Community Planning for Solar: Conducting a Community Solar Survey

Alison Bates

Colby College

NREL Technical Monitor: Sara Farrar

NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC

This report is available at no cost from the National Renewable Energy Laboratory (NREL) at www.nrel.gov/publications.

Contract No. DE-AC36-08GO28308

Subcontract Report
NREL/SR-7A40-90089
June 2024

Community Planning for Solar: Conducting a Community Solar Survey

Alison Bates

Colby College

NREL Technical Monitor: Sara Farrar

Suggested Citation
Bates, Alison. 2024. *Community Planning for Solar: Conducting a Community Solar Survey*. Golden, CO: National Renewable Energy Laboratory. NREL/SR-7A40-90089. https://www.nrel.gov/docs/fy24osti/90089.pdf.

NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC

This report is available at no cost from the National Renewable Energy Laboratory (NREL) at www.nrel.gov/publications.

Contract No. DE-AC36-08GO28308

Subcontract Report
NREL/SR-7A40-90089
June 2024

National Renewable Energy Laboratory
15013 Denver West Parkway
Golden, CO 80401
303-275-3000 • www.nrel.gov

This publication was part of a larger project. The full project can be found at https://ag.umass.edu/solarplanning.

NOTICE

This work was authored in part by the National Renewable Energy Laboratory, operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Solar Energy Technologies Office. The views expressed herein do not necessarily represent the views of the DOE or the U.S. Government.

This report is available at no cost from the National Renewable Energy Laboratory (NREL) at www.nrel.gov/publications.

U.S. Department of Energy (DOE) reports produced after 1991 and a growing number of pre-1991 documents are available free via www.OSTI.gov.

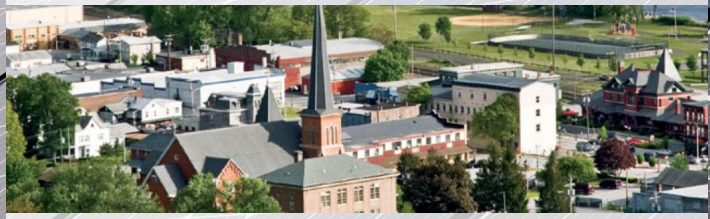
Cover Photos by Dennis Schroeder: (clockwise, left to right) NREL 51934, NREL 45897, NREL 42160, NREL 45891, NREL 48097, NREL 46526.

NREL prints on paper that contains recycled content.

Guide

Conducting a Community Solar Survey

Community Planning for Solar



UMassAmherst

Clean Energy Extension

Development of this guide was funded by the U.S. Department of Energy through the National Renewable Energy Laboratory's Solar Energy Innovation Network cohort program for Solar in Rural Communities, as part of a multi-stakeholder team project to develop a community-informed proactive solar siting and financing model.

The *Community Planning for Solar* project team included UMass Clean Energy Extension (CEE), the UMass Department of Environmental Conservation, Colby College Department of Environmental Studies, the Massachusetts Department of Energy Resources (DOER), the Massachusetts Department of Agricultural Resources (MDAR), the Pioneer Valley Planning Commission (PVPC), the Franklin Regional Council of Governments (FRCOG), the Western Massachusetts Community Choice Energy Task Force, UMassFive College Credit Union, Northeast Solar, PV Squared, Co-op Power, and the Massachusetts towns of Blandford, Wendell and Westhampton.

If you'd like to cite this document, the following format is recommended: UMass Clean Energy Extension, "Guide: Conducting a Community Solar Survey." *Community Planning for Solar Toolkit*, prepared by Alison Bates, March 2022. www.ag.umass.edu/solarplanning.

The outline below summarizes the *Community Planning for Solar* steps and associated documents. For more information, please visit our website at ag.umass.edu/solarplanning.

Community Planning for Solar: Toolkit Steps and Documents

1. Gather your planning team and set goals

- **a. Guide**: Community Planning for Solar - Toolkit Overview
- **b. Fact Sheet**: Forming a Collaborative Community Solar Planning Team

2. Conduct a solar resource and infrastructure assessment

- **a. Fact Sheet**: The Electric Grid, Distributed Generation, and Grid Interconnection
- **b. Guide**: Conducting a Solar Resource and Infrastructure Assessment
- **c. Template**: Solar Resource and Infrastructure Summary
- **d. Example**: Solar Resource and Infrastructure Report

3. Evaluate solar financing and ownership options

- **a. Guide**: Understanding and Evaluating Solar Financing and Ownership Options
- **b. Fact Sheet**: Solar Financing and Ownership Options
- **c. Financial Tool**: Solar Financing and Ownership Options: Cash Flow Model

4. Assess community preferences regarding solar development and financing

- **a. Guide**: Defining Realistic Solar Development Options
- **b. Example**: Realistic Solar Development Options
- **c. Fact Sheet**: Assessing Community Preferences Regarding Solar Development
- **d. Guide**: Conducting Focus Groups for Solar Planning
- **e. Guide**: Conducting a Community Solar Survey — You Are Here
- **f. Template**: Community Solar Survey

5. Develop a *Community Solar Action Plan* to guide solar decision-making and development

- **a. Guide**: Compiling a Community Solar Action Plan
- **b. Example**: Community Solar Action Plan

6. Keep your *Community Solar Action Plan* current

- **a. Fact Sheet**: Monitoring, Evaluating, and Updating Your Community Solar Action Plan

TERM	MEANING
Photovoltaic (PV)	Photovoltaic (PV) systems are solar arrays composed of panels that generate electricity from sunlight. These panels are a different type of technology than the types of panels used in "solar hot water" or "solar thermal" systems.
Capacity	Capacity of a solar array is a description of the instantaneous power output of the panels at top production (i.e., in full sun). It is typically measured in kilowatts (kW) or megawatts (MW). A residential-size solar system is typically 5-10 kW in capacity. Large, ground-mounted solar arrays in Massachusetts are often 1 MW or greater in size.
Annual Generation or Annual Energy Production	The annual generation or annual energy production (AEP) of a solar array is a measure of the yearly electricity output produced by the panels. It is typically measured in kilowatt-hours (kWh) or megawatt-hours (MWh). In New England, annual generation is approximately equal to the array's capacity (in DC) *14% * 8,760 hours per year.
Voltage	Voltage of an electric power line can be thought of as the equivalent of pressure in a water line. The voltage of transmission and distribution power lines is typically measured in kilovolts (kV). One kilovolt is equivalent to 1000 volts (V). In residential use in the United States, electrical wires within a household carry electricity at 120 V.
Three-Phase vs. Single-Phase Power Lines	Distribution lines are either three-phase lines or single-phase lines; the "phase" describes the distribution of power across them. Single-phase lines typically have one line that carries power and one neutral line. Three-phase lines have three wires which are all carrying power out of phase with each other, exactly 120 degrees apart; in some configurations, there is also a fourth neutral and line and ground. The practical implication is that three-phase lines provide a more consistent source of electricity and are better able to handle higher electricity loads. They typically are used to serve commercial and industrial buildings and can power large industrial electric motors. Single-phase lines are suitable for serving residential lighting and heating loads. Three-phase lines can also accommodate larger inputs of energy from distributed electricity generation facilities (such as solar arrays) than single-phase lines.
Abbreviations & Acronyms	
AC	AC is the abbreviation for *alternating current*, the type of electricity flowing into the grid from a solar array, after it has gone through an inverter.
CEE	UMass Clean Energy Extension
DC	DC is the abbreviation for *direct current*, the type of electricity produced by solar panels. The DC capacity of a solar array is a good indication of its size, and footprint on the landscape.
DOER	Massachusetts Department of Energy Resources
kV	kilo-volt, a standard unit of voltage
kW	kilowatt, a standard unit of solar PV capacity
kWh	kilowatt-hour, a standard unit of electricity production or consumption
MDAR	Massachusetts Department of Agricultural Resources
MVP	Municipal Vulnerability Preparedness plan, a municipal planning document
MW	megawatt, a standard unit of solar PV capacity, equal to 1000 kw
MWh	megawatt-hour, a standard unit of electricity production or consumption, equivalent to 1000 kwh
NREL	National Renewable Energy Laboratory
OSRP	Open Space and Recreation Plan, a municipal planning document
SEIN	Solar Energy Innovation Network, a program of the National Renewable Energy Laboratory, funded by the U.S. Department of Energy's Solar Energy Technologies Office
sf	square feet

Table of Contents

Introduction

This guide is designed to assist community officials, volunteers, and regional planning agency staff in conducting a survey of residents to learn about attitudes and development preferences towards solar energy within the community. The guide will provide the key steps, timelines, distribution options, ethics, and considerations that should be made in developing a survey distribution strategy. The guide also contains an overview of various question types and response categories, with considerations for the type of data that are needed for the study. The guide concludes with recommendations for managing data and databases, data visualization, and reporting results. The appendix includes samples of materials used in a solar energy survey, from invitation letters to the survey.

Purpose of This Guide

This document is intended to provide a practical guide for implementing a survey in communities that are proactively planning for solar development. The guide offers a practical "how-to" plan for conducting a survey. It may be advantageous to consult with an expert in survey development who will be familiar with any methods and techniques described in this guide, but this is not necessary. This guide offers basic considerations and examples of questions and analyses to help a community understand preferences of the community.

A Focus on Solar PV in Rural Communities

In this guide, we focus specifically on solar photovoltaic (PV) development for electricity generation, although a similar approach could potentially be used for other clean energy technology planning. This project focuses on rural communities, although many aspects of this approach would be applicable to suburban or urban communities.

Associated Documents

Several additional components of our *Community Planning for Solar* toolkit will also help guide you through Step 4: *Assess community preferences regarding solar development and financing.* These include the following:

- *Defining Realistic Solar Development Options* guide (Step 4, Item a), ag.umass.edu/solarplanning4
- *Assessing Community Preferences Regarding Solar Development* fact sheet (Step 4, Item c), ag.umass.edu/solarplanning4
- *Conducting Focus Groups for Solar Planning* guide (Step 4, Item d), ag.umass.edu/solarplanning4
- *Community Solar Survey* template (Step 4, Item f), ag.umass.edu/solarplanning4

Choosing to Distribute a Survey

The choice to disseminate a survey should be made based on your goals for community engagement. Please refer to the *Assessing Community Preferences Regarding Solar Development* fact sheet (Step 4, Item c), ag.umass.edu/solarplanning4, to review other choices to engage with community members.

Surveys are an excellent choice when you are hoping to gain an understanding of how a community on the whole perceives various solar development options. While community meetings may raise any major areas of concern, it can be difficult to assess how widely held these beliefs are without systematically surveying the community. A survey can build rapport, providing the broader community a means to participate in the planning process, without the time or logistical commitment of coming to meetings - and with anonymity, making for a more inclusive process. You can tailor a survey to the community, by building in specific areas

of interest, locations under consideration, or specific issues that have been submitted by community members. One downside of a survey is that it must be carefully conducted in a way to limit bias in the data, or the results will not be credible nor reliable. Surveys can also be time-consuming, complex, and, depending on the mode of survey used, expensive.

