significant progress to complete subtask 3.2, Developer and Financier Scoping/Networking. Industry trade associations, such as the Coalition for Community Solar Access, have been identified as primary means to engage participation from solar developers in the developer-facing aspects of this research. The Coalition for Community Solar Access has agreed to distribute Solstice's developer survey to its membership base when data collection begins. Currently, there are over 35 active members in this coalition. Another key avenue to engage with respondents will be the National Community Solar Partnership dashboard. This dashboard represents a group of stakeholders that are dedicated to working in community solar, and therefore are primary targets for survey dissemination. To date, Solstice has engaged with the National Community Solar Partnership dashboard to share information about this research and to source potential participants to share churn and default data, which is discussed more below. Solstice also plans to tap its network of strong relationships with community solar developers across the country to increase participation in this research. Solstice staff have drafted a growing list that will be used to distribute its Developer and Financier survey.

Solstice has made significant progress to meet GNG-1B: Memorandum of Understanding. Arcadia Power has signed a memorandum of understanding with Solstice Initiative agreeing to provide at least 2 MW of historic churn and default data from their existing projects. This dataset will include LMI subscribers. In addition to providing customer's monthly payment history, Arcadia will also provide data on the contract subscribers have signed. This data will include contract savings rate, term length, cancellation clause, and length (number of pages). Solstice has partnered with Experian PLC to purchase an additional dataset to be appended to that collected from Arcadia. This secondary data will encompass a broad range of demographic and income variables that will allow Solstice to run substantial analyses into the rates of churn and default for low income subscribers.

Solstice has secured a second memorandum of understanding from Energy Outreach Colorado. This MOU stipulates that Energy Outreach Colorado will provide Solstice with

at least 2 MW of program data from community solar projects. All of this data will be representative of low income households in Colorado. Due to issues around confidentiality and data sharing, Energy Outreach Colorado is unable to provide identifying information that will allow Experian to pin the dataset provided to their own database. While useful for portions of analysis and the discussion section of the forthcoming white paper, this data will provide the granularity necessary to pin to Experian's database.

Due to difficulty filling low-income projects in Colorado, many developers donated the 5% LMI carve out dedicated to projects. As a result, households may not make monthly payments for the bill credits they receive. The data provided by Energy Outreach Colorado may lack detailed payment history due to this fact. This state-specific market failure illustrates that the community solar industry in Colorado is not built to incentivize developers to work with low-income communities in a substantive way. Solstice plans to collect and analyze this data despite it not including some key attributes. This data, and data regarding the low-income community solar market in Colorado collected via interviews with Energy Outreach Colorado staff, will be used as a case study in this analysis. This case study will make a strong argument that the Colorado market is not functioning in a way that can sustain low-income community solar long term. The case study will make recommendations to improve contract recommendations as found by this study.

Solstice is currently in the middle of a number of other fast moving conversations with developers to secure additional MOUs to provide a dataset similar to that which will be provided by Arcadia. Co-op Power, which has focused intently on community solar since 2016, has made a verbal commitment to signing an MOU at this time. Because of Co-op Power's leadership structure, the final decision to sign the MOU lies with their Board. Conversations with Co-op Power's President and CEO have confirmed that she is fully supportive of sharing project data and does not expect the Board to reject this proposal. As of the time of writing this Continuation Application, all materials have been provided to Co-op Power to be distributed to board members. Solstice is currently awaiting their response, which is expected by the end of October.

Several other developers are currently reviewing the request with their legal teams. US Solar and Clean Energy Choice are both at this stage. Pivot Energy has also expressed strong interest in sharing data and is currently working internally with their team to assess whether or not they will be able to complete the request. Solstice expects to secure additional MOUs from the developers listed.

To date, Solstice has conducted outreach to approximately thirty community solar developers. Unfortunately, many have cited that they do not have data to share at this time. Some developers have pointed out that they have not enrolled subscribers in projects yet and that they have projects will be coming online soon. Developers in these

situations have shown interest and have asked if they could share data in several years once they have historic churn and default rates collected. Other developers have cited COVID-19 related impacts, noting they do not have the time or staff resources to devote to this request. COVID-19 has also resulted in more drawn out conversations with developers due to staff capacity as well. This constraint has resulted in Solstice still having ongoing conversations with organizations around data sharing. Some developers, like Energy Outreach Colorado, have run into issues related to privacy and data sharing. When conducting outreach for this request, Solstice has also asked if developers would be willing to participate in the survey component of this research. Nearly all developers have agreed to this request, and have been added to a future distribution list.

In order to produce meaningful results, Solstice has asked for developers to provide data that spans a period of two years. By collecting data over this given time period, we are confident that we will be able to document episodes of churn and default as they have occurred historically. In addition to exploring the relationship between demographics and churn and default rates, one secondary question we intend to answer is if there is a period of time after signing a contract during which a subscriber is most likely to default on payment or churn from a project. Having data spanning a period of at minimum two years will allow for this analysis across time periods. Based on our submitted and validated study design, we do not deem it necessary to require individuals included in the dataset to have been subscribed for a minimum amount of time.

Solstice has established relationships with Experian staff to create a secure system to manage the data transfer associated with this research component. This process is outlined here. Experian will set the Third Party (solar developer) up with a Secure Transport Site (STS) hosted by Experian. Experian will provide the solar developer with a User ID and temporary password, which will allow the solar developer to login to the STS and establish a permanent password. The solar developer will find two folders located in the STS, to and from EXP. They will then select the To EXP File Folder and will upload their input file. A Study ID will be assigned to each consumer at this stage. The developer will provide a separate performance file to Solstice Initiative all variables, exclusive of name and address, outlined above along with the proper Study ID. These variables will be representative of the contract terms associated with a particular community solar project. The developer will not share any Personal Identifying Information or PII with Solstice. Experian will pin their extensive database to the consumers in the file and then destroy the input file. Experian will then assign its own unique user ID along with the Study ID provided and return all of the credit data, minus the Personal Identifying Information like name and address. This file will be sent to Solstice for final analysis.

Task 4.0: Research Execution for Contract Innovation Study, **M14-M30**

Task Summary: During this period, Solstice will be conducting a number of data collection activities for the contract innovation study, leveraging software as needed. Participants are randomly allocated to one combination of the contract conditions out of the four possible combinations developed in BP1. Study analysis, writing, and publishing will continue into BP3.

Subtask 4.1: Subscriber Outreach, **M14-M30**

Subtask Summary: Solstice's outreach team will be using tactics to enroll subscribers into the study using reservation forms that include, but are not limited to, online and offline advertising, in-person outreach, and community-based organizing. Solstice may slightly vary from our standard subscriber acquisition strategies in order to control for possible study bias, but processes may be similar in order to recreate real-world enrollment conditions. In the case of leads that choose to not sign a reservation form with Solstice, a light-touch, optional exit survey will be administered either over the phone or over the internet. The survey will be a multiple choice question inquiring as to why the potential customer opted out of the subscription.

