United States Environmental Protection Agency

RE-Powering America's Land Initiative

Community Solar

An Opportunity to Enhance Sustainable Development on Landfills and Other Contaminated Sites

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Contents



1. Introduction

Community solar programs (also called "shared solar") offer the economic and environmental benefits of solar to the 49% of Americans without traditional solar access.[1] Such programs are experiencing rapid growth, with active projects across 26 states, up from 6 states in 2010.[2] This market has the potential to grow more than 50-fold from the 110 megawatt (MW) capacity in early 2016 to between 5,500 MW and 11,000 MW by 2020.[3] Previously, it was often uneconomic to develop individual solar projects of less than 2 MW in capacity (2,000 kilowatts [kW])[4] if they were not tied directly to or net metered with a customer site. With community solar, projects between 50 kW and 2,000 kW are often viable because numerous off-site subscribers can purchase shares of a solar installation rather than hosting the installation themselves. By bringing an enormous source of new demand into the market and offering new contracting arrangements to the 51% of Americans who already have potential solar access, community solar is expected to greatly expand the market for mid-sized solar projects.

One strong but sometimes overlooked source of suitable sites for community solar are those covered by the U.S. Environmental Protection Agency (EPA) RE-Powering America's Land Initiative. The RE-Powering Initiative provides data, tools, analysis, case studies, issue briefings, and outreach resources to encourage renewable energy development on contaminated lands, landfills, and mining sites (collectively "RE-Powering sites"). RE-Powering sites represent a large and varied collection of sites that include former Superfund sites, brownfields, landfills, and mine sites, as well as other formerly contaminated sites under various federal and state cleanup programs. Such sites occupy millions of acres across the country and are often found in and among communities. In addition, the percent of households with income below the poverty line and living in close proximity to RE-Powering sites is generally higher than the overall U.S. population; that is, surrounding populations tend to be poorer than average.

RE-Powering sites can therefore potentially provide a higher number of sites for community solar projects and thereby deflect development pressures away from open space and lands with other environmental or economic re-use options. As described later in this paper, nearly 9,500 pre-

[1] The White House, *Fact Sheet: Administration Announces New Initiative to Increase Solar Access for All Americans*, July 7, 2015, https://www.whitehouse.gov/the-press-office/2015/07/07/fact-sheet-administration-announces-new-initiative-increase-solar-access [accessed July 2016].

[2] National Renewable Energy Laboratory (NREL), *Community Solar: Status, Trends, Legal, and Financial Issues*, March 9, 2016, page 3, https://www.epa.gov/sites/production/files/2016-03/documents/webinar_20160309_oshaughnessy.pdf [accessed July 2016]. NREL's full list of the 26 states and the number of projects completed by state is provided as **Figure 8** in **Appendix C** of this paper. In total, 108 projects are in the NREL document. Community Solar Hub's website lists similar data on 98 shared solar projects in 25 states with a combined capacity of 100 MW, https://www.communitysolarhub.com/ [accessed November 2016].

[3] NREL, *Shared Solar: Current Landscape, Market Potential, and the Impact of Federal Securities Regulation*, April 2015, page v, http://www.nrel.gov/docs/fy15osti/63892.pdf [accessed July 2016].

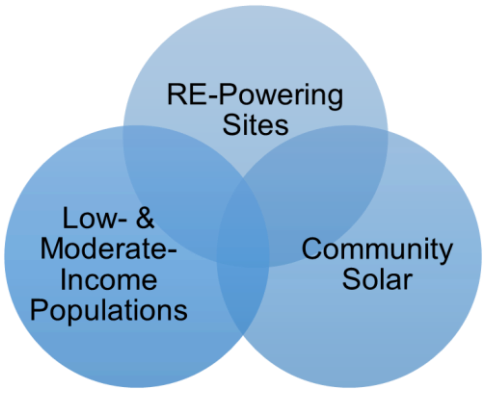
[4] 1,000 kilowatts (kW) = 1 megawatt (MW). While 2 MW has been a common historical limit to individual community solar projects, larger examples are likely in the future. Xcel Energy's Minnesota Solar*Rewards Community® program has several hundred MWs of applications from the time when "co-location" of five adjacent projects of 1 MW_{AC} was allowed, which effectively makes a 5 MW_{AC} project. Another example is the utility Southern California Edison, which will allow community solar projects up to 3 MW_{DC} in capacity, as highlighted in **Section 3.3** of this paper.



screened RE-Powering sites, representing 8,800 MW to 15,200 MW of technical solar photovoltaic (PV) potential, are available for development in the 26 states that currently have community solar projects.[5] This means that RE-Powering sites could, in concept, meet the entire community solar market forecast previously described. Beyond the raw numbers, RE-Powering sites offer valuable added benefits. They enable a unique opportunity to re-purpose sites that may have no other immediate development potential and have historically created environmental concerns for the community. RE-Powering sites also can add sustainable re-use to the winning combination of subscriber access and economies of scale that has fueled community solar growth.