Surveys are best used in conjunction with other methods to assess community preferences in a more focused and in-depth way, such as community meetings, focus groups, or interviews with residents. Using a combination of methods provides an opportunity to explore both the breadth, and depth, of the various perspectives in your community.

Selecting Participants

If you are surveying a community in order to provide a large proportion of residents an opportunity to respond, you should consider the size of the community, the amount of data you need, ability and time to process and analyze data, and transparency. For small towns, it is likely advantageous to sample the entire community. If the community population size is greater than ~3,000, surveying the entire population of adult residents could result in more data than is needed or manageable. In addition, for certain types of surveys, the costs might become prohibitive. For example, printing and mailing costs can range from $2-$4/survey. If surveying the entire community is cost-prohibitive or too logistically challenging, you may instead want to survey a random sample of your population. Random sampling is important if you cannot sample the entire population, to reduce bias in your results and avoid generating an inaccurate summary of resident preferences.

Whether you are sampling the entire community or only a subset, it is always important to design a methodology that reduces sampling bias to the greatest extent possible. Some groups of people are more likely to respond to surveys, such as those with more available time or an interest in community planning processes. Giving all participants an equal chance to respond, making the survey process as simple as possible, and providing multiple response methods are all ways to encourage responses and reduce bias to the extent possible.

Survey sampling firms can provide address databases for a modest fee, if needed for mailed surveys. Addresses can be provided for the entire community, or for a random subset, depending on the survey method being employed.

Responses

The target size of your survey population depends on the composition of your community. In small towns, you may be targeting 100% of the adult population; the percentage will be much lower in cities. It is common to send out anywhere from 1,000 – 3,000 surveys; more than that is typically unnecessary. If you are designing a survey to be statistically representative and plan to publish your findings broadly, it is recommended that you consult a survey design text or professional. Data analysts typically like to see at least 100 responses as a minimum number to be able to summarize results, although a larger sample size is preferable. The number of responses you receive will of course be limited by the size of your town or target community and the number of people who choose to respond. Aiming for 200-300 responses will help ensure you have results that are varied and represent your population. In your analysis, you may consider reporting the *response rate* – the proportion of people that answered the survey, minus bad addresses or undelivered mail. Response rates may be improved if you offer a monetary incentive for completing the survey, such as entry into a raffle for a gift card. Note that your organization should be aware of any legal or policy restrictions associated with offering financial incentives.

Ethics

Any time you are conducting research involving people, ethical considerations are of utmost importance, to protect people's confidentiality and to ensure that opinions are provided without coercion. Topics as seemingly benign as attitudes towards energy systems can be contentious and divisive, and power dynamics in a community can influence who participates and in what way. It may be advantageous to bring in an outside entity to facilitate your survey, such as a University partner, Extension Service, regional planning entity, or consultant. Ethical considerations can be handled by a trained researcher. Many University researchers are certified by an ethics board.

Consent

You should consider having participants sign a "consent" form, whereby you state that they are voluntary participants in the survey and are free to answer or ignore any questions at will. Depending on your partnerships or funding sources, a formal consent form may be required. A sample consent form is provided in Appendix B. Note that this was tailored to meet the requirements of an academic institution; you may choose different verbiage for your consent form.

Confidentiality

Surveys are typically not considered to be anonymous, but the data can be kept confidential. Being transparent with your confidentiality protocols is important to protect people, and to develop trust in the organization conducting the survey and in the process. Even if surveys do not include people's names or contact information, there is a remote chance that individual responses could be identifiable if released. Therefore, survey data should only be released in aggregate – that is, once you have collected all your data, you should release summary reports and not include any individual responses.

Data Management

Survey data is typically entered into a computer database for analysis. You should carefully consider how you will store completed paper surveys, as well as data entered into a computer. Data stored electronically should be kept in secure data storage on a password-protected computer. It is common to keep raw data (the surveys themselves) for a period of time (e.g., three years). If you work with a research partner, they will likely have specific practices for data management, and this should include a plan for secure data storage. If you plan to share the database outside the team leaders, you should inform survey respondents of this prior to collecting data - for example, within the consent form.

Designing a Survey

Surveys can vary widely in length and content, depending on the goals of the study. The process of survey development typically takes several months. We recommend allocating at least six months for survey development, distribution, and analysis.

Writing Questions

A variety of questions can be integrated into a survey, including multiple choice, written answer, numerical, or questions along a scale – such as level of agreement, level of concern, level of support, expected benefits, or others.

Survey Response Types

Many options exist for writing and organizing survey questions. In general, questions can be either open or close-ended. There are benefits to both.

- **Open-ended:** The respondent can freely write a short or long response. The benefit is that you do not limit responses to your response options, but these answers are harder, and more time consuming, to analyze.
- **Close-ended:** These questions ask respondents to check one or several response options from choices you provide, such as check boxes, entering a number or frequency, or selecting a preferred action. These are easier for respondents, and are easier and faster to analyze, but they are limited by your selected list of options.
- **Scale Responses:** For close-ended questions occurring along a scale, you will need to choose the number of response options. For example, for a scale from agree → disagree, you could choose from the different scales below. The more options provided, the better the quality of the response data, at the expense of a longer and more complex survey.
    - **3-point scale:**
        - Agree
        - Neither Agree nor Disagree
        - Disagree
    - **5-point scale**
        - Strongly Agree
        - Agree
        - Neither Agree nor Disagree
        - Disagree
        - Strongly Disagree
    - **7-point scale**
        - Strongly Agree
        - Agree
        - Somewhat Agree
        - Neither Agree nor Disagree
        - Somewhat Disagree
        - Disagree
        - Strongly Disagree

  For questions on a scale, you may or may not want to include a "midpoint" or neutral category. Either option may be appropriate. Excluding a neutral category forces people to respond for or against something. However, if you are asking about a topic people may not know much about, having a midpoint, or neutral category, can be beneficial and less frustrating for respondents who truly do not have an opinion.

  Another option is to have an "I don't know" option, which captures respondents who feel they need more information. This category differs from a neutral option, which may be applicable to people who can see both sides of an issue and are not sure which side they prefer.

Question Topics

Many types of questions can be integrated into a survey. Here are some common examples:

- **Factual:** Whether a respondent engages in an activity or does, has, or likes something; these are often yes/no questions.
- **Behavioral:** How often something occurs, what types of behavior or decision a person or household engages in, such as: a number of times in a time period, approximate ranges, or general estimations (e.g., "often," "sometimes," "never").
- **Beliefs or attitudes:** Whether or how a respondent thinks a certain action or activity should occur.
- **Demographics:** Questions on age, gender, level education, income, etc. These questions can help you understand whether your survey is representative of the population. Sometimes these types of questions may be negatively perceived by respondents.

Writing Good Questions

Writing good questions is difficult, but a few recommendations can help you avoid asking questions that are confusing, which can give you unreliable data. Here are some suggestions:

- Use language familiar to the layperson, avoid unfamiliar terms.
- Be sure to give enough context to answer the question. Avoid poorly defined or vague terms or ideas.
- Avoid complex grammar, such as long sentences or wordy questions.
- Don't ask individuals to answer two questions at once. For example, consider this question: "*To what extent do you agree or disagree with this statement: Solar power is economically and environmentally beneficial to my community.*" This asks respondents to evaluate two separate issues at once (environmental and economic costs/benefits of solar), and should be split into two separate questions.
- Use neutral language. Pay careful attention to wording and use unbiased language so as not to position the respondent for or against a certain response.
- Allow respondents to "skip" questions that do not apply to them.

You may want to provide basic information upfront in your survey, so that all respondents are working with the knowledge necessary to answer questions. Keep this short and easy to read, such as a few sentences or bullet points. In addition to providing upfront information, you can "prime" the respondents to answer your questions by asking a few questions to trigger memory recall, or by including a few questions at the beginning that are relatively easy to answer to warm them up to taking the survey.

Survey Length

The shorter the survey, the higher the likely response rate; response rates for complex surveys will be lower. Best practices indicate a survey that takes 10 minutes or less to complete is preferable. A 20-minute survey is the maximum you can typically expect respondents to complete.

Pre-Testing and Pilot Testing

Two distinct stages of survey development can minimize errors and issues prior to survey distribution. *Pre-testing* is a step during which you ask people to take your survey in full or in part, as you are developing your questions. You should debrief with them afterwards: ask them to comment on what was unclear,

biased, or unfamiliar within the survey, and to bring up any other issues they encountered in answering the questions. It is common for a full survey to go through 5-10 iterations before finalizing the questions – with pre-testing done at multiple stages. *Pilot testing* is something that should be done once your survey is "final" – but before distributing to the target audience. You should have people from various backgrounds take your survey as if it were "live" – and learn further about length, bias, unclear questions, etc. If possible, you may want 50 or more people to take the survey at the pilot testing stage. Minor changes after this step are important to finalizing your survey instrument. If you are starting with a template, such as the one provided in this guide, the pre- and pilot testing process may be minimal, but still a recommended step to make sure the survey is well suited to your intended audience.

Survey Mode

Surveys can be distributed in multiple ways: by mail, phone, online, in-person, or a combination of these. With any of these methods, you should consider time, cost, and access for your community. All methods will require follow-up to remind participants to take the survey. Data collection typically takes several weeks or more. It is recommended to coordinate with municipal officials to minimize conflict with other community activities or survey requests, and also to coordinate if there will be large gatherings where data collection can be expedient. Town meetings or elections are good examples of this.

Online Distribution

Online surveys are very convenient for the researcher, because response data can be easily downloaded in a spreadsheet format for analysis. Online surveys are typically inexpensive, and can be conducted with a fast turnaround. Many programs exist for collecting survey data; some are free, while others require payment of a one-time fee or subscription. Free programs may not have the same level of options, functions, or formatting, but can be perfectly suitable for data collection. We recommend that you check the privacy and security options for any program you choose, so that you can be sure your data remains confidential.

The downsides of online data collection are two-fold. First, if you are distributing a web link to the survey, you have little control of where and how that link is shared. This can be problematic because you may receive spam or unqualified respondents taking the survey attempting to gain a reward. This is particularly true when there is a monetary incentive for survey completion. It is also possible that people from outside the community will take the survey. The second downside to online distribution is that there is no public database for email addresses, such as exists for mail addresses. Therefore, it can be very difficult to email the survey to all intended residents, and it can bias the responses against people who do not have internet access – such as people who live in rural communities, people who cannot afford internet, or senior citizens. Posting the survey link to local social media sites, listservs, and town websites can be a way to distribute the survey more broadly. You can also mail a postcard or letter with the web link directly to households. If a survey is short and on a topic that is highly debated within the community, there is also the possibility that respondents could try to "stuff the ballot box" by filling out the survey multiple times. This is not likely to be an issue if the survey is long or the community is engaged and respectful of the planning process.