Subtask 4.2: Financiers Questionnaires, **M15-M18**

Subtask Summary: A piloted-questionnaire will be sent out to solar project financiers to determine price sensitivity for offering inclusive terms, language. The questionnaire will also poll financiers on desirability of a guarantee fund in the absence of robust contract terms data and the necessary ratio of guarantee fund to leveraged capital from investors. Solstice will aggregate questionnaire results and analyze for trends.

Milestone 2.1: Financier Survey, **M18 – Completed**

Subtask 4.3: Reservation Forms, **M15-M21**

Subtask Summary: Solstice will be employing a number of outreach tactics to collect reservation forms from potential subscribers including (but not limited to) newspaper advertisements, online advertisements, flyer distribution, engagement through educational events, and liaising with established community leaders. LMI-specific strategies will be used in order to contact and enroll LMI subscribers. Additionally, Solstice will have a procedure in place to assess LMI-status of subscribers.

Milestone 2.2: Reservation Forms, **M17 – Completed**

GNG-2C: Reservation Forms, **M32 – Complete**

Subtask 4.4: Developer Churn and Default Data Analysis
Task Summary: This analysis will produce a report on the churn and default data that Solstice obtains from developers with active projects. The report will identify trends in subscriber default and delinquency as they vary by income, payment history, project contract data, and other variables Solstice determines to be statistically significant. By analyzing churn-and-default data by LMI status, Solstice will analyze if there is a much weaker correlation between low-income status and default rates than previously thought

by the community solar industry. Additionally, analyzing the relationship between contract data and churn and default rates will allows us to assess whether the type of contract a customer is subscribed to is correlated with the likelihood of that subscriber defaulting on their payments or leaving a program.

This data will be supplemented by payment performance and contract data collected through the Solar Energy Evolution and Diffusion Studies-2 (SEEDS-2) award DE-EE0007659. Under SEEDS-2 grant, Solstice collected data on utility payment history and developed a machine learning algorithm that has the ability to accurately predict default and delinquency rates among subscribers, while inclusively qualifying populations typically rejected by traditional credit scoring mechanisms. Solstice will design a plan for analysis of these churn-and-default data acquired through developer partnerships, and will supplement this data with data collected through SEEDS-2 and the developer and financier surveys, provided Solstice is able to collect the data necessary to support a meaningful analysis of the relationship between churn and default rates and EnergyScore qualification. To ensure compliance with human behavior research standards, Solstice will obtain IRB approval or exemption. Additional review and validation of study design will come from an academic or professional consultancy third-party that Solstice identifies in conjunction with DOE.

GNG-2B: Developer Churn and Default Data Analysis, **M32 – Complete**

Task 4.4 Final Report:

This research incorporates data from three distinct datasets: (1) Community Solar Priorities Research: survey forms completed by respondents of varying demographics assessing the favorability of factorial test contracts and offering feedback on various aspects of community solar product; (2) Developer and Financier Research: survey responses from solar developers and financiers to assess price sensitivities of language used in contract agreements; and (3) Churn and Default Research: records of subscribers leaving programs and missing payments provided by solar developers. Additional information about survey methodologies, copies of survey questions, and regression equations can be found on the public GitHub pages made available by the authors [11].

Community Solar Priorities Survey

To evaluate potential customers' willingness to sign up for CSS and identify contract attributes that are correlated with differing rates of contract adoption, a survey was conducted in which respondents were asked to evaluate two hypothetical community solar contracts with varying contract terms. Additional feedback in the form of open response questions was collected on various solar product offerings but is not reported for brevity. To analyze likelihood of contract adoption, a logit model is used to estimate respondents' stated willingness to enroll in the contracts they reviewed, controlling for available demographic characteristics.

The survey data was collected in 2021, resulting in 1,493 unique individuals and 2,986 contract reviews, as each individual reviewed two contracts. We sought to produce a representative sample, developing a sampling scheme and survey weights using data from the American Community Survey (ACS).

Developer and Financier Survey

The developer and financier research consists of an analysis of survey data in which each respondent was asked to provide estimated community solar contract attributes, including estimated savings rate, term length and cancellation fee. Respondents were asked if these rates differ when being offered to income-qualified respondents, and if the difference was positive or negative relative to the general population.

Additionally, respondents reported the relative degree of importance of community solar access for income-qualified individuals is qualitatively coded using a five-point Likert scale. These factorized survey questions included three main sections. The first related to a variety of factors that may influence the respondent's ability to make community solar projects accessible to income-qualified populations. Secondly, which internal factors were most important that lead to the inclusion of income-qualified populations. Finally, what factors affect the project's ability to fill out enrollment in a timely and efficient manner. For brevity, we report only selected findings.

The developer and financier survey data were collected in 2022 resulting in 254 responses received. Due to the small sample size and exploratory nature of this research, we simply report the topline results of this survey without further analysis or significance testing.

Churn and Default

Customers in existing community solar projects typically pay a monthly subscription fee. Participation in community solar farms is voluntary, hence customers may exit the program at any point, occasionally subject to a cancellation fee determined in the contract. Churn refers to the act of a customer exiting the CSS program whereas default refers to the customer failing to pay the monthly subscription fee.

Monthly account-level data was collected from two community solar projects from January 2020 to April 2022, resulting in 812 accounts. We supplemented account-level information with individual-level demographic data from Experian, including Experian's Income Insight Score (a proxy for income), Experian's VantageScore (an alternative credit score metric), and other demographic data such as gender, education, occupation, and homeownership status.

Community Solar Priorities Survey

A logistic regression model is employed to measure Ysignup , the probability of contract adoption, controlling for the following contract attributes and demographic variables:

$$Ysignup=0+\ 1xsavings\ rate\ +\ 2xcontract\ years+\ 3xcontract\ pages+\ 4xcancel\ fee+\ 5xincome+\ 6xrace+\ 7xhomeowner+\ 8xfamiliarity+\ 9xcontract\ reviewal\ time+\ i$$

Contract attributes include savings rate, contract length and pages, cancellation fees, time spent reviewing the contract and of which contracts were reviewed. Demographics include income, race, homeownership status, and familiarity with community solar.

Table 8 below shows the contract attributes and demographic data from the surveyed population, along with the rates of contract adoption ("Signup Status"). The contracts that respondents reviewed varied along the following features: (1) the program's savings rate compared to the typical monthly electricity bill, (2) the program's cancellation fee, (3) the contract term's length in years, and (4) the page length of the contract.