In addition to these benefits, community solar can make a particularly positive impact in low- and moderate-income (LMI) areas. Community solar can overcome financing, contract flexibility, project size, and siting challenges that largely shut out LMI homes, apartments, and small businesses from the solar market, while offering added local economic development benefits if the community solar project itself is located in LMI areas. Because RE-Powering sites are frequently located in or near LMI areas, this paper will explore not only the general potential for developing RE-Powering sites for community solar, but also where siting adjacent to LMI areas extends their benefits. This market intersection is conceptually depicted in **Figure 1**. Within and outside LMI areas, this paper is intended to support sustainable re-use by characterizing the potential and pointing out the challenges and opportunities of community solar development on RE-Powering sites.

Figure 1: Solar Market Development Opportunity



[5] Among the 26 states that have implemented community solar projects, program rules and/or incentives can vary widely, making the jurisdictions more or less favorable for such projects. Within some of these states, community solar programs are not universally available, but restricted to certain utility territories. Turning to the remaining 24 states, this paper's analyses cautiously assume no community solar activity. However, the sharp growth of community solar makes it likely that many of these additional states will welcome community solar in the future. In its *2015 Utility Solar Market Snapshot* published in July 2016, the Smart Electric Power Alliance reports that "89% of utilities surveyed were either offering or planning/researching/considering a community solar program," page 12, https://www.solarelectricpower.org/discover-resources/publications-and-media.aspx [accessed November 2016].



The audiences for this paper include RE-Powering site owners/responsible parties; solar developers; utilities; government energy, environmental, and housing agencies; and other stakeholders. Due to the complexities of many community solar programs, engagement of multiple parties is essential for success. The analysis in this paper is drawn from interviews with stakeholders from across the country that are active in community solar markets, as well as secondary source information on trends, challenges, and best practices. The paper presents:

- The market context for community solar;
- A business case for community solar on RE-Powering sites;
- Challenges to developing RE-Powering sites for community solar;
- Discussion questions to help unlock community solar potential; and
- A bibliography, glossary, and additional reference material.

Green Power Claims & Renewable Energy Certificates

While community solar offers new options for sustainable land re-use and buying energy, it is important to understand how green power claims are treated in different community solar programs and the implications of those treatments. The accounting mechanism for green power claims is typically renewable energy certificates (RECs). Broadly, RECs from a community solar project can be:

- Retained by the solar project owner, utility, or other community solar administrator to use for its own claims;
- Retired on behalf of the subscriber (person or business buying from/participating in the community solar program); or
- Provided to the subscriber.

Only the party that owns the RECs can claim the green power benefits from the solar project. For example, if a business participates in a community solar program following the first option above, then the business cannot under Federal Trade Commission guidelines say that it is buying green power. Likewise, no valid green power purchase claim can be made if the business receives the RECs (third option above), but later sells them for financial gain. The disposition of RECs will also affect how community solar is accounted for in greenhouse gas inventories.

Community solar participants should be informed about how RECs are handled in their programs and make claims consistent with standard environmental practice. The message is not, however, that community solar development on RE-Powering sites is better or worse depending on who owns the RECs. There are many economic, environmental, and social benefits that can result from renewable energy development, irrespective of REC ownership.

2. Market Context

2.1 Overview of Community Solar and Its Growing Importance

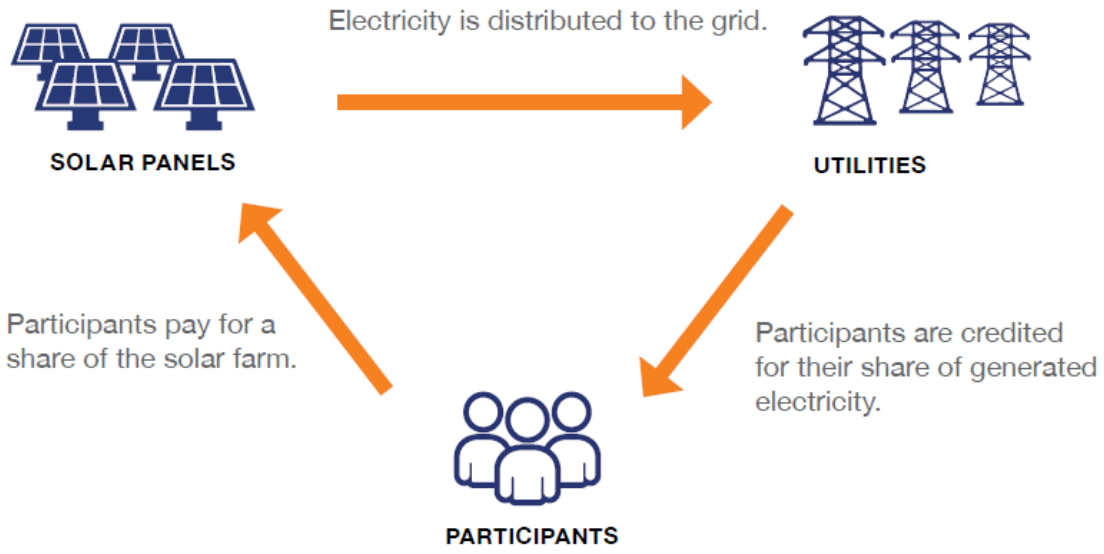
In this discussion, community solar programs include a shared solar array that is subscribed to by multiple utility end-use customers, with credits for energy production applied to customers' existing accounts (see **Figures 2** and **3**). The customers are within the same utility territory as the solar project, but the project is usually off-site (not connected to residential or commercial subscribers' buildings). These projects are often called "solar gardens" because they are similar in concept to community gardens, in which participants get a small plot of land within a larger garden to grow



food. In a solar garden, an individual or business buys or subscribes to a number of solar panels (that is, a share of the solar project's total capacity) and is credited with the electricity produced by those panels as if the panels were on the participant's residence or business.