In-Person Distribution

Another option is to offer surveys in-person. This can be done by making printed surveys available at a central location such as a public library, town hall, or other public facility, where participants can fill out the survey at the location, or take it home to fill out and drop off or mail at a later time. Alternatively,

printed surveys can be made available at public events, such as a town meeting, town elections, library event, weekly "dump day" at a transfer station, or other event or regular occurrence that brings community members to a central location. One potential benefit of an in-person survey at an event or location is that people may be inclined to fill out the survey then and there, rather than put it off until a later time, when they may have forgotten about it. In addition, if a member of the research team is on hand, participants can ask clarifying questions and engage with the research team, building trust with the community. Downsides are that in-person surveys require printing, time for participants to record survey responses, time to collate the data and enter it into a computer database, and permission and coordination with the manager of a facility where data collection will occur. The choice of survey locations must be carefully made to avoid biasing the results of the survey based on who regularly frequents certain events or locations.

Mail Distribution

Mail surveys provide the most straightforward option to directly reach all residents, since databases are available which list all resident mailing addresses. Accessing addresses is commonly done by purchasing an address database from a survey research firm, for a nominal fee. As described above, you might request a random sample of the community, or a full list of all residents, depending on the goals of your project and the size of the community.

The main benefit of a mailed survey is that all residents are provided with equal access to the survey. Mail surveys typically include an outgoing envelope, invitation letter, printed survey, and stamped return envelope. Downsides of mail surveys include cost and speed: printing and mailing costs can be expensive, and this method is slow, because it takes time for people to complete and return the mailed survey. As with in-person surveys, you also need to allocate time for manual data entry into a spreadsheet or database.

Phone

Phone surveys can be particularly useful in places where residents may not have internet access, and where limited funds render a mail survey impractical. Phone surveys are labor intensive, but otherwise very low cost. Several people would likely be needed to ask the questions and fill out the survey for the respondents. Home phone and cell phone call lists can be obtained at low or no cost. For phone surveys to be effective, the questions should be simple and require no visuals.

Survey Components

The components of a survey are dependent on your chosen survey mode. Including a step for invitations or follow-ups will add time to the data collection process.

Survey Invitations

If conducting the survey in-person or by phone, contacts are typically not prearranged. If you are preparing an online or mail survey, an invitation letter should be prepared. See Appendix A for an example invitation letter that could be used as a cover letter for a mail survey, or a stand-alone invitation for the online survey. The invitation should clearly state who is doing the study, the purpose of the study, contact information, and other pertinent details. These should be personalized if possible.

Follow-up Protocols

If using an online or mailed survey, in which respondents fill out the survey at their convenience, you should expect that one or two follow-up reminders will be needed. This can be done via email or social media reminders, or the mailing of a follow-up postcard. It is recommended to send reminders after 2-3

weeks. Researchers sometimes will mail a printed survey after 2-3 contacts if the response rate is low for online surveys, or send a second mailed survey to the respondents if the survey was mailed initially.

Reporting Findings

Reports that summarize your findings should incorporate survey data with written descriptions and visuals, such as graphs, tables and other charts. You may want to work with a researcher, consultant, or other individual with experience in data analysis and presentation to complete a summary report.

Data Representations

A ***variable*** is any characteristic or number that can be measured or counted. *Continuous variables* can be a range that include any number, such as asking for a respondent's age. *Categorical variables* are much more common in this type of survey, where you provide options from which the respondent can select. An example categorical variable would be asking whether a person agrees, disagrees, or has a neutral position regarding a statement. Each respondent chooses the option that best represents their preference.

Data can be represented in many ways. Bar charts, pie charts, scatterplots, and data summary tables are all commonly used to summarize survey responses. A bar chart can be used to count the number or percentage of respondents that chose each category, or a pie chart or table could be used to show the proportion of respondents that chose each response. When comparing two categorical variables, frequency tables are often used, which show the proportion of responses in a certain category (e.g., 23% agree; 77% disagree) There are various versions of these graphs: for example, side-by-side bar charts allow for better comparisons between categories; segmented bar charts (showing parts of a 100% in a single bar) can allow for the visualization of multiple categories at once. Another way to represent questions that have rankings asking about the strength of an opinion, is to create numerical data from the categories. For example, consider the question "What is your general attitude towards solar energy?" with response options [*very positive/positive/neutral/negative/very negative*]; each option is assigned a number 1-5, and then averaged. Examples of each of these options are provided in the section that follows.

Database Management

Survey data is commonly kept in a database or spreadsheet. A simple spreadsheet can be used where each row represents an individual, and each column contains the response to each question. The columns holding the response to each question are considered *variables*. Survey responses may be automatically uploaded into a database if the survey is distributed electronically, or manually entered if the survey is distributed on paper.

Good database management is essential for analyzing data and obtaining accurate results. The name of each variable should provide a shorthand description of the question, using underscores in place of spaces. For example, in the question, "What is your general attitude towards solar energy?" an appropriate variable name could be *attitude_solar*. Categorical data should be represented with numerical values. For example, as above, *very positive*, *positive*, *neutral*, *negative*, and *very negative* becomes values 1-5. This is a process known as *coding*. Keeping an organized codebook is important to keep track of data and ensure analysis is accurate. It may also be useful to perform data cleaning before beginning analysis, in which you remove or correct inaccurate or blank answers.

Weighting

Survey responses are rarely directly proportional to the population demographics, leading to potential biases in the response data. For example, individuals who are retired may be more likely to respond to a survey than younger individuals, thereby underrepresenting younger individuals in the responses. Survey analysts sometimes use "weighting" to apply a higher value on the responses of underrepresented groups. An alternative to weighting the data is to examine how responses vary by demographic group, such as in Figures 5 and 9. These nuances can be applied to any question as desired.

In the examples provided in this guide, respondents were more likely to be older, more educated, and higher income than the population as defined by the U.S. census. The results were weighted accordingly by a statistician. If weighting is not possible, results should be examined as they differ by various demographics as needed.

Examples of Reporting Results

In the following sections, you will find various ways of representing survey responses for some of the questions presented in this guide. For the sake of brevity, a small selection of question responses are shown below. There are many ways to represent data; these examples are meant to demonstrate various options that may be best suited to the data.

Attitudes Toward Solar and Renewable Energy

A baseline understanding of how community members think about solar provides a starting point to understand preferences for size, location, scale, and underlying beliefs and preferences for future installations. As seen in Figure 1 below, pie charts can be used to depict attitudes as a percent of the respondents, and can be useful side-by-side to look at two questions together. These charts show that community members are overwhelmingly supportive of solar energy in general, but feelings about solar in the local community are more mixed. Understanding why people are less supportive of local solar can provide insight about developing future solar plans in a way that is acceptable to a higher proportion of residents. Similar pie charts could be used for responses to questions such as attitudes towards large-scale solar in general, and large-scale solar in their community.

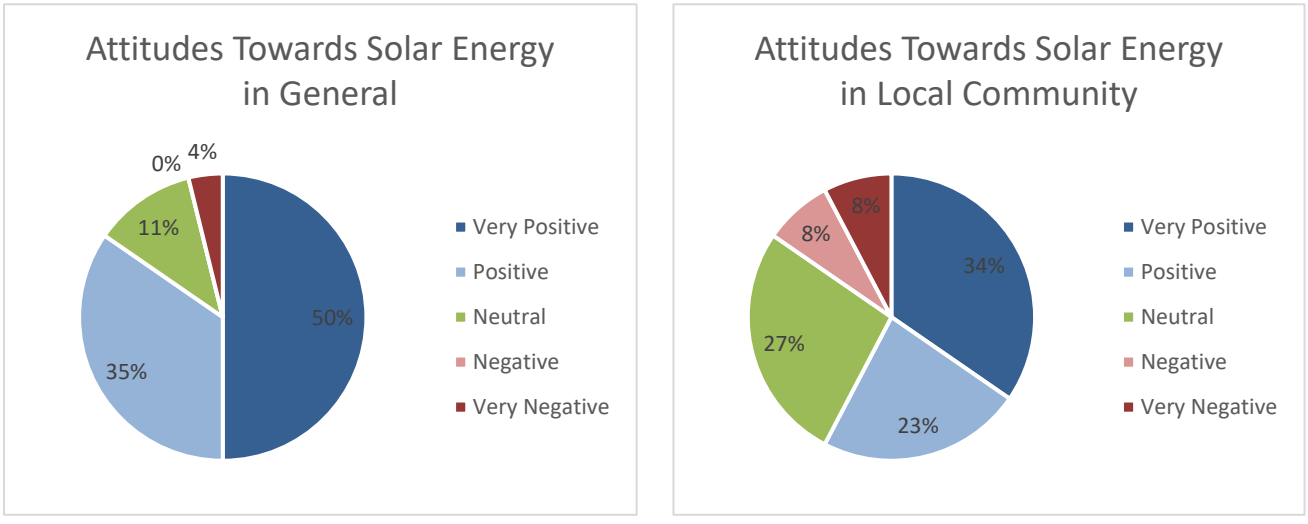


Figure 1. A comparison of attitudes towards solar energy in general and solar energy in the local community, n=257.

A stacked bar chart that totals to 100% is a different way of representing a scale from positive to negative. In Figure 2 below, the stacked bar chart breaks down the percentage of respondents who identify positive, neutral, or negative attitudes towards solar energy in residential applications. The chart compares the responses to two questions and demonstrates that respondents are largely supportive of solar at households, and may prefer rooftop applications over ground-mounted applications. The use of the same color with different patterns adds visual distinction but also can be easily read where color cannot be seen.