Signup Status	No, N = 1,215	Yes, N = 1,771
Savings Rate		
5% savings rate	418 (34%)	583 (33%)
10% savings rate	404 (33%)	599 (34%)
20% savings rate	393 (32%)	589 (33%)
Cancellation Fee		
$250 Cancellation Fee	612 (50%)	879 (50%)
Zero Cancellation Fee	603 (50%)	892 (50%)
Contract Length Pages		
10-page contract	602 (50%)	889 (50%)
20-page contract	613 (50%)	882 (50%)
Contract Length Years		
1-year contract	572 (47%)	924 (52%)
25-year contract	643 (53%)	847 (48%)
Race		
01 White	511 (42%)	693 (39%)
02 Black	223 (18%)	357 (20%)
03 Hispanic	151 (12%)	263 (15%)
04 Asian	192 (16%)	242 (14%)
05 Other POC	138 (11%)	216 (12%)
Homeowner Status		
01 Homeowner	652 (54%)	1,076 (61%)
02 Renter	563 (46%)	685 (39%)
Income		
01 High	333 (27%)	439 (25%)
02 Low	398 (33%)	420 (24%)

03 Moderate	484 (40%)	912 (51%)
Familiar with CSS		
01 Less familiar	804 (66%)	550 (31%)
02 More familiar	411 (34%)	1,221 (69%)

Table 8. Summary Statistics by Signup Status

Table 9 details the probability of contract adoption across various contract terms. When holding all other variables constant, low-income individuals are less likely to adopt contracts compared to high-income individuals.

Variable	**Probability of Contract Adoption** **Odds Ratios**						
10% savings rate	1.131	1.071	1.062	1.124	1.125	1.17	1.17
20% savings rate	1.098	1.071	1.072	1.08	1.081	1.124	1.127
02 Moderate income		1.433**	1.367*	1.354*	1.360*	1.195	1.193
03 Low income		0.801	0.742*	0.794	0.793	0.700*	0.706*
02 Black			1.184	1.183	1.178	1.095	1.078
03 Hispanic			1.31	1.367	1.378	1.185	1.175
04 Asian			0.904	0.93	0.932	0.985	1.005
05 Other POC			1.225	1.461	1.458	1.555*	1.558*
02 Renter				0.730*	0.722**	0.913	0.933
20-page contract					0.938	0.936	0.945

25-year contract					0.801*	0.796*	0.799*
$250 Cancellation Fee					1.013	1.039	1.043
02 More familiar						4.355***	4.388***
02 More review							1.291*
Reference Categories: Savings Rate - 5%; Income - High Income; Race - White; Homeownership - Home Owner; Contract Pages - 10 pages; Contract Years - 1 Year; Cancellation Fee - Zero; Familiarity - Less Familiar; Review Time - Less							

* p<0.05 ** p<0.01 *** p<0.001

Table 9. Probability of Contract Adoption Regression Results, Odds Ratios

From the second model results, the odds of contract adoption for medium income participants are 1.8 times those of low-income participants. No statistically significant difference in contract adoption is observed when respondents are shown differing savings rates. The strongest indicator of probability of sign up is familiarity with the subject of community solar. Relative to less informed participants, more informed participants are 4.4 times more likely to sign up, holding constant all other contract and demographic attributes.

Developer and Financier Survey

The results from the Developer and Financier Survey are presented in Figures 1 and 2. Figure 1 shows the factors for making CSS accessible to income-qualified customers. 55.5% of developer respondents highlighted customer acquisition costs as the largest barrier to enrolling income-qualified customers.

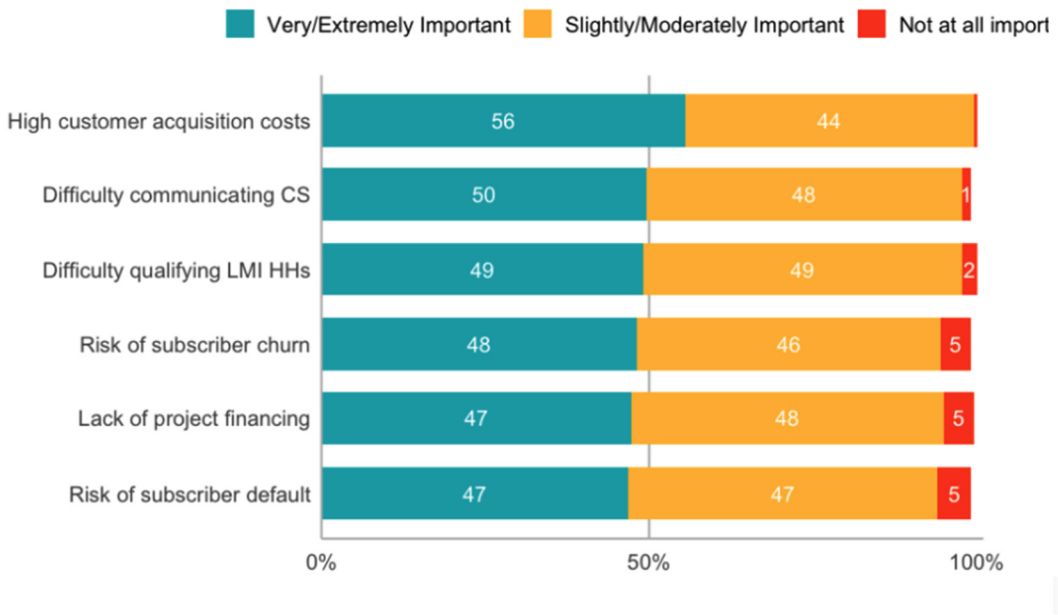

Fig. 1. Factors to make CSS Accessible to LMI Customers

Figure 2 shows the top factors that influence the decision if developer and financiers will include LMI customers in their projects. The importance of policy requirements is key when deciding whether to include LMI individuals in community solar projects. 63% of developers noted that policy requirements are very or extremely important. This was the highest-rated category compared to company interest, developer/financier interest, equity and inclusion, and community interest.