Community solar project sizes can vary from very small (20 kW in capacity[6]) up to 2,000 kW in capacity or more. In almost all cases, though, they tend to enjoy economies of scale compared to residential and small commercial solar projects. Community solar projects are often more than 100 times larger than residential systems (community solar projects average 1,000 kW, versus residential systems, which average 6.1 kW).[7] This translates into power costs that are lower for subscribers than on-site PV systems, even after paying the administrative costs of community solar programs.

Figure 2: Community Solar Program Schematic at the Power System Level[8]



[6] In this paper, capacity is expressed in direct current (DC) units unless otherwise noted, per typical practice in the PV industry. Corresponding alternating current (AC) capacity data will be lower due to electricity losses in the process of converting the DC power received at the PV panels into the AC power provided to the utility. While the extent of total losses can vary widely from approximately 10% to 25% depending on system design and engineering, an approximate midpoint loss rate (or "derate") in the PV industry is 17%.
[7] This is the median residential PV system size in the United States as defined in Lawrence Berkeley National Laboratory, *Tracking the Sun IX: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States*, August 2016, page 10, https://emp.lbl.gov/publications/tracking-sun-ix-installed-price [accessed November 2016].
[8] Solar Electric Power Association (now Smart Energy Power Alliance), in conjunction with Solar Market Pathways, *Community Solar: Program Design Models*, page 3, http://www.solarelectricpower.org/media/422095/community-solar-design-plan_web.pdf [accessed July 2016].



Figure 3: Community Solar Program Schematic at the Individual Project Level[9]

The fundamental economic advantage of the community solar program structures depicted in **Figure 2** and **Figure 3** is only one reason for its growth. Other key reasons include improved access to solar and greater flexibility. As mentioned at the outset of this paper, 49% of Americans lack *the ability to host* on-site solar because (i) their properties are not technically suitable for solar (e.g., due to shading or roof age, condition, or orientation); (ii) they rent their apartment or lease their business properties; or (iii) they lack access to capital for upfront solar investment costs or the credit standing to have a third-party owner install solar on their building. *Flexibility* is another advantage of many community solar programs.[10] Subscriptions can be sold in increments as small as 1 kW, compared to typical on-site residential system sizes of 5 kW to 9 kW and even larger commercial systems. Smaller subscriptions enable participation by individuals with smaller electricity loads or without the financial wherewithal or interest to participate in larger solar

[9] Clean Energy Collective, http://www.morecleanenergy.com/graphics/csu/community.solar.csu.800.jpg [accessed November 2016]. The Clean Energy Collective is a large developer of community solar projects that also operates community solar programs. No endorsement is implied by the use of this graphic. See also www.cleanenergycollective.com [accessed July 2016].

[10] For a review of the variety of pricing, financing, billing, REC treatment, program length, portability, and other options that have been employed in community solar programs, see Solar Electric Power Association (now Smart Energy Power Alliance), in conjunction with Solar Market Pathways, *Community Solar: Program Design Models*, page 11, http://www.solarelectricpower.org/media/422095/community-solar-design-plan_web.pdf [accessed July 2016].



transactions. Subscriptions, unlike physical solar projects, also can be portable if the participant moves within the same utility territory.[11]

For all of these reasons, community solar programs tend to be very popular and are often rapidly subscribed to during initial rollout periods. However, the combined capacity to-date in community solar programs of 110 MW is less than 1% of the total U.S. solar market of 25,600 MW.[12] This small volume is partly because community solar is a new product that often requires state legislation to be allowed in investor-owned utility (IOU) markets, but also points to the complexity of designing and launching multi-subscriber programs for solar developers, utilities, and subscribers compared to traditional solar projects. The passage of community solar laws and expansive community renewables deployment goals (e.g., 600 MW in California)[13] has set the stage for rapid market growth, and there is now an opportunity to simultaneously realize such growth and address other environmental and land-use considerations.