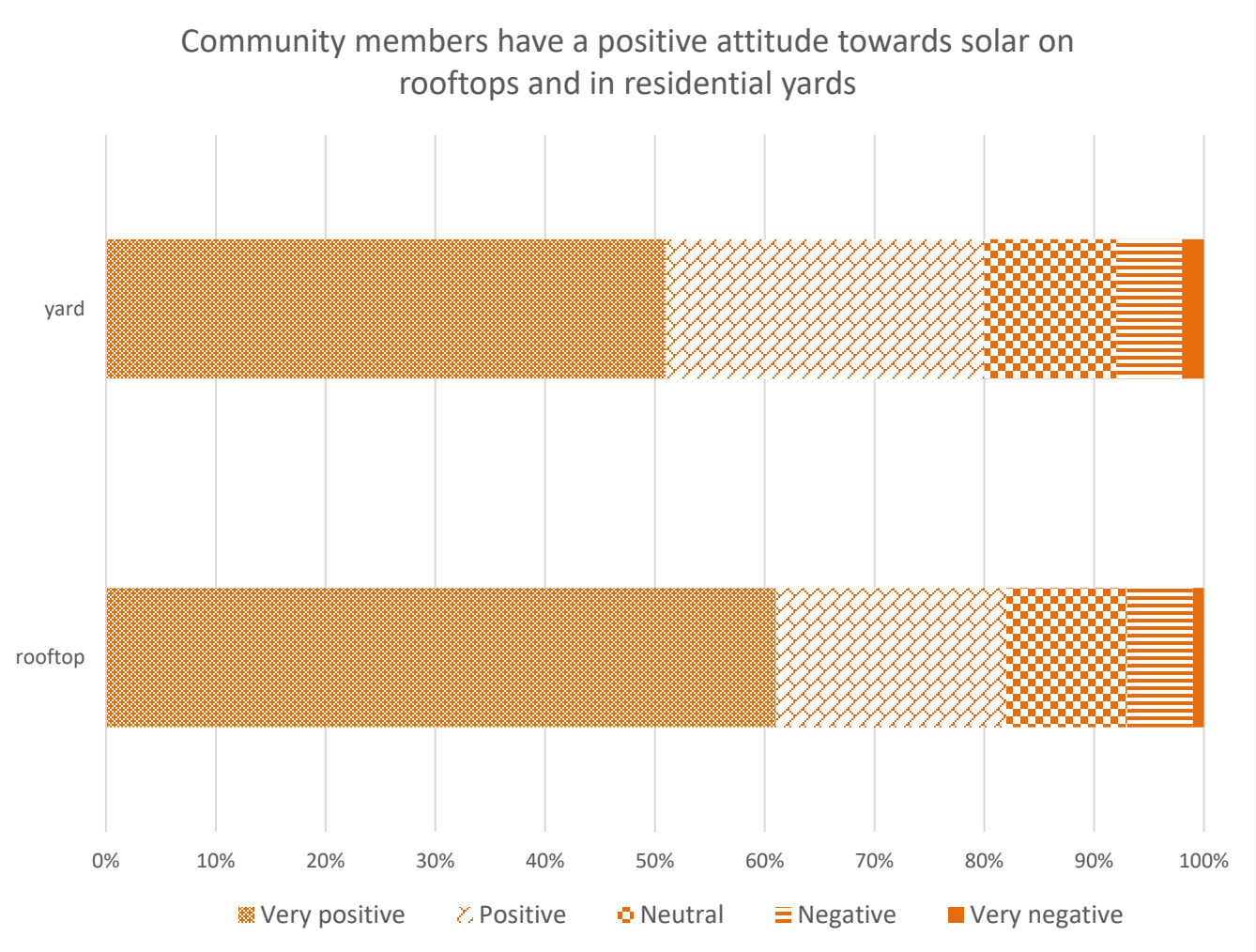


Figure 2. Attitudes towards residential solar on rooftops and ground-mounted systems in yards, n=262.

Town planners may be interested in whether community members are interested in installing solar at home. It may also be illustrative to identify the reasons why people who want solar do not yet have it installed. A total of 49% indicate they are interested in solar, 26% are not interested, and 24% are not sure. Respondents were asked to select from a long list of reasons why they do not have solar at home, and in many cases, respondents chose more than one option. The comparative bar chart in Figure 3 below shows that cost is a primary reason that solar has not been adopted – but this also demonstrates the relatively strong influence that distrust with solar developers or utilities can have, particularly among those who decidedly want solar. Understanding nuances may help identify ways in which programs can be designed to help those who want household solar, to obtain that solar in a manner that addresses the unique concerns of community members.

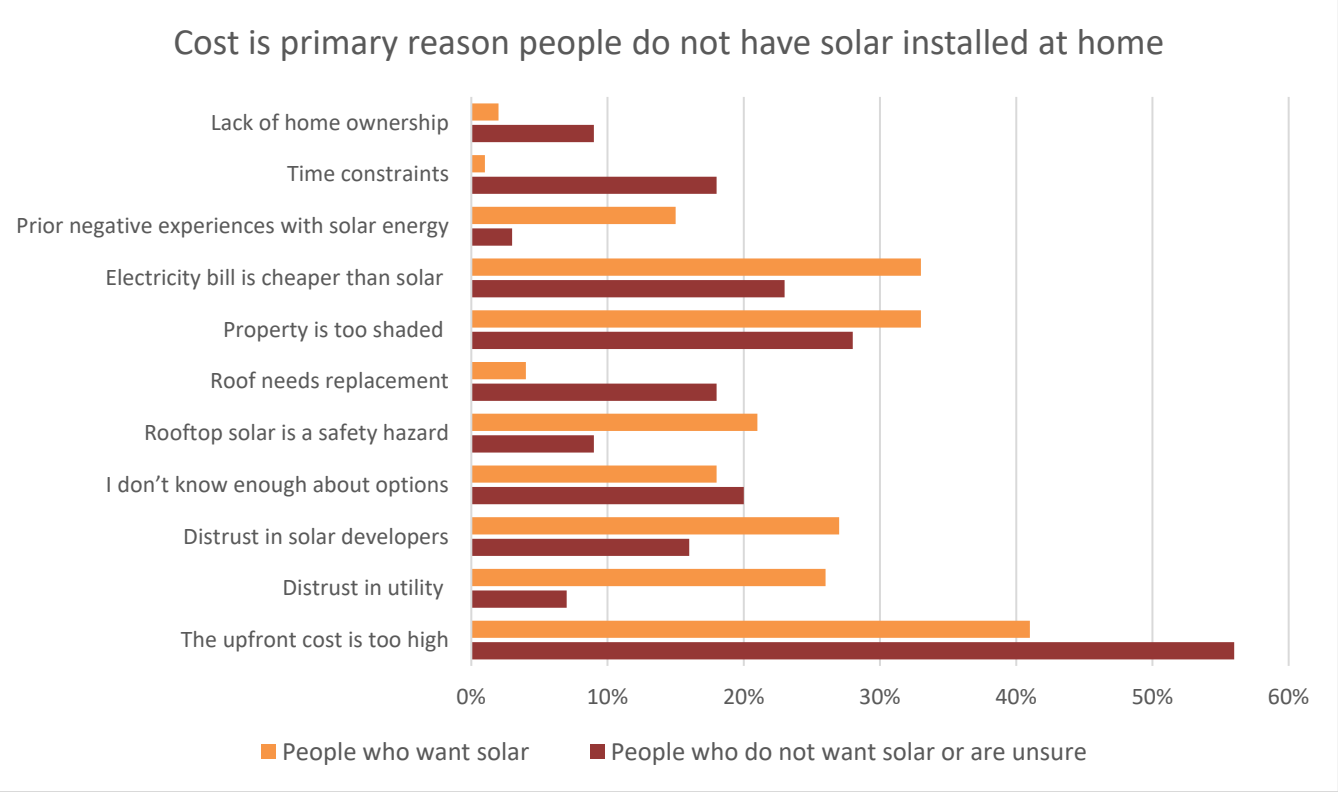


Figure 3. Reasons that residents have not yet installed solar at home, differentiated among people who want solar (n=78) or who do not want solar or are unsure (n=105).

Community Benefits and Role of Community in Solar Planning

Local benefits and local role in decision making are likely important considerations in planning of future solar development. Several of the survey questions document the ways in which community members perceive benefits from solar, and which benefits may increase their support for solar development.

In the example below, respondents were given choices to indicate their perception of the impact of solar development in their town. Tables provide an alternative to graphically representing data. In Table 1 below, we find that the majority of community members see solar development benefiting electricity costs and a plurality believe there will be benefits to property tax rates; yet a majority also identify aesthetics and farmland preservation as being harmed. Solar planners may be able to allay some of these concerns through siting requirements. This table, which totals to 100% for each response category, is a simple way to show which issues are most important for people.

Table 1. Believed effects of new large, ground-mounted solar in the local community, n=246.

	Percent of Respondents (total 100% by row)			
	Benefit	No Impact	Harm	Not sure
The cost of electricity	65%	17%	3%	15%
Local property taxes	38%	35%	4%	23%
The reliability of electricity (backup during outages)	35%	39%	2%	25%

	Percent of Respondents (total 100% by row)			
	Benefit	No Impact	Harm	Not sure
Local job creation or economic development	22%	61%	6%	11%
Property values	21%	20%	25%	33%
Aesthetics or "look" of local landscape	15%	11%	64%	11%
Community cohesion	16%	36%	38%	15%
Preservation of farmland	11%	7%	64%	17%

In a table variation, the following analysis in Table 2 converts a 4-point "likelihood" scale to numerical values, where *very likely =1, likely =2, not very likely =3, and not at all likely =4*. The responses are then averaged, whereby lower values indicate which benefits may help increase support in the community. This is an easy way to generate an ordered list of preferred benefits. One drawback to this method is that the numerical values are somewhat arbitrary, and they do not fully demonstrate the range of responses. As we analyze this table, we see that community members in this example are more likely to support solar construction if it provides direct payments that reduce property taxes or if it reduces electricity rates for all residents. The top three categories are options that increase likelihood of support, and the bottom four categories are options that do not increase likelihood of support for solar development. This would demonstrate to a policymaker that direct payments and lower electricity rates should be targeted as incentives to benefit the community.

Table 2. Likelihood of supporting large, ground-mounted solar energy locally if various community benefits were provided.

Community Benefit Options	Average response 1=very likely to support 4= not at all likely to support	Increases likelihood of support?
Direct payments that reduce property taxes	1.708	Yes
Reduced electricity rates for all residents	1.88	Yes
Direct payments that supported town budget needs	1.88	Yes
Jobs for local residents	2.08	No
Back-up power	2.166	No
Local ownership	2.24	No
Reduced electricity rates for low-income residents	2.32	No

Solar Energy Ownership Options

Proactive development of solar in communities may include changes to scale and location, but also provides opportunities for variations in ownership models. In the following example (see Figure 4 below),

relative benefits and risks were presented of three solar ownership models, and each of the three options provided were found to have mixed support. A segmented bar chart totaling to 100% displays attitudes towards each of the ownership models. The third-party option is the least preferred, with relatively strong support for both the "flip" model and the community ownership model.

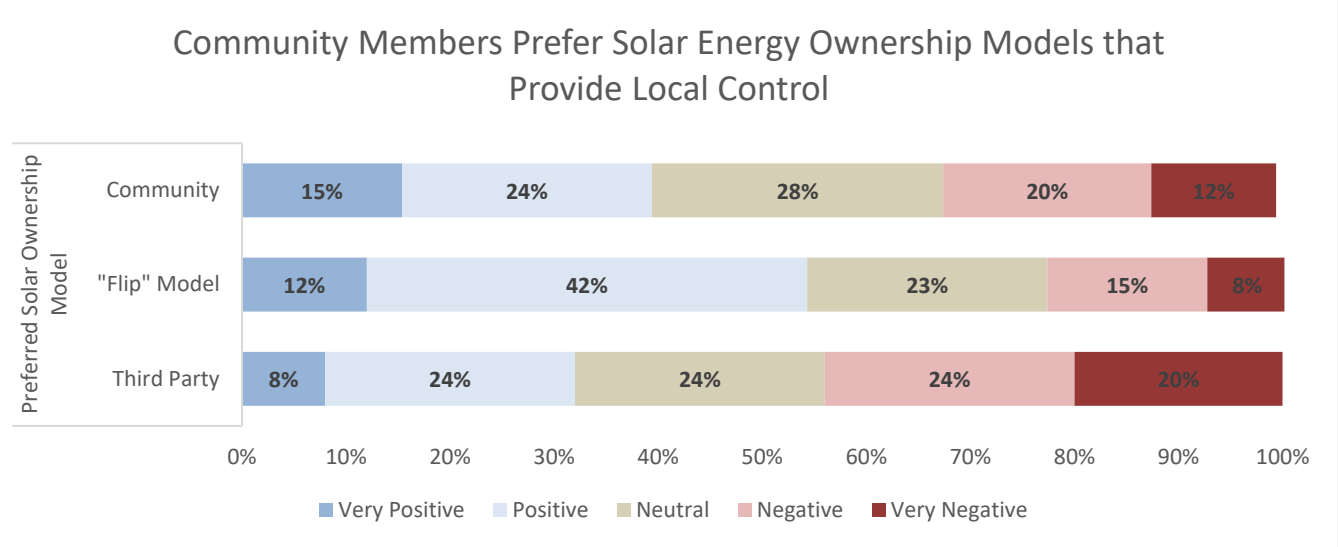


Figure 4. Attitudes towards various ownership choices for a large-scale (1-MW) ground-mounted solar projects in local community (n=227)

Further examination of these data can provide additional insights, such variation in response across demographic categories. For example, items such as risk tolerance, financial capabilities, personal gain, may all influence how people consider future development scenarios. For this question, we found a statistically significant difference in ownership preference among income groupings (see Figure 5 below). Taking the "third party" ownership model as an example, it is evident that households with low or moderate incomes are more supportive of third-party ownership than families with higher incomes, above $100,000 per year. While this does not change the result that this is the least preferred option overall, communities may have specific goals to incorporate preferences of underrepresented families. In that case, it is advantageous to examine the data in a nuanced way.