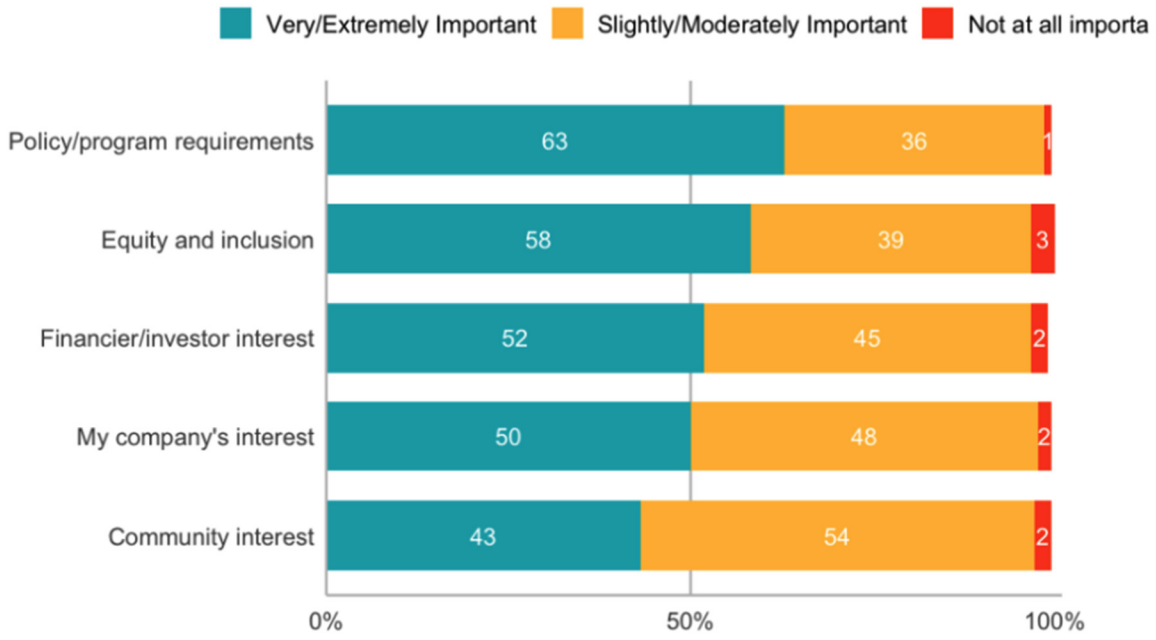

Fig. 2. Factors to influence decision to include LMI Customers in Projects

Churn and Default

For the final component of the research, we analyze probability of churn or default in two active community solar farms. A logistic regression model is employed to measure Ychurn , the probability of churn. Logarithmic transformations for continuous variables are used, namely VantageScore and Income Insight Score.

$$Ysignup=0+ 1xTenure + 2xSolar\ kWh+ 3xGender+ 4xVantageScore+ 5xIncomeInsight+ 6xOccupation+ 7xhomeowner+ 8xMarital\ Status+ 9xEducation+ i$$

Note that given the few observations of default, results are only shown for churn events. Table 10 shows the descriptive statistics for the demographic and socioeconomic factors of the CSS customers.

Variable	**Overall**, N = 812	**Farm A**, N = 454	**Farm B**, N = 358
Churn	118	59	59
Default	6	1	5
Average Tenure (Months)	22	22	23
Average kWh	6.1	5.9	6.3
Gender			

Female	182	117	65
Male	193	111	82
Marital Status			
Married	228	134	94
Single	33	27	6
Occupation			
Healthcare/Education Services	25	16	9
Management/Technical	6	0	6
Self Employed/Other	23	14	9
Services	14	6	8
Education			
Completed College	99	61	38
Graduate Degree	114	63	51
High School or Some College	150	95	55
Income Insight Score, Average	122	114	167
Average VantageScore, Average	804	803	806

Table 10. Churn and Default Summary Statistics

A logistic regression determines the probability that an account will experience churn, with results in Table 11. Increased tenure length is consistently associated with decreased probability of churn. For example, a one-month increase in tenure is associated with a 0.15 decrease in log odds of churn.

Variable

Tenure	-0.195***	-0.141***	-0.152***	-0.150***	-0.185***
kWh Solar	-0.045	-0.008		-0.025	
Gender (Female)		-0.554*			-0.019
Vantage Score Logged	0.164	0.069			-0.083
Occupation					
Management/Technical					0.067

Self Employed					0.191
Services					-0.657
Homeowner		0.088	0.246		1.315
Income Logged			0.045	0.068	
Married				0.883	
Education					
Graduate Degree			0.491	0.447	
High School or Some College			-0.201	-0.165	
Other			-1.261	-0.878	

	**	***	
* p<0.05	p<0.01	p<0.001	

Table 11. Regression Results, Probability of Churn

This research provides insight into barriers to accessing community solar. The community-facing survey offers insight into how community solar programs can incorporate the priorities of climate-impacted groups such as income-qualified individuals. The developer and financier survey helps reveal what the industry perceives as barriers to climate-impacted communities' inclusion in their programs. Finally, the analysis of payment performance data from active solar projects points to little relationship between demographic and socioeconomic factors and the observed risk of churn.

Our community-facing survey reveals key takeaways about individual preferences in community solar programs. Our data shows that an increased savings rate may not result in more income-qualified participation. Instead, in our data, familiarity with community solar is the strongest factor to influence likelihood of contract adoption, demonstrating the importance of education initiatives when encouraging sign-ups. Shorter contract lengths also influence likelihood of contract adoption among our respondents - individuals preferred 1-year contracts over 25-year contracts.

Our developer-facing survey points toward key next steps for organizations who advocate for climate-impacted groups. Across all reasons for including and prioritizing climate-impacted groups in CSS, developers are most likely to ensure inclusion when policies require it. States that require a certain percentage of project capacity to flow to climate-impacted communities are critical to meeting President Joe Biden's Justice40 Initiative, whose goal is to deliver 40% of federal investments in clean energy to low-income communities and communities of color. Customer acquisition costs were identified as a barrier to including income-qualified individuals. Customer acquisition costs for income-qualified populations are higher compared those of the total population [6]. More research is needed in this area to increase access to CSS. For example, many CSS programs require excessive

documentation for income eligibility determination. This trend demonstrates a need for a more streamlined system. Moreover, data transparency could help lower overall projects costs by ensuring that project stages such as interconnection happen in a timely manner.

Our analysis of payment performance data challenges the notion that income-qualified individuals pose a higher risk to the success of community solar projects. Our findings found no statistically significant correlation between income level and the likelihood of defaulting on payment. Our results demonstrate the benefits of education for communities on community solar starting from project inception. Individuals who are familiar with the potential benefits are more likely to sign up for a CSS program. Additionally, policies requiring income-qualified carve outs in CSS projects are important to ensuring that Justice40 initiatives are met, as developers noted that they are most likely to include income-qualified individuals when legislation makes it a requirement. Support from nonprofit partners such as energy justice organizations that advocate for these policy changes are critical to spur inclusion.

Previous research has demonstrated that various groups are likely to be left out of renewable energy projects. Yet, to the best of our knowledge, previous research has not collected either survey data on community solar contract preferences or payment performance data from actual community solar projects.

As a project that was the first of its kind for the community solar industry, this study faced a number of challenges. Regarding the community-facing survey, we were limited by measurable variables. Our demographic variables were self-reported, and results require future research to validate. The survey weighting methodology required aggregating a number of racial groups, limiting our ability to include a more disaggregated analysis. For the analysis of payment performance data, the probability model was limited due to a low sample size of churn events. Future research could be helpful in creating a broader understanding of community solar preferences across the United States. Future research between policy change and inclusion is a critical next step in understanding how barriers to access could be impacted.