2.2 Confluence of Community Solar, RE-Powering Sites, and Low- and Moderate-Income Communities

Among the innovations necessary to achieve community solar's potential is finding creative ways to engage households in LMI areas in the solar market.[14] LMI areas include categories of energy consumers who are less likely to install on-site solar due to challenges such as a lack of solar-ready sites, availability of financing, property ownership structure (e.g., apartment renters), and budget pressures. While there are programs offered by the federal government, states, and electric utilities to help reduce LMI electricity costs, these customers often are excluded from many of the benefits of clean energy. That is why there are special provisions in some programs directed at LMI areas, such as California's dedication of 100 MW within its community renewables statute for projects of 1 MW or less in "impacted and disadvantaged communities."[15] When reviewing community solar for LMI areas, it is critical to distinguish if and how electricity bill savings are flowing to LMI subscribers (i.e., whether they, too, can achieve direct financial benefits from the program instead of just the property owners or housing subsidy providers benefiting).

[11] For an example of subscription portability, see Solar Electric Power Association (now Smart Energy Power Alliance), *Solar Success for Nonprofit Utilities: Grand Valley Power's Low-Income Community Solar Program Version 2*, page 4, https://www.solarelectricpower.org/media/387496/sepa-grand-valley-power-case-study.pdf [accessed July 2016].

[12] Total national PV capacity from GTM Research and Solar Energy Industries Association (SEIA), *U.S. Solar Market Insight Executive Summary: 2015 Year in Review*, page 5, http://www.seia.org/research-resources/solar-market-insight-2015-q4 [accessed July 2016]. The 110 MW community solar capacity data point is from NREL, *Community Solar: Status, Trends, Legal, and Financial Issues*, March 2016, page 3, https://www.epa.gov/sites/production/files/2016-03/documents/webinar_20160309_oshaughnessy.pdf [accessed July 2016].

[13] See *Green Tariff Shared Renewables Marketing Implementation Advice Letter* from California IOU Pacific Gas & Electric (PG&E) describing the California law as implemented by the California Public Utilities Commission with a program cap of 600 MW of shared renewables projects allocated across the three IOUs in California, page 2, http://www.pge.com/nots/rates/tariffs/tm2/pdf/ELEC_4638-E.pdf [accessed July 2016]. While this law applies to renewable energy technologies other than PV, and RE-Powering sites have the potential to support other technologies on a community renewable program scale, the great majority of community renewables projects in the United States have relied on PV technologies, and PV is the exclusive focus of this paper.

[14] *Low-Income Solar Policy Guide*, page 7, http://www.lowincomesolar.org/why-act/ [accessed July 2016]. For example, that report notes that there are more than 6 million U.S. affordable housing units and many more households below 80% of local area median income.

[15] See *Green Tariff Shared Renewables Marketing Implementation Advice Letter* from PG&E, page 2, http://www.pge.com/nots/rates/tariffs/tm2/pdf/ELEC_4638-E.pdf [accessed July 2016].



RE-Powering sites may be an excellent way to engage LMI communities. RE-Powering sites are often located in or near economically disadvantaged communities and in areas where there may be a scarcity of other sufficiently large sites for community solar. Solar development may also turn sites inappropriate for other uses into opportunities to lower power costs, provide a cleaner electric grid, and create local jobs.[16]

3. Business Case for Community Solar on RE-Powering Sites

3.1 Overall Business Case

The case for RE-Powering sites as attractive options for community solar development, especially in connection with LMI areas, rests on three pillars. The three pillars reflect inherent advantages in that RE-Powering sites can deliver:

- Ample, low-cost land (without competing uses);
- Special benefits of sustainable re-use; and
- Proximity to LMI communities.

Affordable Housing Benefits from Solar Development on a RE-Powering Site

In Massachusetts, a 4-acre remediated brownfield on the former urban site of a furniture manufacturer was used for an aggregated solar purchase (though not within a utility-administered community solar program itself) by an affordable housing development as well as by service providers for disabled adults and other local organizations. This is an example of a project, at the average community solar size of 1 MW, for which a RE-Powering site was chosen as the best place for development.

Source: MassSolar is Working, Inc., *Shared Solar: Helping local nonprofit focus funds on mission in Gardner, MA*, December 20, 2015, http://solarisworking.org/stories/shared-solar-helping-local-nonprofit-focus-funds-mission-gardner-ma [accessed July 2016].

Land availability: Land acquisition costs can be a major factor in solar development in some markets because solar projects cover a considerable amount of ground. For a typical 500 kW to 2,000 kW community solar project, approximately 3 to 12 contiguous acres are needed, depending upon solar equipment selections and designs.[17] Among RE-Powering sites, a closed and capped municipal solid waste landfill often offers an ideal location for a solar installation due to the large unobstructed area of the cap and a lack of competing uses. Contaminated lands and mining sites may have different, unique attributes to lower solar

[16] For more information on strategies for LMI engagement in solar development, including community solar, see *Low-Income Solar Policy Guide*, http://www.lowincomesolar.org/why-act/ [accessed July 2016].

[17] NREL data show that the average size of fixed-axis, ground-mounted PV projects is 5.5 acres of direct land area or 7.6 acres of total land area per MW_{AC} of generating capacity. See NREL, *Land-Use Requirements for Solar Power Plants in the United States*, June 2013, page v, http://www.nrel.gov/docs/fy13osti/56290.pdf [accessed July 2016]. At an industry midpoint DC to AC derate factor of 17% that translates into 4.6 acres of direct land area or 6.3 acres of total land area per MW_{DC}. Footnote 6 describes derate factors in more detail.



development costs and shorten development timeframes. These include the ability to leverage existing electrical infrastructure and improve project economics with reduced land costs and tax incentives.