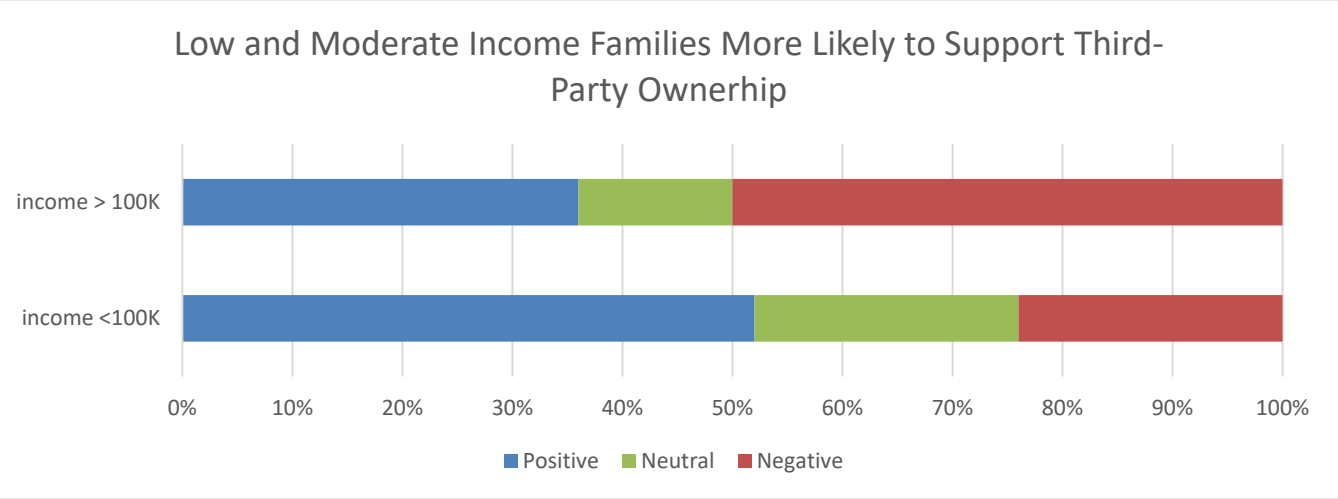


Figure 5. Third-party energy ownership is more preferable for low- and moderate-income households than higher income households, n=227.

In addition to asking preferences for ownership, understanding the reason *why* individuals are more supportive of certain options may be illustrative for community planning. In Figure 6 below, we document the factors that were important to respondents in selecting their solar ownership preferences. In this example, we specifically compare community members who felt *positive* or *very positive* about community ownership to community members who felt *positive* or *very positive* about third-party ownership. It becomes evident that proponents of third-party ownership are more concerned about financial risk than proponents of community ownership; and conversely, proponents of community ownership are more concerned with aspects of community role in decision making and other local benefits.

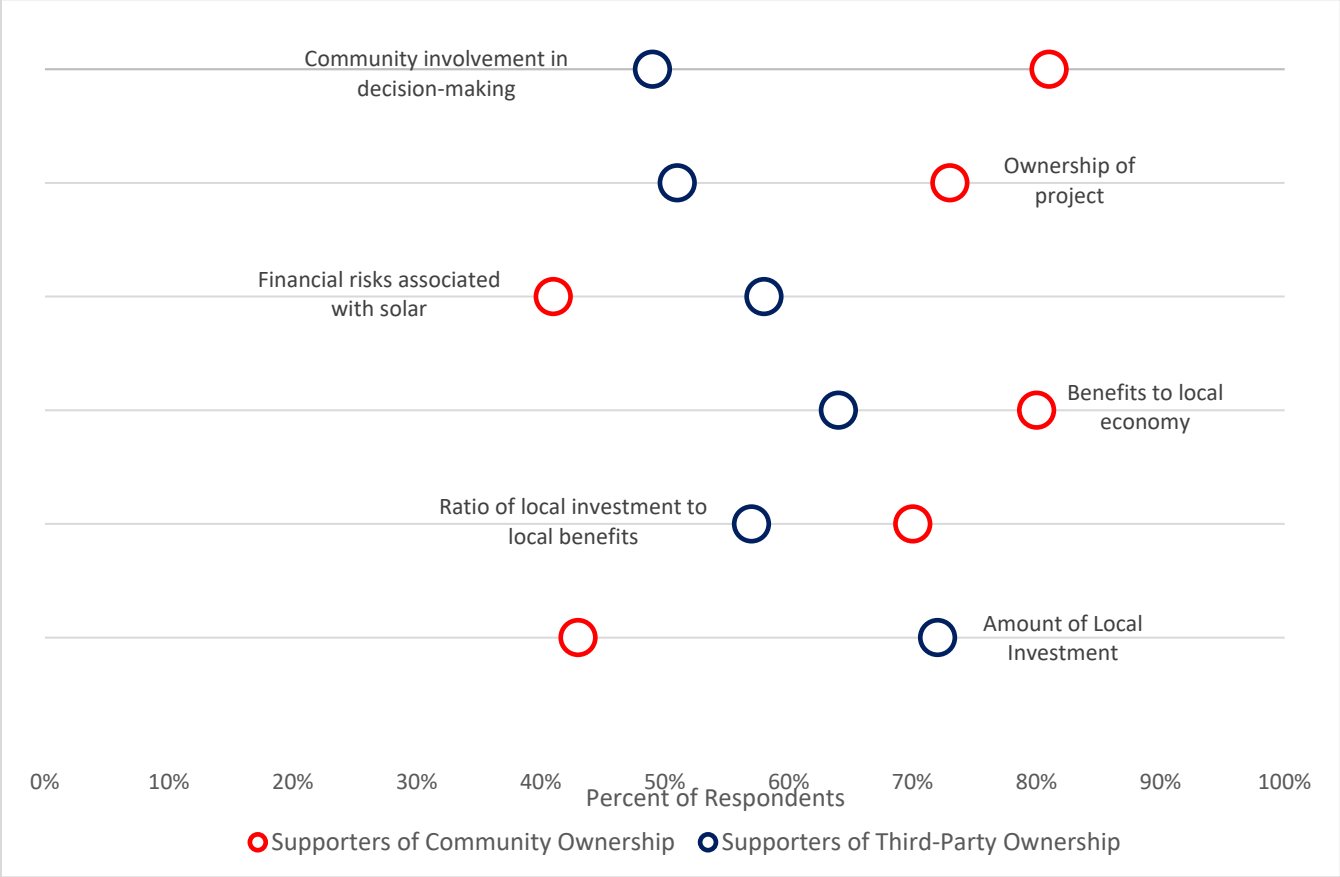


Figure 6. Attributes most important to respondents that were positive about third-party ownership (n=75) and community ownership (n=125)

Location and Capacity Preferences for Future Solar Development in Local Community

Several survey questions addressed location preferences for future solar development, and a related theme of scale. These themes are related because increasing scale requires solar development in green spaces to a greater degree. Figure 7 below shows attitudes towards eight non-agricultural land cover locations for large-scale (1-MW) solar development. In this example, the differences were extreme – meaning preferences were very clear. In the survey, the response options were given on a 5-point scale ranging from *strongly support* to *strongly oppose;* the *support* options were combined and the *oppose* options were combined. This is a simpler way to view the data without losing the sentiment.

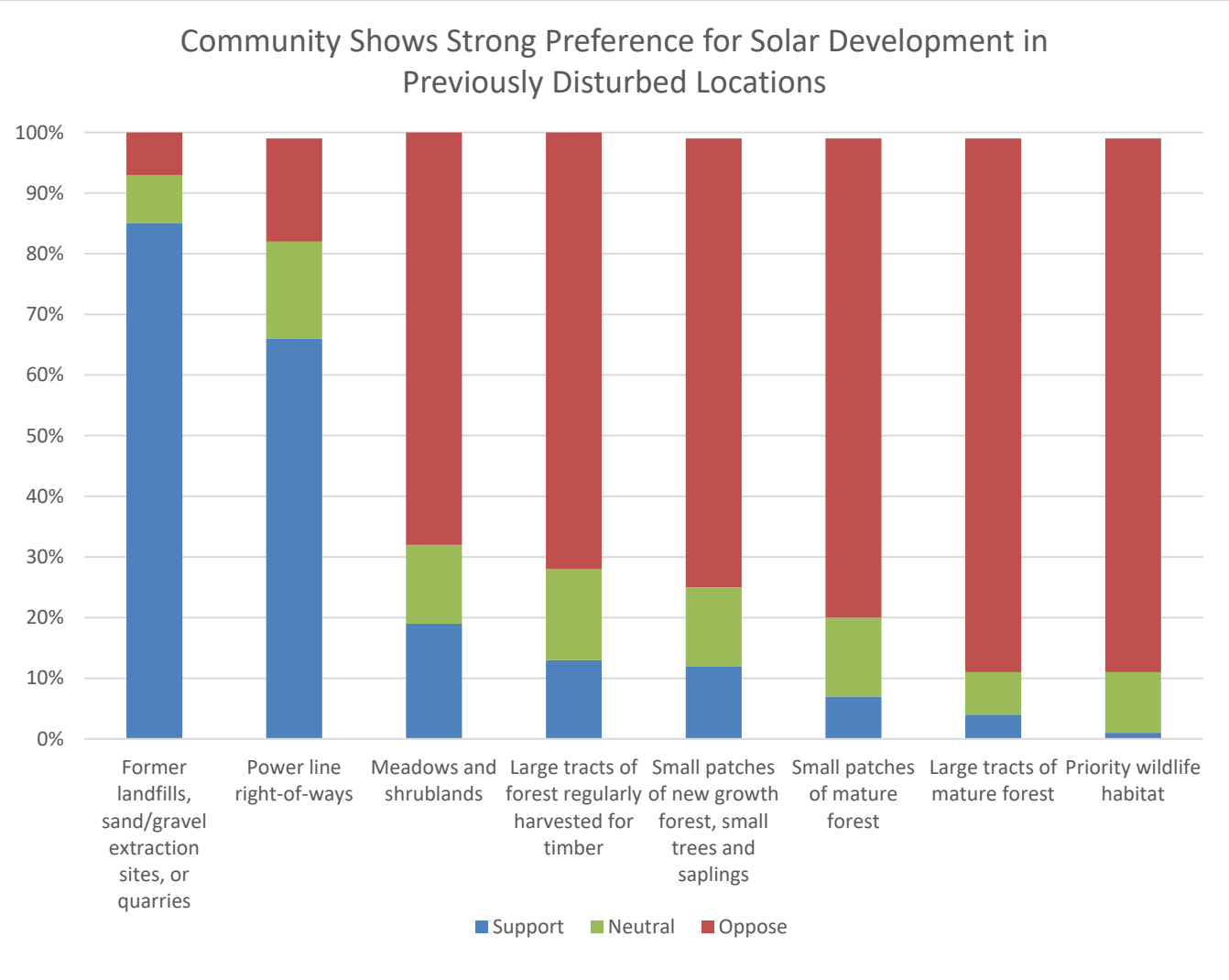


Figure 7. Locational Preferences for Future Large-Scale Solar Development, n=214.