Ultimately, community solar contract terms can be improved for communities. Individuals have preferences that are not being met by current offerings. However, income-qualified inclusion in the clean energy transition goes beyond contract terms. Developers should prioritize community input at every project stage. Policies are instrumental to ensuring inclusion, and creating measurable requirements for climate-impacted inclusion in community solar projects is critical to ensuring that the benefits for clean energy projects flow to climate impacted communities.

Task 5.0: SEEDS-2 Subscriber Performance Research, **M13-M30 - Discontinued**

Task Summary: This research will be a follow-on study from the Solar Energy Evolution and Diffusion Studies-2 (SEEDS-2) award DE-EE0007659 and will tie into the final research article. Under SEEDS-2 grant, Solstice collected data on utility payment history and developed a machine learning algorithm that has the ability to accurately predict default and delinquency rates among subscribers, while inclusively qualifying populations typically rejected by traditional credit scoring mechanisms. Solstice then went on to pilot the EnergyScore in a real-world case study. Payment data from the case study, as well as contract data, will be analyzed and presented in this follow-on study.

Subtask 5.1: Data Methodology and Research Design, **M18-M24**

Subtask Summary: Solstice will develop a robust study design that analyzes subscriber payment performance data as it varies by the type of contract signed by subscribers during the SEEDS-2 grant period.

Milestone 2.4: Customer Performance Research Data Methodology and Research Design, **M24**

> **Milestone Summary:** Report. Summary of data gathered from 750 customers enrolled under SEEDS-2 grant/participating in EnergyScore study. Description of methodology and future analysis.

Subtask 5.2: Data Analysis and Presentation, **M24-M30**

Subtask Summary: Solstice will use this period to carry out the research plan laid out in Subtask 8.1 and then will summarize the anonymized data received from SEEDS-2 study participants gathered from subscribers enrolled under SEEDS-2 grant and participating in EnergyScore projects in a report for DOE.

Subtask 5.3: Study Dissemination, **M28-M30**

Subtask Summary: Solstice will identify outlets in which SEEDS-2 EnergyScore research can be published and arrange agreements to ensure the report will be accepted into the outlet. Solstice will author one report/white paper on the SEEDS-2 grant research and have it published in the industry outlet determined.

GNG-2A: Follow-On Subscriber Performance Research, **M30**

> **Milestone Summary:** Report. Tracked and analyzed contract data gathered from 750 subscribers enrolled under SEEDS-2 grant/participating in EnergyScore study, and published in one industry/trade outlet.

Task 5.0 Final Report

Solstice has moved from studying the correlation between subscriber payment performance and contract type strictly through participants enrolled using EnergyScore to researching this correlation through the Churn and Default Analysis. With this new approach, Solstice will aim to collect enough data to assess the strength of any correlation between subscriber payment performance and absence/presence of a specific contract term. This data would be run through a larger regression model that would measure the impact of EnergyScore enrollment on customer's likelihood to churn and default. This research will add an additional layer of information to this research regarding the impact of community solar product terms on the management of community solar programs, something developers and financiers consider when setting their product terms.

This pivot emerged from the lack of available data needed to facilitate a substantive analysis from the SEEDS 2 grant research project. EnergyScore is not being used to enroll community solar participants yet, and it's likely that the 750 customer records needed to facilitate this analysis will not be available prior to the listed milestone dates. Data collected through EnergyScore enrollment will be appended to the data collected through the Churn and Default Analysis to enable a more thorough analysis of the correlation between contract type and subscriber performance. If sufficient data is available from subscribers enrolled through EnergyScore, Solstice will test for the impact of EnergyScore enrollment on subscriber performance.

Task 6.0: Research on Guarantee Fund Activities, **M27-M32**

Task Summary: Solstice will investigate the necessity of a guarantee fund in the community solar arena through research and outreach. This research will be used to determine the necessity of a Solstice-established guarantee fund. In Solstice's experience, more often than not, guarantee funds do not make developers more or less amenable to more inclusive practices. Solstice will research the use of guarantee funds in the solar market by speaking with both financiers and developers to quantify the size of a guarantee fund necessary to mitigate the risk of an investment. This task will be capped by a decision on whether to pursue further guarantee fund activities in BP3.

Subtask 6.1: Preliminary Research, **M27 - Completed**

Subtask Summary: Research will identify existing guarantee funds in the renewable energy sector, as well as identify existing gaps in coverage of LMI projects. Research may include outreach, networking, and travel to conferences convening around financial innovation of loan-loss reserve funds and philanthropy. This research will also involve gathering data to help Solstice make a decision about whether or not to pursue a guarantee fund in BP3.

Subtask 6.2: Guarantee Fund Work Plan **M28-M32 - Completed**

Subtask Summary: Solstice will write a work plan that lays out the necessary steps for forming a guarantee fund in order to understand the full scope of activities required. Solstice will conduct outreach, holding meetings and conversations, and ask established foundations for advice on how best to mitigate developer risk. This work plan will contribute towards deciding if the guarantee fund tasks in BP3 should be pursued.

Subtask 6.3: Guarantee Fund Meetings **M30-M32 - Completed**

Subtask Summary: Solstice will meet with organizations to discuss the formation of a guarantee fund. Solstice may draw on previous guarantee fund research and conversations to set up these meetings. These meetings will contribute towards deciding if the guarantee fund tasks in BP3 should be pursued.

Milestone 2.5.1: Guarantee Fund Scoping **M27 - Completed**

Milestone 2.5.2: Guarantee Fund Scoping **M30 - Completed**

> **Milestone Summary:** Report. Preliminary research on work required to set-up a guarantee fund for the purpose of mitigating developer risk.

GNG-2D: Guarantee Fund Outreach - **M32 - Completed**

> **Milestone Summary:** Count. Proof of meetings with at least two organizations to discuss the formation of a guarantee fund. Determine whether Guarantee Fund initiative should continue based on research conducted in BP2.

Task 6 Final Report:

By the definition provided by the Department of Energy, “a loan guarantee is a contractual obligation between the government, private creditors and a borrower—such as banks and other commercial loan institutions—that the [guarantor] will cover the borrower’s debt obligation in the event that the borrower defaults.” The guarantor is often a government agency or, more frequently in recent years, a philanthropic institution.

As stated in the above definition, guarantees are traditionally used to backstop loans so that the lender bears less risk in case of default. These guarantees are most often utilized in instances where the loan program serves a public good, such as reaching lower income individuals or expanding services like energy efficiency programs. The majority of community solar projects do not require any line of credit for an individual resident to participate. Rather, they take the form of a subscription model. Yet because financiers’ profit model depends on the continuous and timely payment of these monthly subscriptions, the revenue risk associated with a subscriber resembles that of a borrower. Solstice is pursuing this research into the applicability of guarantee funds to the community solar industry because of the similarity in the eyes of developers and financiers to home loan programs, thereby implying that a guarantee fund inserted into a community solar project could have the potential to reduce risk for the financier and

potentially make them more likely to leverage their capital toward a broader audience of potential subscribers.