Sustainable re-use: By revitalizing unused, potentially contaminated sites, renewable energy can improve surrounding property values, divert development pressures from open space, improve air quality, increase local economic activity, and address contamination, if present, during the project development process.[18] Solar projects also can enhance the protectiveness of a remedy on RE-Powering sites.[19] The societal benefits of re-use, along with a desire to avoid unnecessarily dedicating greenspace to solar development, are among the reasons that some jurisdictions implement specific solar incentives and streamlined processes to accelerate development of RE-Powering sites. One prominent example is the Solar 4 All® program that has led to 42 MW of new solar projects on landfills in the territory of New Jersey's largest utility.[20] Other jurisdictions like Massachusetts have a more general preference for siting solar where there are no alternative uses (e.g., on roofs or parking lot canopies) to preserve green space for other purposes.[21]

Proximity: Proximity between a community solar project and LMI communities can lead to the creation of local jobs and land improvements in these disadvantaged areas. Proximity also can bring added efficiency to the electric grid: shorter distances between generators and users results in less "line loss" of electricity output. The site screening results presented in this paper (see **Section 3.3**) indicate that RE-Powering sites technically suitable for community solar are widespread and near a high number of urban and rural LMI areas. As shown in **Appendices D through F**, in excess of 8,700 RE-Powering sites with community solar potential are within 3 miles of urban areas and may offer LMI opportunities due to the clustering of residents and businesses. It is important to note, however, that placement of a solar installation within an LMI community may not unambiguously benefit the ratepayers within that community; the benefits depend on whether community residents are subscribers to the community solar project.

Taken together, these three pillars (land availability, sustainable re-use, and proximity) provide the rationale for seriously exploring RE-Powering sites as an underdeveloped part of the community solar market.

[18] More information on this topic can be found in EPA, *Potential Advantages of Reusing Potentially Contaminated Land for Renewable Energy*, https://www.epa.gov/sites/production/files/2015-04/documents/contaminated_land_resuse_factsheet.pdf [accessed July 2016], and EPA, *Energy Efficiency and Renewable Energy in Low-Income Communities: A Guide to EPA Programs*, January 2016, page 28, https://www.epa.gov/sites/production/files/2016-03/documents/epa_low_income_program_guide_508_2-29-16.pdf [accessed July 2016].
[19] Examples of this extra benefit include the physical deterrent effect that solar panels offer on landfills against off-road vehicles, dirt bikes, or others who would otherwise ignore institutional controls and cross a landfill to the detriment of the site. Ground-mounted solar panels also reduce the amount of area exposed to degrading elements.
[20] See Public Service Electric & Gas (PSEG), https://pseg.com/family/pseandg/solar4all/extension/landfills.jsp [accessed July 2016].
[21] See Massachusetts Department of Energy Resources, *Solar Canopies at State and Municipal Facilities in MA*, April 15, 2015, page 10, http://www.mass.gov/eea/docs/doer/green-communities/pubs-reports/solar-canopy-webinar-4-15-15-slides.pdf [accessed July 2016].



3.2 Characteristics of the Most Promising RE-Powering Sites

Promising RE-Powering sites can be identified, as a first cut, by applying the following four filters. This type of analysis can be done through EPA's *RE-Powering Screening Dataset*, which is a public database that estimates the potential for various renewable energy technologies, including PV, and includes over 80,000 landfills, contaminated lands, and mining sites.[22]

Filter #1: All sites with PV capacity above 500 kW. This minimum (which is larger than some community solar projects) reflects the benefits of economies of scale,[23] which are especially important in light of the development complexities of some RE-Powering sites. The filter uses an assumed acreage per MW to identify candidate sites.[24]

Filter #2: Maximum per site PV capacity of 2,000 kW. Most existing community solar programs are capped at a maximum individual project size of 2,000 kW. For RE-Powering sites with more than 2,000 kW of technical potential, the limit of 2,000 kW was applied (i.e., it was assumed that the sites would be developed up to 2,000 kW, but if they had additional suitable land, that would not be dedicated to community solar due to project caps).

Filter #3: Distance to the nearest electrical substation less than or equal to 3 miles. There is typically a preference for community solar systems to be connected at the distribution level (rather than at the transmission level) of the electricity grid. Distances or interconnections that are longer or more complex could incur prohibitive costs.

Filter #4: Location in a state with existing community solar projects. While community solar is not universally available within each of the 26 states that currently has these projects (e.g., it may be occurring only in a selected electric co-op or municipal utility market) and other states are expected to deploy community solar in the future, the list of current states provides a baseline that is consistent with metrics used elsewhere in this paper.

Because there may be additional economic development benefits from having a solar project in close physical proximity to cities or towns, an additional "urban area" filter also was applied.[25] The results from applying that extra filter are provided in **Appendices D through F**.