The survey responses to a question asking about which capacity option – increasing from the existing developments (status quo) ranging to order of magnitude increases in capacity (~2x, 20x) shows a clear preference for two of the five provided options: a preference for a moderate increase of solar which would be limited to existing developed spaces (rooftops, disturbed land), or enough to meet community needs for the town only (See Figure 8 below). Community members did not prefer to leave development in an ad-hoc manner whereby individual landowner decisions would dictate future capacity, nor were they strongly interested in developing more solar than was needed locally to help the region or state achieve clean energy goals. This bar chart is depicted by centering the responses on one side of a vertical line – in this case, all positive responses to the right, and neutral or negative responses to the left. This type of centering can help draw attention to which choices are preferable.

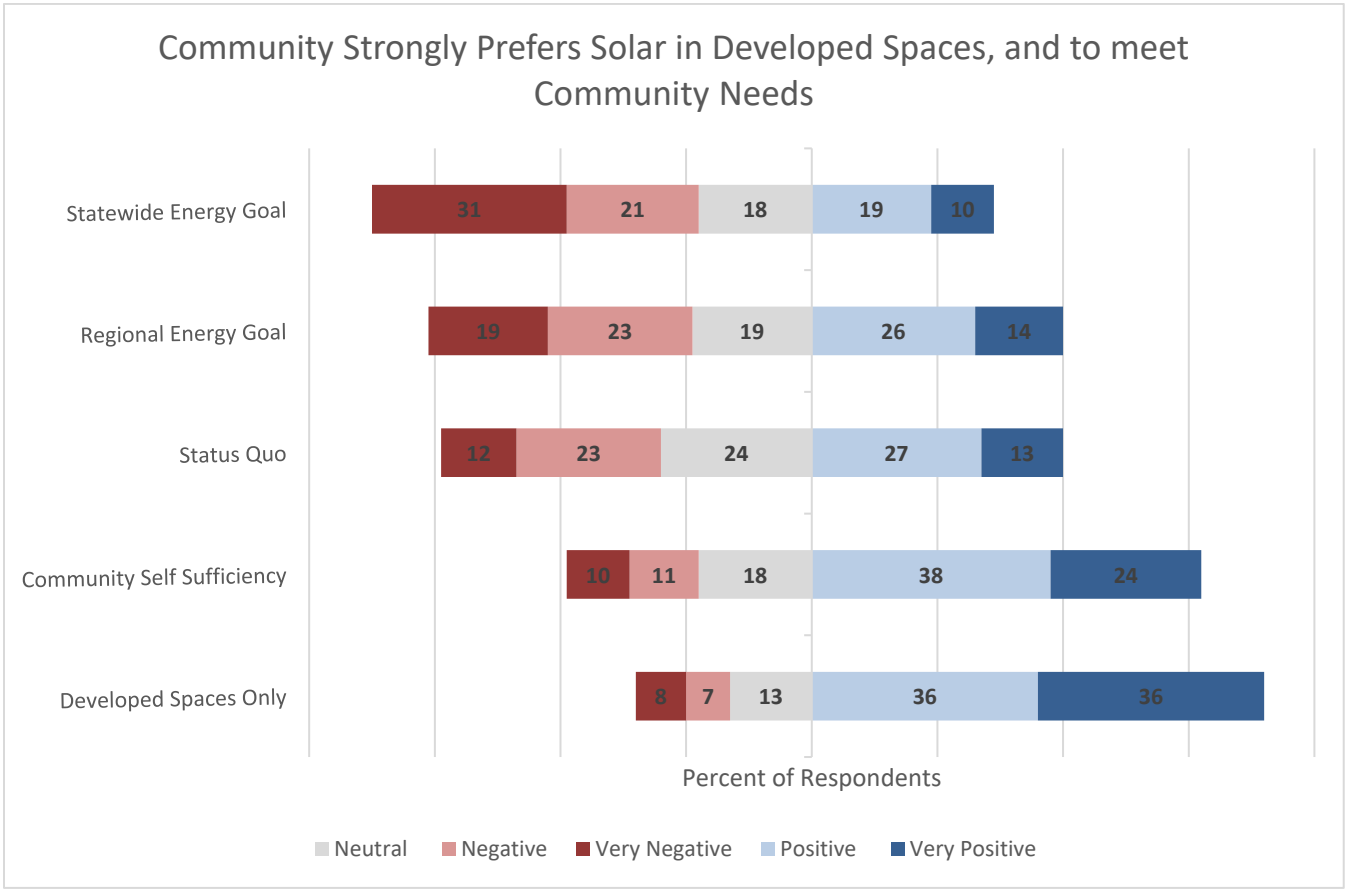


Figure 8. Attitudes towards five different capacity options for future solar energy development in the local community, n=205.

Further, a follow-up question asking which attributes were most important to the attitude towards each capacity option reveals more information about the decision process. Because this question is forward looking in terms of solar development, Figure 9 below illustrates the items of importance by age: to respondents 55 and younger, and those over 55. As seen below, similar items are rated as important across the age grouping, with total land area being the most important item to nearly 80% or respondents in all age categories, followed by climate and pollution benefits. Supporting energy goals – whether for a town's fair share or energy goals more broadly, were less important.

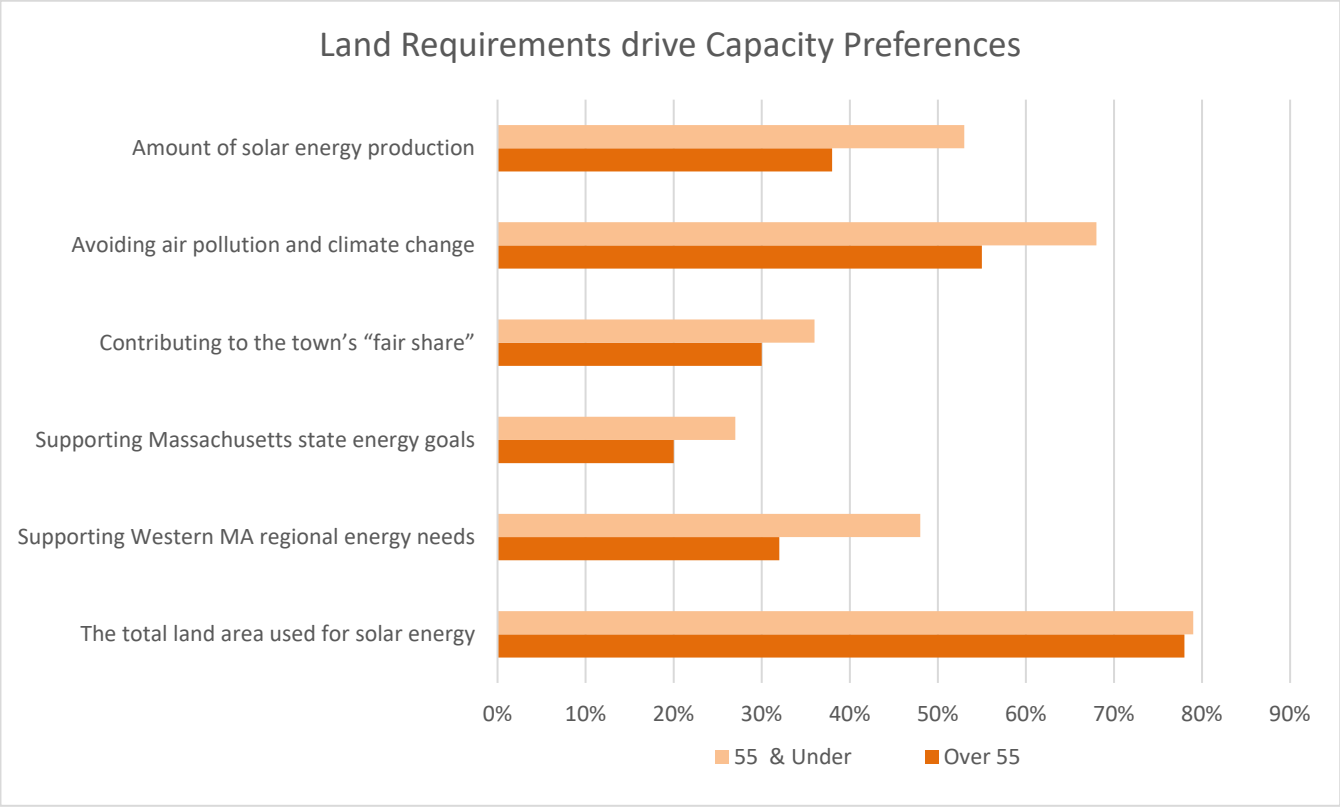


Figure 9. Respondents identify land area as the most important reason for choosing sole capacity options for their community, regardless of age, n=211.

Conclusion

Using this guide, community officials, volunteers, regional planning agency staff, or other interested individuals can develop a survey to assess opinions for solar energy in their community. The various considerations that should be made to develop a survey resulting in usable data are included, with examples throughout to help planners through the process. Finally, the many options for handing data, maintaining confidentiality, and visualizing responses to share externally are provided within. Responses to solar energy in communities will vary considerably, highlighting the need for data collection at the local level. Understanding the nuances of how community members respond to solar, and the relative preferences for location, scale, ownership, and benefits can help communities plan proactively to develop solar in a way that is locally preferred and acceptable. These studies can also help community planners identify ways that policy makers may be able to better support solar development to achieve clean energy targets at local, state, regional, or national scales.

Appendix A – Example Invitation Letter

This template can be modified for a mail and/or internet survey. The consent form can also be modified to fit your needs. Consent forms for internet surveys are typically done by clicking "agree."

Greetings, [date]

We are writing to ask for your help in a study being conducted to understand attitudes and preferences towards solar energy in [town]. We sent you an invitation to take this survey online several weeks ago, and we are following up with a printed copy. If you already took this survey, please disregard this mailing, or you may give this to another adult in your household.

This survey is part of a project funded by the [list agencies, if any]. We are working in partnership with your town, and [any partners, such as businesses, local or regional government agencies, community groups, universities, etc.].