There are a few notable differences, however, between the financial structure and risk allocation of community solar and other home loan programs. Firstly, while monthly customer payments make a majority of the revenue stream for community solar projects, the :”underwritten” asset (the community solar farm allocation assigned to that customer) is not physically tied to that customer. In other words, if the customer defaults on their payments, they are 100% replaceable. With rooftop solar PV or energy efficiency upgrades, the underwritten asset can not be moved or transferred to another individual who is more likely to pay their monthly bill. Thus, a customer default has more serious consequences in those loan programs than community solar.

Secondly, the nature of community solar as an asset that is not on-site of a customer’s property means that the customer pool is more diversified. Subscribers can be renters of single family homes, multi-family homes, or in large apartment complexes; they can be young or old; they can be urban, rural or suburban. The only limitation to participation in community solar is that the household’s utility participates in community solar. This not only adds to the “replaceability” of each subscriber, but it means that the risk of default is minimized by greater diversification from economic events, weather events, or even socio-political events.

To our knowledge, guarantee funds, loan loss reserves and other financial backstops have not been deployed in community solar, specifically -- at least at a meaningful scale. They have been deployed in tangential fields such as residential PV and other home energy building improvements. As part of our research, we conducted interviews with a number of professionals with expertise in these endeavors across Community Development Financial Institutions (CDFI), the insurance sector, and philanthropy.

From the perspective of CDFIs, we heard that guarantee funds are unlikely to significantly move the needle on including more LMI households in community solar. Inclusive Prosperity Capital is a national CDFI that has a $10M guarantee fund through Kresge Foundation since 2019. This guarantee fund is being deployed across multiple climate resiliency program areas for IPC including commercial solar, multifamily and nonprofits, single family LMI residential solar, and small infrastructure projects. Kerry O'Neill, CEO of IPC, reported that the existence of the guarantee has helped bring financiers to the table, so to speak, to discuss projects, but it has not been transformative in terms of their perception of risk. Investors still wanted to make the most profitable deals for themselves when entering negotiations with IPC and to ensure that the financing institution was bearing some amount of the risk above and beyond the available guarantee funds.

Mary Templeton, CEO and President of Michigan Saves, expressed similar sentiments around the feasibility of guarantee funds to dramatically expand access. While she has seen success at Michigan Saves with a Loan Loss Reserve fund, part of the success comes from the to recycle the capital in the fund because the backstop is fully funded.

On the other hand, guarantees are typically “unfunded” meaning the capital is not provided to the financing institution until it is called upon from a loss. This means that if losses are not not realized at the expected rate, the capital can grow and be put to work for an additional loan. Nonetheless, she points out that both backstops are flawed as a tool for expanding inclusion in clean energy because regardless of the leverage ratio, the fund will eventually be depleted. Additionally, most guarantee funds in the sector are being offered by private philanthropic institutions which then attach their own requirements to how the funds are used which might be different than if they were deployed by a public entity.

DeWitt (Dick) Jones, Executive Vice President of BlueHub Capital, provided a very different perspective on the use of financial backstops in community solar to expand access to LMI households. He suggests that capital deployed for expanding access in community solar should take the form of direct grants that allow LMI free participation in community solar programs such that they receive 50% or greater reduction in their electricity bill.

On the philanthropic side, one sentiment that we heard across all three philanthropic entities we talked to is that community solar finance combined with risk securitization is more complicated than most are comfortable with at the current moment. Guaranteeing loan programs for home improvement is much more straightforward use of a guarantee. With community solar, tax equity comes into the mix along with the subscription model. The guarantee is minimizing risk at a portfolio level more-so than at the individual level. Jillian Bunting, Deputy Director of the Coalition for Green Capital suggested that a better use of philanthropic capital might be to *incentivize* developers to include LMI households in their projects, rather than mitigating risk for their inclusion.
On the other side of the industry, we spoke with insurance firms who have primarily provided services in the commercial & industrial side of solar: Energetic Insurance and Horton Group Solar Energy. Both firms acknowledged that there could be opportunities in community solar for risk mitigation, but had not worked to-date in community solar specifically. Energetic developed a credit backstop for solar developers when they noticed that banks weren’t lending to as broad a segment as developers would have liked. Because their product is based off of actuarial models, there would need to be a significant amount of data on customer churn and default risk in community solar to make accurate predictions for their actuarial table. Thus, this might be more feasible at the conclusion of the quantitative portion of our research project.

In conclusion, our conversations thus far lead us to conclude that a guarantee fund might be a feasible financial solution to mitigate risk in community solar, but it is likely not a solution that will radically improve access to community solar for LMI households. Firstly, not enough data currently exists publicly in the sector to quantify the risk of LMI households to community solar projects. Additionally, from a risk perspective, LMI is likely too broad of a term to encapsulate the varying levels of risk of churn and default by income levels. We do recognize that it's possible that churn and default behavior for LMI households may be higher than mass market households — something we plan to get greater insight on through our churn and default analysis. Yet issues of nonpayment

are likely due to the financial burdens and systemic injustices that LMI households face in their daily lives. Mainly, the impossible choice of “whether to heat or whether to eat”. It seems contrary to logic that an inability to pay energy bills precludes one from gaining access to energy bill *discounts* which would result from participation in community solar. If our goal is to dramatically increase participation of marginalized households in community solar, than de-risking their participation in community solar for financiers does not go far enough.

Task 7: Study Dissemination

Task Summary: Solstice will work to have the contract innovation research distributed through a webinar in an effort to benefit community-based organizations, low-income organizers, grassroots organizers, and otherwise marginalized populations that would not otherwise be able to attend or travel to conventional conferences.

Subtask 7.1: Webinar Partnership Scoping **M24-M31**

Subtask Summary: Solstice will conduct outreach in order to identify interested partners for hosting a webinar around LMI inclusion in community solar and product innovation. Both regional and national organizations will be considered. Solstice will contact at least three specific organizations.

Milestone 2.3.1: Webinar Outreach **M24 – Completed**

Milestone 2.3.2: Webinar Event Details Finalization **M31 – Completed**

Task 7 Final Report:

Solstice Initiative reached an agreement with the Clean Energy Group/Clean Energy States Alliance to co host a webinar showcasing the results of this study. This webinar seeks to illustrate the impact of the research by touring through the data and pairing it with guest speakers that can demonstrate the applicability of these findings through case studies.

Task 8.0: Contract Innovation Study Finalization and Dissemination **- COMPLETE**
Task Summary: Solstice will pursue a number of activities to write and publish the results of the study and create a tangible impact on the solar market through agreements to use better practice contracts.