[22] Information on the RE-Powering data sources, screening, and analysis can be found at: https://www.epa.gov/sites/production/files/2015-04/documents/repowering_mapper_datadocumentation.pdf [accessed July 2016].
[23] For examples of the relationship between declining capital costs and rising solar project scale, see GTM Research and SEIA, *U.S. Solar Market Insight Executive Summary: 2015 Year in Review*, http://www.seia.org/research-resources/solar-market-insight-2015-q4 [accessed July 2016].
[24] The ratio applied in the *RE-Powering Screening Dataset* is 6 acres per MW of PV capacity. This value is within the range discussed in footnote 17. See *RE-Powering Screening Dataset* at: https://www.epa.gov/re-powering/re-powering-mapping-and-screening-tools [accessed November 2016]. For more background, see RE-Powering America's Land Initiative, *Data Documentation for Mapping and Screening Criteria for Renewable Energy Generation Potential on EPA and State Tracked Sites*, updated August 2015, https://www.epa.gov/sites/production/files/2015-04/documents/repowering_mapper_datadocumentation.pdf [accessed November 2016].
[25] The definition of "urban area" applied is from EPA's *RE-Powering Screening Dataset*: "The closest 'urban area' as defined by the U.S. Census Bureau. In general, this territory consists of areas of high population density and urban land use resulting in a representation of the 'urban footprint.' There are two types of urban areas: urbanized areas (UAs) that contain 50,000 or more people and urban clusters



3.3 Technical Potential of RE-Powering Sites for Community Solar

The dataset resulting from the four filters was summed for the total number of sites and PV capacity. Landfills were separated from other RE-Powering sites (i.e., contaminated lands and mining sites) due to differences in solar development techniques. Results of this initial screening are shown in **Figure 4**. Because the average community solar project is approximately 1 MW in capacity, an alternative set of results was created with a 1 MW cap on individual projects and is displayed in the right column of **Figure 4**. The number of sites does not change if a 1 MW cap is used (because all 2 MW sites have 1 MW sites within them), but the cumulative capacity declines.

Figure 4: Technical Potential of RE-Powering Sites for Community Solar Development across the 26 States with Existing Community Solar Projects

Type of Site	Number of Sites	Cumulative PV Capacity (MW_{DC}) of Sites	
		2 MW_{DC} Maximum Individual Project Size	1 MW_{DC} Maximum Individual Project Size
Landfills Only	787	1,492	776
All Other RE-Powering Sites	8,698	13,790	8,078
Total	***9,485***	***15,282***	***8,854***

It is critical to note that these results reflect only technical potential. They portray sites that are technically appropriate to generate solar power given their physical characteristics (e.g., land use). They do not distinguish differences in solar resource (irradiance) between sites, which affects PV system performance (e.g., annual electricity output).[26] And, other than the filter for distance to the nearest substation, they do not have economic variables. Solar potential studies often begin with *technical potential* metrics, and then filter results further for *economic potential* (e.g., with power prices and utility rate structures, solar cost and performance, incentives, and other variables), and, finally, *market potential* or likely level of actual solar deployment given that many economically attractive sites do not get developed in practice.[27] Though assessing technical potential is only an

(UCs) that contain at least 2,500 people, but fewer than 50,000 people (except in the U.S. Virgin Islands and Guam which each contain urban clusters with populations greater than 50,000)."

[26] The *RE-Powering Screening Dataset* contains a solar resource metric (maximum direct normal irradiance) that can assist in estimating PV performance at individual sites.

[27] For a thorough discussion of renewable energy screening and potential, see NREL, *Estimating Renewable Energy Economic Potential in the United States: Methodology and Initial Results*, July 2015, http://www.nrel.gov/docs/fy15osti/64503.pdf [accessed July 2016].



initial, necessary step in describing solar market potential, conducting economic potential or market potential analyses is beyond the scope of this paper.

To link the screening results to a specific community solar program, an example for the Southern California Edison (SCE) utility territory is provided in **Figures 5** and **6**, with a map displaying all 578 sites identified by the application of the four filters. Because SCE is establishing its first community solar program with a program cap of 269 MW, this screening could provide timely, high-value input for the potential siting of new community solar projects. Moreover, SCE has a target of 45 MW within its community renewables program and its green rate program for environmental justice communities.[28] Individual project sizes in the SCE program are slated at 500 kW to 3,000 kW (0.5 MW to 3 MW).[29] Screening results for SCE are shown not only for 1 MW and 2 MW individual project maximums for comparability with the earlier 26-state results,[30] but also for the maximum 3 MW size in the SCE program, because economies of scale in solar development would dictate that larger projects will be targeted if there are enough subscribers.