Our purpose in conducting this survey is neither to advocate nor oppose solar energy. Rather, the purpose is to clarify local attitudes and preferences towards solar energy as the Commonwealth has a goal of 100% renewable electricity by 2050. We are inviting all residents of [your town] to participate in this survey. Your participation is voluntary, although will be very much appreciated to help shape the future of solar energy in [Western Massachusetts]. The results will help educate town Select Boards or Planning Boards and other local decision-makers and constituents regarding community priorities around solar energy. The results may also inform state and federal policy makers and improve communication between government agencies and the public.

Be assured, your answers are completely confidential and will be released only in summaries in which no individual's answers can be identified. If you have any questions or comments about this study, we would be happy to talk to you. Please contact researcher [insert name, phone, email].

If you are willing to participate, please fill out the enclosed survey and return it in the envelope provided to you. We will also have printed copies available at the library, where surveys can be filled out and dropped off. We also will have copies available at town meeting and town elections.

If you prefer, you may complete the survey digitally. Please hold your phone camera to the image and it will automatically generate a notification that will take you to the survey. Alternately, you may type in this link into your internet browser:

[insert weblink] **[insert QR code]**

Thank you very much for helping with this important study.

Sincerely,

[name, affiliation]

Appendix B – Example Consent Form

Consent forms may be presented online with an opportunity for participants to click "I agree" or "I do not agree," or they may be presented in print form. If printed, they typically include a statement that by returning the survey, they are consenting to the terms you have specified. An example of a printed consent form is provided. This example was used as the second page of an invitation letter for a print survey, as found in Appendix A.

Notification of Consent

You are being invited to participate in a research study titled "Solar Preferences Survey." This study is being done by [name, affiliation]. You were selected to participate in this study because you live in the town of [insert town]. The purpose of this research study is to investigate and understand the preferences of stakeholders living in rural areas of Massachusetts with regard to potential solar installations, community solar projects, and future renewable energy installations in your town. If you agree to take part in this study, you will be asked to complete the survey on the next page. This survey will ask you to look at some diagrams and tables pertaining to solar installations and answer a few questions. It will take approximately 20 to 30 minutes to complete. You may not directly benefit from this research; however, we hope that your participation in the study may help guide the equitable development of future renewable energy projects in Western Massachusetts. To the best of our ability your answers in this study will remain confidential. We will minimize any risks to breach of confidentiality. Your name will not be attached to your responses to the survey. We will minimize any risks by storing all survey data in a computer in a locked office at [location]. After a period of 3 years following the end of the survey, all identifying information collected as part of this survey will be destroyed.

Your participation in this study is completely voluntary and you can withdraw at any time. You are free to skip any question you choose.

If you have questions about this project or if you have a research-related problem, you may contact [enter name(s), affiliation, and contact information].

- **By proceeding to the survey on the next page you are indicating that you are at least 18 years old, have read and understood this consent form and agree to participate in this research study.**
- **Please keep this page for your records and return the survey/questionnaire to the researchers.**
- **Please DO NOT write your name on the survey/questionnaire.**

Appendix C – Example Survey

The distribution mode of your survey will dictate the formatting. The following questions were presented in a mail survey, and were also used in an online format distributed via Qualtrics XM Survey Software. There are some questions included here that you may not need or choose to ask, such as demographics. This survey is quite long. We have included the full range of questions you may be interested in, but a survey that is much shorter may suit your needs and would likely be preferable.

In addition to the survey itself, we presented the following preliminary information for respondents:

Solar energy is growing significantly in the United States. Many states, including Massachusetts, have set policy goals to increase solar energy in order to reduce pollution from fossil fuel power plants. In this study, we aim to understand your attitudes about solar energy in general, and your preferences for solar energy growth in your community. In this survey, when we use the term "solar energy," we are referring to systems which produce electricity from solar photovoltaic panels, which are also referred to as "solar power," "solar arrays," "solar facilities," "solar development," or "solar PV." Here are some examples of solar energy projects. Solar energy projects are often described in terms of their **size** in kilowatts (kW) or mega-watts (MW), 1 MW = 1000 kW.

Residential rooftop solar

(about 10 kW on one roof, enough to power 1 home)

Solar parking canopy

(about 100 kW on a half-acre parking lot, enough to power 10 homes)

Large, ground-mounted solar

(about 1000 kW – or 1 MW - on 5 acres of land, enough to power 100 homes)

Wendell Survey

Clean Energy Extension

Your Opinions on Solar and Renewable Energy

Solar energy is growing significantly in the United States. Many states, including Massachusetts, have set policy goals to increase solar energy in order to reduce pollution from fossil fuel power plants. In this study, we aim to understand your attitudes about solar energy in general, and your preferences for solar locally.

1. **What is your general attitude toward solar energy?**
□ Very positive □ Positive □ Neutral □ Negative □ Very negative

2. **What is your attitude toward solar energy currently installed in Wendell?**
□ Very positive □ Positive □ Neutral □ Negative □ Very negative

3. **To what extent do you agree or disagree that the following should be encouraged by state or local policy makers: (check one box on each line)**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Energy conservation by residents, municipal governments, and businesses	☐	☐	☐	☐	☐
Development of solar energy in the Commonwealth of Massachusetts	☐	☐	☐	☐	☐
Development of solar energy in Western MA	☐	☐	☐	☐	☐
Development of solar energy in Wendell	☐	☐	☐	☐	☐
Development of solar energy in Wendell that is owned by the town or community members	☐	☐	☐	☐	☐
Energy conservation by residents, municipal governments, and businesses	☐	☐	☐	☐	☐
Development of natural gas power generation in MA	☐	☐	☐	☐	☐
Development of offshore wind energy in MA	☐	☐	☐	☐	☐

In the next section, we will ask about solar energy in your community. It may be installed on house rooftops - or sometimes in a residential yard - to contribute towards a family's energy needs. It also may be a larger project on a roof, over a parking lot, or on the ground, that provides more energy than one household needs.

4. **What is your attitude toward solar energy that is installed on house rooftops?**
□ Very positive □ Positive □ Neutral □ Negative □ Very negative

5. **What is your attitude toward solar energy that is installed in a residential yard to serve that household's electricity needs?**
□ Very positive □ Positive □ Neutral □ Negative □ Very negative

6. **Do you have solar panels installed at your home?**
□ **No (continue to question 7)** □ **Yes (skip questions 7 & 8 and go to the section on Large, Ground-mounted solar** on the next page)

7. **Are you interested in installing solar at your home?**
□ **No** □ **Yes** □ **Not sure**

If you have questions about this survey, please contact [name, contact info]

8. Please indicate the reason(s) you do not have solar at your home. *Please check all that apply.*

□ I've had, or am aware of, negative experiences with solar energy.
□ I don't trust solar developers to work in my best interest.
□ I don't trust my utility to work in my best interest.
□ I don't know enough about my options.
□ The upfront cost is too high.
□ Paying my electricity bill is cheaper than paying for solar panels.
□ My property is too shaded to allow for solar panels.
□ I am concerned that solar on my roof will be a safety hazard.
□ I don't own the property.
□ I am interested, but I need to wait until the next time my roof is replaced.
□ I am interested, but haven't found the time.
□ I am not interested.
□ Other: _____

Large, Ground-Mounted Solar

These projects are large enough to generate electricity for dozens or hundreds of households. Many systems like this exist in Western Massachusetts. These projects are an assembly of many solar panels connected together, installed on the ground, on various types of land, such as the images below.

(Image: https://www.wbur.org)

9. What is your attitude toward large, ground-mounted solar energy in general?
□ Very positive □ Positive □ Neutral □ Negative □ Very negative

10. What is your attitude toward large, ground-mounted solar energy in Wendell?
□ Very positive □ Positive □ Neutral □ Negative □ Very negative

11. In general, do you believe development of large, ground-mounted solar energy should be:
□ Encouraged and promoted
□ Allowed and promoted in appropriate circumstances
□ Not sure
□ Allowed but not promoted
□ Prohibited in all instances

12. To what extent do you agree or disagree that the process of large, ground-mounted solar energy development in your town has been fair?
□ Strongly agree
□ Agree
□ Neither agree or disagree
□ Disagree
□ Strongly disagree
□ Not Sure

The next set of questions will ask you about your thoughts regarding <u>future</u> solar energy in your community. Massachusetts is considering setting a goal of 100% renewable electricity by 2050, in order to reduce pollution from fossil fuel power plants. This will mean that large amounts of renewable energy will be needed, including solar energy. To meet this goal, many communities in Massachusetts will see proposals for new renewable energy development, including large-scale solar energy.

Wendell Survey

Clean Energy Extension

13. I think our town should invest in solar energy projects on municipal buildings or parking lots for municipal electricity needs.

□ Yes □ No □ It depends: _____

14. Which of the following types of community involvement would you like to see if a large-scale solar energy project was being planned in Wendell? *[Please select all that apply]*

□ Information should be shared at public meetings.
□ Community members should have the opportunity to review and comment on the siting and design.
□ Community members or the municipality should have the opportunity to communicate concerns directly to the solar project developer.
□ Community members should have the opportunity to be a part owner of the large-scale solar project.
□ Community members should be involved in deciding where the best place in town is for a solar project.
□ Voters should have the right to vote on solar projects before they are approved.
□ Developer should have a local office to enable community interaction.
□ Other [Please mention]: _____

15. How do you think that new large, ground mounted solar projects in Wendell will affect:

Check one box for each item below	Benefit	No Impact	Harm	Not Sure
Local job creation or economic development	☐	☐	☐	☐
The cost of electricity	☐	☐	☐	☐
Local property taxes	☐	☐	☐	☐
The reliability of electricity (backup during outages)	☐	☐	☐	☐
Aesthetics, or "look" of local landscape	☐	☐	☐	☐
Property values	☐	☐	☐	☐
Community cohesion	☐	☐	☐	☐
Preservation of farmland	☐	☐	☐	☐

16. How likely would you be to support large, ground mounted solar energy in Wendell if the project provided the following benefits to your town?

Check one box for each item below	Very Likely	Somewhat Likely	Not Very Likely	Not at all Likely
Reduced electricity rates for residents	☐	☐	☐	☐
Reduced electricity rates for low-income residents	☐	☐	☐	☐
Direct payments that reduced property taxes	☐	☐	☐	☐
Direct payments that supported town budget needs (e.g. school funding, fire or police vehicles)	☐	☐	☐	☐
Jobs for local residents	☐	☐	☐	☐
Back-up power to the school, emergency shelter, or senior housing in case of power outage	☐	☐	☐	☐
Offers local ownership for residents who can't put it on their houses	☐	☐	☐	☐

3

If you have questions about this survey, please contact [name, contact info]

Wendell Survey

Clean Energy Extension

Solar energy may be installed in many different places, which could include developed land, undeveloped land, or it could be co-located with another land use. The next several questions ask about which locations you would support solar energy in your town.