Subtask 8.1: Analyze Data and Write White Paper **- COMPLETE**
Subtask Summary: Solstice will analyze the qualitative and quantitative data collected in BP2 through the financier and developer surveys, churn and default data purchase, and survey forms, and focus group discussions with participants having a minimum level of energy and financial literacy. Solstice will use statistical analysis and data modeling software to analyze trends in the data, and then present these trends in a white paper/article.

Subtask 8.2: Finalized Event Details **- COMPLETE**

Subtask Summary: Solstice should identify a hosting platform, advertising strategies to ensure participation by target audiences, identify a day and time, a plan for recording and distributing the webinar, and possible speakers/presenters. Webinar will be hosted and completed as Subtask 11.2.

Subtask 8.3: Host Webinar **- COMPLETE**

Subtask Summary: Solstice will host an online webinar with the goal of reaching community organizers, low-income inclusion advocates, community organizations that work with LMI populations, and other actors in this policy space of community solar. The webinar will be recorded and distributed through Solstice's media center and other advocacy partners interested in sharing the webinar.

Milestone 3.1: Stakeholder Engagement – Webinar **- COMPLETE**
Milestone Summary: Video. Webinar was recorded digitally as proof of its occurrence.

Milestone 3.2: Stakeholder Engagement – 2 Submissions of Project Abstract - **COMPLETE**
Milestone Summary: Count. Submission of research abstract to two research presentation events with an explicit focus on environmental justice, energy justice, or LMI populations.

Subtask 8.4: Contract Innovation Study Dissemination **-- COMPLETE**
Subtask Summary: Solstice will submit abstracts through a rolling process of scoping and applying to conferences, workshops, summits, and other kinds of events as opportunities arise. Additionally, Solstice will publish developer, financier, and subscriber-facing articles based on findings contained in manuscript in national and industry news outlets such as Greentech Media, Grist, and Solar Power World.

EOP-3B: Study Publication and Dissemination - **COMPLETE**
Milestone Summary: Report. Proof of submission of manuscript to academic, peer-reviewed journal. Study draws together findings from financier questionnaires, historical performance data from developers, and end user responses (completed survey forms) collected. Publication of 3 articles based on findings contained in manuscript in national and industry news outlets such as Greentech Media, Grist, Solar Power World.

Subtask 8.5: Better Practice Contract Prototypes **- COMPLETE**
Subtask Summary: The most tangible result of these grant activities is a series of better practice contract prototypes which can then be used, in conjunction with the manuscript and validated study, to pitch developers an inclusive and equitable, yet still low risk, method of including LMI subscribers in community solar projects.

Task 8 Final Report:

We successfully completed all the subtasks under Task 8.0, leading to the accomplishment of all the milestones set for the task. We analyzed both qualitative and quantitative data from BP2, including surveys, focus group discussions, and churn and default data, using statistical analysis and data modeling software. The findings have been presented in a variety of formats including webinars, articles, a manuscript, and other forms of dissemination such as via climate activists to ensure that the information is spread throughout the industry. The webinar with CESA was on January 16, 2023 and was recorded and distributed through Energy Allies and other advocacy partners who were interested in sharing the video. It is available to the Clean Energy States Alliance website for viewing. The webinar brought together a host of energy justice experts including Gilbert Michaud, Summer Sandoval, Daniel Chu, and Kim Shields. We also submitted abstracts, and got accepted to two conferences. The first took place in November 2022, in D.C. and was the Behavior, Energy, and Climate Change Conference. The second took place in August 2023, in Boulder, CO, and is the American Solar Energy Society Conference. These events both had tracts that had an explicit focus on environmental justice, energy justice, or LMI populations - ensuring a relevant audience for the findings. The manuscript was accepted to Springer Nature, an academic peer-reviewed journal as part of the ASES Conference proceedings. The manuscript draws together findings from financier questionnaires, historical performance data from developers, and end-user responses collected from the community-facing survey. It is the first of its kind for the community solar industry, and details key findings that will be critical for the next steps of the solar industry. Finally, based on these research findings, we developed a better practice contract, which we refer to as a guideline for developers. This guideline works to detail data-based best practices for ensuring community solar program contracts get adopted.

Task 9.0: Set-Up for Contract Pilots - **- COMPLETE**
Task Summary: Following this research, Solstice hopes to use the finalized contract and the findings of the study to garner interest from developers in using a better practice contract. This may include Solstice representatives pitching to developers, presenting at developer conferences and events, and hosting meetings with individual developers, with the objective of securing MOUs to pilot the contracts.

EOP-3A: “Better Practice” Contracts **- COMPLETE**
Milestone Summary: Count. At least one “better practice” contract, including the most inclusive and viable terms currently offered by the market, with the possibility of area-specific language/terms if analysis reveals geography creates significant difference in uptake/equity outcomes. Contract will combine key product features to be pitched as template to industry stakeholders.

EOP-3C: Memorandums of Understanding **- COMPLETE**
Milestone Summary: MOUs with solar developers, which state their confidence in securing the necessary capital and usage of new contract terms, to pilot “better practice” contracts through forthcoming CSS projects.

Task 9 Final Report:

We created a better practice guide, as detailed above, that serves as a guideline for developers in inputting community needs. We have shared these better practice contracts in a number of settings. Often we have received pushback from developers on our suggestion of a higher savings rate. Many developers feel that they are unable to offer savings rates that energy justice advocates suggest - rates around 50%. Moreover, some developers have argued that longer contracts are good for customers as long as their is no cancellation fee. Because our research explored these terms in a vacuum, more research is needed to assess what potential subscribers might want in terms of contract length when other variables are involved. Most importantly, we suggest to developers that they involve communities in stage zero of project development. In the industry, we've seen many shifts to partnerships with local-nonprofit organizations, and other groups that are on the ground so that developers can do a better job of taking into account community needs when designing projects.

Task 10.0: Legal structure of Guarantee Fund - **Discontinued**
Task Summary: Should Solstice decide to pursue the creation of a Guarantee Fund (Task 6.0), Solstice will work with legal counsel and fund experts in order to structure a guarantee fund that is both financially and legally sound. This will involve drawing on the previous contacts made through previous guarantee fund activities, and potentially reaching out to a few more specialists in this field.

Task 10 Final Report:
Solstice Initiative decided on February 14th, 2022 to discontinue with the process of establishing a guarantee fund through this award after hearing from multiple perspectives of people knowledgeable about efficacy of guarantee funds in clean energy that this would be a misuse of project capital. This decision is allowable under the opt-out provision ascribed to GNG 2D - Guarantee Fund Outreach. The justification for this decision is detailed in the Milestone 2.5.1 - Guarantee Fund Scoping report submitted on November 30th, 2021. To summarize, Solstice Initiaitive's research on the application of guarantee funds in community solar suggests that these financial backstops do not go far enough in de-risking LMI community solar projects to substantially increase participation of low-income households. Philanthropists and financiers approached by Solstice suggested that directly incentivizing developers to allow LMI customers to participate in their projects would be a better use of funds than mitigating risk of their inclusion. Solstice Initiative plans to continue researching the application of risk mitigation strategies to LMI community solar projects and plans to highlight unique and innovative approaches within the discussion of the churn and default analysis completed through this project.