Figure 5: Technical Potential of RE-Powering Sites for Community Solar Development in Southern California Edison Territory

Type of Site	Number of Sites	Cumulative PV Capacity (MW_{DC}) of Sites		
		3 MW_{DC} Maximum Individual Project Size	2 MW_{DC} Maximum Individual Project Size	1 MW_{DC} Maximum Individual Project Size
Landfills Only	63	173	120	62
All Other RE-Powering Sites	515	1,052	808	482
Total	***578***	***1,225***	***928***	***544***

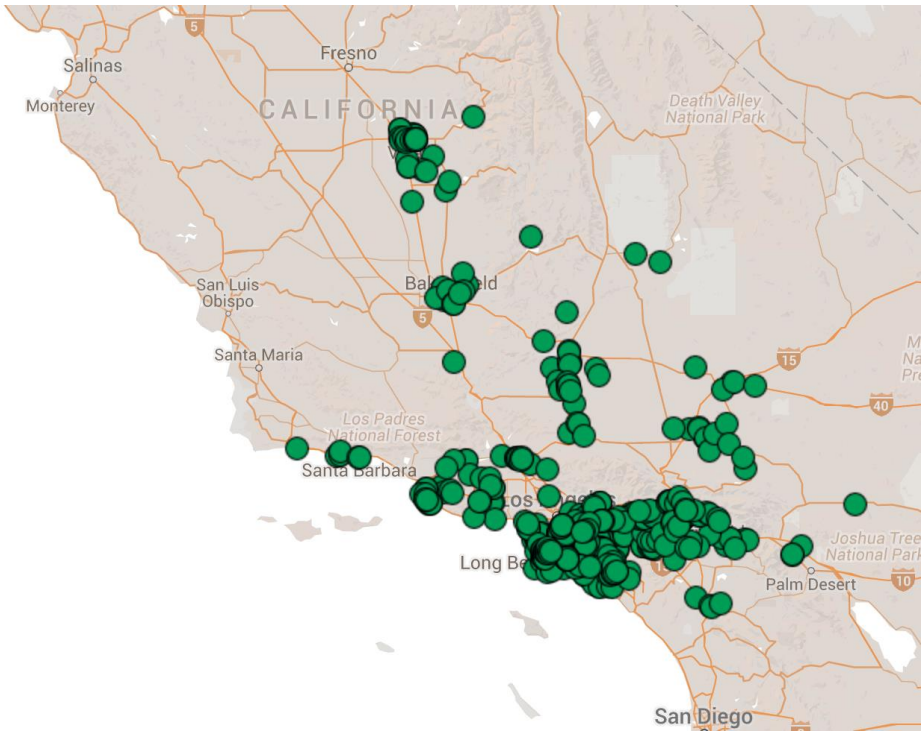
[28] Catherine Leland, *SCE's Community Renewables Program*, February 25, 2016, page 7, http://www.cert.ucr.edu/events/solar2016/Panel%205%20-%20Catherine%20Leland.pdf [accessed July 2016]. SCE defines environmental justice communities in its territory as the most-impacted 20% of census tracts, as measured by the CalEnviroScreen score.

[29] Catherine Leland, *SCE's Community Renewables Program*, February 25, 2016, page 5, http://www.cert.ucr.edu/events/solar2016/Panel%205%20-%20Catherine%20Leland.pdf [accessed July 2016]. SCE's 3 MW individual project cap is larger than the 2 MW maximum that is common for community solar projects elsewhere in the United States.

[30] For example, SCE territory contains 578 (or about 6%) of the 9,485 technically viable sites in the 26 active community solar states screened.



Figure 6: Map of RE-Powering Sites with Technical Potential for Community Solar Development in Southern California Edison Territory



To supplement this analysis and present results for an entire state, **Figures 12** and **13** in **Appendix F** include technical potential screening outcomes for Massachusetts.

3.4 Opportunities to Increase Deployment of RE-Powering Sites for Community Solar

As previously mentioned, nearly 9,500 RE-Powering sites in 26 states that are candidates for community solar development have adequate technical potential. To maximize their chances of being developed, stakeholders (site owners/responsible parties; utilities; solar developers; federal, state, and local government agencies; LMI property managers; and others) should be made aware of such opportunities and provided assistance, as needed and appropriate, towards transforming these formerly contaminated properties into solar electricity-producing installations.

Community solar projects can be initiated by any or all of the stakeholders that will eventually become involved in a project. Communities and local governments can create a favorable context for such investments. Utilities, solar developers, and site owners can explore solar feasibility and



available incentives. And, large electricity consumers interested in expanding their use of clean energy can motivate and help anchor community solar projects. **Figure 7** describes these types of opportunities in more detail.

Figure 7: Key Community Solar Opportunities for RE-Powering Sites[31]

Opportunity	Brief Description
Jurisdictional Support	This can be provided in the form of pre-planning for solar redevelopment, accelerated permitting processes, advanced interconnection planning and pre-approval processes, creating development partnerships, and other potential incentives.
Site Owner Engagement and Incentives	One good example of outreach to RE-Powering site owners is occurring in New Jersey, where the utility PSEG has established a highly targeted effort to directly engage with landfill site owners, including Waste Management Company, and is having rapid success in launching solar (though not community solar) projects.[32]
Utility Engagement	Certain utilities can be more nimble and tailored to individual community needs. For example, municipal utilities and electric co-ops can develop community solar programs outside of the state regulatory processes governing IOUs. The first community solar program in the nation was created by a co-op in Colorado. Another recent example is from the Lansing Board of Water & Light (Michigan), which is redeveloping a retired landfill site for the first community solar project in its service territory.[33] This is not to say that IOUs cannot host strong community solar markets; rather, that an understanding of the appropriate regulatory and governance structures of various utilities, as well as direct interaction with the utilities, can create opportunities that may not otherwise be apparent.