17. To what extent do you support or oppose solar energy on various types of agricultural land cover?

Choose one option for each statement below	Strongly Support	Support	Neutral	Oppose	Strongly Oppose
Active hayfields or pastureland converted to solar	☐	☐	☐	☐	☐
Solar panels raised above agricultural land to allow farming to continue beneath	☐	☐	☐	☐	☐
Agricultural land used for vegetable or fruit production	☐	☐	☐	☐	☐
The edges of active agricultural land	☐	☐	☐	☐	☐
Agricultural land not currently being farmed	☐	☐	☐	☐	☐

18. To what extent do you support or oppose solar energy on various types of non-agricultural land cover?

Choose one number for each statement below	Strongly Support	Support	Neutral	Oppose	Strongly Oppose
Former landfills, sand/gravel extraction sites, or quarries	☐	☐	☐	☐	☐
Priority wildlife habitat	☐	☐	☐	☐	☐
Large tracts of mature forest	☐	☐	☐	☐	☐
Large tracts of forest regularly harvested for timber	☐	☐	☐	☐	☐
Small patches of mature forest	☐	☐	☐	☐	☐
Small patches of new growth forest, small trees and saplings	☐	☐	☐	☐	☐
Meadows or Shrublands	☐	☐	☐	☐	☐
Powerline right-of-ways	☐	☐	☐	☐	☐

19. To what extent do you support or oppose solar energy on locations around your community?

Choose one option for each statement below	Strongly Support	Support	Neutral	Oppose	Strongly Oppose
Along waterbodies: streams, rivers, ponds, lakes, wetlands	☐	☐	☐	☐	☐
Adjacent to public recreation areas	☐	☐	☐	☐	☐
Adjacent to the town center	☐	☐	☐	☐	☐
Adjacent to historic buildings or properties	☐	☐	☐	☐	☐
Adjacent to residences	☐	☐	☐	☐	☐
Along rural roads	☐	☐	☐	☐	☐
Along major roads	☐	☐	☐	☐	☐
Areas visible from scenic vistas or high elevation locations	☐	☐	☐	☐	☐
Areas hidden by trees or low elevation sites not easily visible	☐	☐	☐	☐	☐

If you have questions about this survey, please contact [name, contact info]

Wendell Survey

Clean Energy Extension

Ownership Options for Solar Energy

There are several ways that large, ground mounted solar projects can be purchased and owned. The options have different costs and benefits for communities. Please read the following descriptions of each, and then provide your opinion for each option.

Third-Party Ownership: A developer or out-of-town company finances, develops, and owns the project for the entire 30 years. Any additional costs from delays or problems are the responsibility of the third party. Revenues come from the third-party developer, in annual payments to the town and/or land owner. The process is quite simple for the community, but there is little role for local decision-making.

"Flip" Model Ownership: A developer or out-of-town company finances, develops, and owns the project for the first 6 years. Then, the project is sold to a local partner (non-profit, community group, or municipality) at fair market value. Any additional costs from delays or problems are the responsibility of the third party until ownership switches. Revenues increase to the town once the ownership switches because the local owner/community earns the money from electricity sales. Possibility for a greater role for the community in decision-making.

Community Ownership: A local entity finances, develops, and owns the project for the entire 30 years. A local entity could be the town, nonprofit, group of residents, or local business. Any additional costs from delays are the responsibility of the local entity. Revenues stay in the local economy, and decision-making is local.

Here are some estimates of the investment costs and financial benefits to the local economy of these ownership models for a 1 MW ground-mounted solar project, which is enough energy for about 100 homes.

Ownership Type	Investment Cost for Locals	Net Financial Benefit to Local Economy over 30 years
Third-Party Ownership	$0	$500,000
"Flip" Model Ownership	$500,000 (to buy the project)	$1.8 million
Community Ownership	$1.5 million	$2.8 million

20. What is your attitude towards each of the ownership options described above?

Ownership Type	Very Positive	Positive	Neutral	Negative	Very Negative
Third-party ownership	☐	☐	☐	☐	☐
"Flip" model ownership	☐	☐	☐	☐	☐
Community ownership	☐	☐	☐	☐	☐

21. Which attributes were most important in considering your attitude towards each of the solar energy ownership options? *Check all that apply.*

☐ Amount of local investment required
☐ Ratio of local investment to local benefits
☐ Benefits to the local economy
☐ Financial risks associated with solar development
☐ Who owns the solar energy project
☐ Community involvement in decision-making
☐ Other:_____

Wendell Survey

Clean Energy Extension

Capacity of Solar Energy in Wendell

In order for Massachusetts to meet the goal of 100% renewable electricity by 2050, solar energy would need to increase **at least 10x** from the current capacity, from 3,000 MW to 30,000 MW or more.

- Massachusetts **currently** generates half of the electricity that it needs, mostly from natural gas;
- Wendell **currently** generates 60% of the electricity that it needs from solar energy;
- It is expected that electricity needs in Massachusetts increase **2.5X** in the future, and electricity needs in Wendell will **triple**, as heating systems and private vehicles use electricity for fuel.

Here are some options for how much solar development could be planned for Wendell in the future.

- **Status Quo**: "Ad-hoc" development, town does not plan for an increase in solar; individual landowners may choose to develop solar.
- **Developed Spaces**: Moderate increase: roofs, parking lots and disturbed land would be developed.
- **Community Self-Sufficiency**: Town generates 100% of community energy needs from solar.
- **Regional Energy Goal**: All Western MA towns develop 1.25% of their land for solar to meet the four-county regional energy needs.
- **Statewide Energy Goal**: All MA towns develop 4% of land for solar to meet statewide solar energy goals.

Option	Increase in Current Solar Development	Total Capacity	Acreage of Forest and Farm Land Needed in Wendell
Status Quo	Depends on landowners	2 MW or more	10 acres (already developed) *or more.*
Developed Spaces	3x	6 MW	10 acres (already developed)
Community Self-Sufficiency	5x	10 MW	12-30 acres
Regional Energy Goal	27x	55 MW	About 250 acres
Statewide Energy Goal	80x	160 MW	About 750 acres

22. What is your attitude towards the capacity options described above?

	Very Positive	Positive	Neutral	Negative	Very Negative
Status Quo	☐	☐	☐	☐	☐
Developed Spaces	☐	☐	☐	☐	☐
Community Self-Sufficiency	☐	☐	☐	☐	☐
Regional Energy Goal	☐	☐	☐	☐	☐
Statewide Energy Goal	☐	☐	☐	☐	☐

23. Which attributes were most important in considering your attitude towards each solar capacity option? *Please check all that apply.*

☐ Amount of solar energy production
☐ The total land area used for solar energy
☐ Contributing to the town's "fair share"
☐ Supporting Massachusetts state energy goals
☐ Supporting Western MA regional energy needs
☐ Avoiding air pollution and climate change
☐ Other: _____

24. Indicate the percent (of the maximum possible) solar energy you would choose to be installed on various sites in Wendell, with technical availability listed. You can choose up to 100% of each option.

Residential (up to 1.5 MW) _____ Large rooftops (up to 1 MW) _____ Parking lots (up to 4 MW)_____
Landfill (up to 6.5 MW) _____ Undeveloped Land (forests, farms, other green spaces) (up to 285 MW) _____

6

If you have questions about this survey, please contact [name, contact info]

Wendell Survey

Clean Energy Extension

Solar Energy Scenarios

We have created a set of "solar energy scenarios" that *could* be considered in Wendell. They would generate the same amount of solar energy, but they would be installed in various configurations.

- Imagine a situation in which Wendell has decided to allow the installation of 10 MW of solar, about enough to cover all community electricity needs.
- Wendell currently has approximately 0.32 MW of solar energy installed on 50 residences, municipal buildings, and community businesses and one 1.5 MW large, ground mounted solar development.
- Adding more solar may require upgrades to the electric grid. The following questions assume that these upgrades are possible.

	 **Roofs and Parking Lots**	 **Previously Disturbed Land: Landfill, Gravel Pits**	 **Forest and Farmland**	**Cost** Increase to monthly electricity bill
OPTION 1	35% *3/4 would have solar*	40% *20 acres of solar*	25% *12 acres of solar*	$8-20
OPTION 2	25% *1/2 would have solar*	25% *12 acres of solar*	50% *25 acres of solar*	$5-12
OPTION 3	15% *1/3 would have solar*	10% *5 acres of solar*	75% *38 acres of solar*	$2-5
OPTION 4	10% *1/4 would have solar*	0% *No Solar*	90% *45 acres of solar*	$0

25. What is your attitude towards the four options described above?

	Very Positive	Positive	Neutral	Negative	Very Negative
Option 1	☐	☐	☐	☐	☐
Option 2	☐	☐	☐	☐	☐
Option 3	☐	☐	☐	☐	☐
Option 4	☐	☐	☐	☐	☐

26. How important were the following attributes in your attitude towards the solar energy scenarios?

	Very important	Somewhat important	Not important
The impact to my electricity bill.	☐	☐	☐
Environmental considerations: forest or farm land with solar, wildlife.	☐	☐	☐
Locating solar on developed spaces, such as buildings, parking lots.	☐	☐	☐
The amount of previously disturbed areas (gravel pits, landfills) with solar.	☐	☐	☐
Visibility considerations (how the solar will look).	☐	☐	☐

If you have questions about this survey, please contact [name, contact info]

Wendell Survey

Clean Energy Extension

Finally, a few questions about yourself and your household to help us interpret the results of the survey. <u>All questions are optional</u>.

27. My town is part of my identity.
- □ Agree
- □ Somewhat agree
- □ Neither agree or disagree
- □ Somewhat disagree
- □ Disagree

28. I feel attached to my town.
- □ Agree
- □ Somewhat agree
- □ Neither agree or disagree
- □ Somewhat disagree
- □ Disagree

29. I feel attached to Western Massachusetts.
- □ Agree
- □ Somewhat agree
- □ Neither agree or disagree
- □ Somewhat disagree
- □ Disagree

30. I feel attached to the Commonwealth of Massachusetts.
- □ Agree
- □ Somewhat agree
- □ Neither agree or disagree
- □ Somewhat disagree
- □ Disagree

31. What is your personal level of concern about climate change?
- □ Extremely concerned about climate change
- □ Moderately concerned about climate change
- □ Slightly concerned about climate change
- □ Not at all concerned about climate change
- □ Not sure

32. Do you rent or own your current residence?
- □ Rent
- □ Own

33. What is your age? _____

34. Are you male or female, or non-binary?
- □ Male
- □ Female
- □ Non-binary
- □ Prefer not to answer

35. What is the highest degree or level of school that you have completed?
- □ Grade school
- □ Some high school
- □ High school graduate
- □ Some college credit
- □ Associate degree
- □ Bachelor's degree
- □ Graduate degree

36. What is your current employment status?
- □ Employed for wages
- □ Self-employed
- □ Out of work
- □ A homemaker
- □ Student
- □ Retired

37. Which category best describes your household income (before taxes) in 2020?
- □ Less than $15,000
- □ $15,000-$24,999
- □ $25,000-$34,999
- □ $35,000-$49,999
- □ $50,000-$74,999
- □ $75,000-$99,999
- □ $100,000-$149,999
- □ $150,000 and above

38. What is your race/origin? (check as many as apply)
- □ White
- □ Black or African American
- □ Asian
- □ American Indian or Alaska Native
- □ Native Hawaiian or other Pacific Islander
- □ Hispanic or Latino origin
- □ Other:_____

Your contribution to this effort is greatly appreciated. Thank you!

Additional Comments:

8

If you have questions about this survey, please contact [name, contact info]