8. Significant Accomplishments and Conclusions:

We have successfully completed the project's tasks and milestones, including the finalization and dissemination of the contract innovation study. Our Community priorities survey collected responses from 1,493 individuals from 8 states. The Developer and Financier Survey collected responses from 256 individuals from all over the country. The Payment Performance Data analyzed churn and default date from 620 community solar accounts in New York. Our biggest challenges came from the churn and default data. Developers were very hesitant to give us their data and it took a very trusted partner to be able to get us what we needed. In the end we were only able to get data from one developer but still met the MW requirements. It wasn't as much as we originally hoped for but it was enough for statistical analysis.

Our developer-facing survey research has indicated that developers are more likely to incorporate low-income households in their projects when there are specific policy requirements in place. These policies, which mandate the inclusion of low-income participants, are essential for ensuring that the benefits of development projects are distributed more equitably. Therefore, it is crucial to enact policy changes that require the participation of low-income households in development projects to promote a fairer distribution of benefits.

We created a better practice guide that serves as a guideline for developers in inputting community needs. We have shared these better practice contracts in a number of settings. Often we have received pushback from developers on our suggestion of a higher savings rate. Many developers feel that they are unable to offer savings rates that energy justice advocates suggest - rates around 50%. Moreover, some developers have argued that longer contracts are good for customers as long as there is no cancellation fee. Because our research explored these terms in a vacuum, more research is needed to assess what potential subscribers might want in terms of contract length when other variables are involved. Most importantly, we suggest to developers that they involve communities in stage zero of project development. In the industry, we've seen many shifts to partnerships with local-nonprofit organizations, and other groups that are on the ground so that developers can do a better job of taking into account community needs when designing projects.

Moreover, as policy works set a threshold for low-to-moderate income participation in community solar programs, the needs of climate-impacted communities are critical to understanding to ensure that programs are adopted. Our research into contract preferences works to illustrate what individuals may want from programs – demonstrating that different communities will want different benefits from community solar projects. Overall, the data illustrated that the savings rate is not enough to spur low-to-moderate income participation. Instead, familiarity with community solar resulted in a higher likelihood of adopting community solar contracts. This illustrates that as community solar expands to incorporate more low-to-moderate income

individuals, education will be a critical component of ensuring that expansion is successful.

Although we initially intended to pursue guarantee fund research we decided not to after our initial interviews with a number of professionals with expertise in these endeavors including Community Development Financial Institutions (CDFI), the insurance sector, and philanthropy. Our conversations lead us to conclude that a guarantee fund might be a feasible financial solution to mitigate risk in community solar, but it is likely not a solution that will radically improve access to community solar for LMI households. Firstly, not enough data currently exists publicly in the sector to quantify the risk of LMI households to community solar projects. Additionally, from a risk perspective, LMI is likely too broad of a term to encapsulate the varying levels of risk of churn and default by income levels. Therefore we decided not to pursue the development of a guarantee fund.

Despite that, we feel very accomplished with the research we did conduct and are proud that we were able to disseminate the research in a variety of formats including webinars, articles, a manuscript, and other forms of dissemination such as social media to ensure that the information is spread throughout the industry.

Our final challenge for this project was the sheer amount of reporting requirements needed to unlock funds and the milestone nature of the grant. Having to cover 20% of the work with our own budget as well as having to be reimbursed for expenses was difficult for us as a small non-profit. All the reporting requirements took up a lot of staff time as they were not always straightforward and simple. Close to the end of the project, we changed our organizational name from Solstice Initiative to Energy Allies and it took months for the paperwork to go through, delaying our final payment. And on top of that, we were notified 9 months after submitting what we thought was our final reporting requirement, that we were missing this technical report. Because of this tedious, onerous bureaucracy, one of our lessons we took away from this project was that we do not want to pursue another milestone based federal grant again.

9. Path Forward:

We have no plans to further this research as we have decided to move away from research as a core area of focus for our mission. Future research by others could be helpful in creating a broader understanding of community solar preferences across the United States as the industry evolves. Future research between policy change and inclusion is a critical next step in understanding how barriers to access could be impacted.

10. Products:

- Behavior, Energy and Climate Change Conference (BECC) Presentation, 'Brining Perspectives to Community Solar' November 2022
- CESA webinar 'Bringing Perspectives to Community Solar' January 2023: https://youtu.be/G3uk2dOf3UU
- Solar Power World article: 'Community solar research shows policy change is needed to meet Justice40 goals', February 2023: https://www.solarpowerworldonline.com/2023/02/community-solar-research-shows-policy-change-is-needed-to-meet-justice40-goals/
- Collaboration with Intersectional Environmentalist on Instagram, March 2023: https://www.instagram.com/p/CqbDQa4u8VJ/?img_index=1
- American Solar Energy Society (ASES) Conference presentation, 'Bringing Perspectives to Community Solar' August 2023
- ASES Conference Proceedings, Spring Nature, Manuscript, "Priorities' Role in Community Solar: Survey-Based Study and Payment Performance Analysis: https://www.springerprofessional.de/en/priorities-role-in-community-solar-survey-based-study-and-paymen/25871152?searchResult=1.zahra&searchBackButton=true , October 2023
- Better Practice Guide for Community Solar Developers: https://docs.google.com/document/d/1INh751Arb-Kjz5bN6q_twGMxXqjFwTcaEOip-gZVdDE/edit
- Energy Allies website: https://www.energy-allies.org/research/
- Github page: https://jake-ford.github.io/SETO_Data_Analysis/index.html

11. Project Team and Roles:

Steph Speirs - PI from 2019 - 2021
Sandhya Murali - Business contact from 2019- 2021
Lauren Levine – PI from 2021 - 2022
Winslow Lewis – Program Associate from 2019- 2022
Zahra Thani – PI and Research Project Manager from 2022 - 2023
Jake Ford – Data Scientist from 2022 - 2023
Abigail – Research Fellow 2023
Liz Neyens, Data Analysis Associate from 2019 - 2023
Eli Goldman - Program Manager from 2019 - 2022
Hedi Osgood – Fellow 2021-2022
Solstice Power Technologies – Churn and Default Data
NMR Group – Research analysis
TSNE – Focus group coordination

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11. Ford, Jacob. SETO Data Analysis GitHub Repository, available at: https://jake-ford.github.io/SETO_Data_Analysis/