[31] Information in this figure is based on interviews with parties involved in community solar development and secondary source material.
[32] PSEG, *PSE&G Building Its Largest Grid Connected Community Solar Project on Burlington County Landfill*, October 30, 2015, https://www.pseg.com/info/media/newsreleases/2015/2015-10-30a.jsp#.VwurWhIrL2Q [accessed July 2016].
[33] Lansing Board of Water & Light, *Community Solar Parks to be Developed in Cities of East Lansing and Lansing*, October 27, 2015, https://www.lbwl.com/About-the-BWL/News/Community-Solar-Parks-to-be-Developed-in-Cities-of-East-Lansing-and-Lansing/ [accessed July 2016].



Opportunity	Brief Description
Commercial Sector Offerings	Another largely untapped market for solar energy consumption is the commercial sector, which frequently encounters property ownership and management structures impairing traditional on-site solar. Commercial organizations can serve in multiple roles: as subscribers to community solar capacity, project sponsors, and providers of information, recognition, or incentives to employees. In relative impact, a mid-sized commercial enterprise that consumes 600 megawatt-hours (MWh) per year in electricity may have the ability to purchase as much solar power as 50 individual residential subscribers. [34] Although community solar projects frequently emphasize residential offerings, the potential for commercial involvement is significant. For example, a business may act as an "anchor subscriber" to a large-scale community system that can then be offered to residents and perhaps even discounted to employees as a benefit.

4. Challenges to Developing RE-Powering Sites for Community Solar

The boom in community solar growth has occurred largely outside of RE-Powering sites. This is perhaps due to a lack of awareness of the number of, variety, and special advantages offered by RE-Powering sites. However, it is also likely due to concerns about site preparation complexities, potential liability, and costs associated with landfills, contaminated lands, and mining sites. While the availability of financial incentives and supportive regulatory rules for RE-Powering sites can mitigate these concerns and costs, other re-use options for contaminated properties may remain more attractive to communities. This section provides a brief discussion of challenges internal to RE-Powering sites, as well as external factors that may affect community solar development.

Site preparation challenges and costs: Site-specific barriers can include experience with or perceptions of the risk of owning and operating assets on RE-Powering lands, as well as costs for remediation, site preparation, and construction to ensure safe operation of solar power systems. Compared to development on property where no remediation is required and where environmental review can be expedited in certain states,[35] RE-Powering sites may be considered less desirable from the developer's perspective. Also, local permitting and land-use requirements may not be

[34] According to the U.S. Energy Information Administration, the average U.S. home uses about 11 MWh of electricity annually. See http://www.eia.gov/tools/faqs/faq.cfm?id=97&t=3 [accessed July 2016].
[35] For example, in California, solar projects on rooftops and on previously developed land can be deemed either statutorily exempt from restrictions under the California Environmental Quality Act or expedited. See http://resources.ca.gov/ceqa/guidelines-sb226/ and the process flowchart at http://resources.ca.gov/ceqa/flowchart/ [accessed July 2016].



"solar ready," requiring additional review processes, lengthening approval timelines, and further increasing project costs. As described by both developers and utilities in interviews, without concerted efforts by local jurisdictions, RE-Powering sites can present significant development challenges.

In addition to complying with any required engineering or institutional controls, solar development on contaminated or cleaned-up sites may have other technical requirements, including minimal site disturbance, avoidance of remediation/testing equipment, and requirements for ground stability, ground leveling, and site orientation and slope. Community solar systems may need to be designed and constructed to avoid interfering with existing and potential new groundwater extraction and monitoring wells, as well as to avoid the piping and other utilities associated with operating treatment systems.

Beyond emphasizing the inherent advantages that RE-Powering sites can bring to community solar development to help overcome these barriers (see **Section 3**), developers can bundle sites for participation in community solar procurements to improve the chances that impediments at one site will not eliminate their potential for eventual success. There also are categories of RE-Powering sites that may receive a more streamlined development process than those subject to ongoing remediation. These sites include:

- No cleanup necessary: "Initially, the site may have been considered contaminated. However, after assessing the site, it is determined that levels of contamination do not pose unacceptable risk to human health and the environment."[36]
- Post-cleanup: After cleaning up contaminated areas of a site, renewable energy may be installed if the site remains protective of human health and the environment over the long term.

Beyond site-specific challenges, there are four external factors that affect whether RE-Powering sites will have the ability to capture their full potential for community solar. Each of the four factors is discussed in turn below, accompanied by suggestions in *italics* on how to manage that factor.

Community solar program scale: The costs that can accompany building, owning, and operating a solar facility on a RE-Powering site can be mitigated by economies of scale with larger solar projects. That is, the costs can be amortized over a larger revenue stream with lower per-unit costs. However, most community solar projects have not been developed large-scale, primarily due to community solar program design and procedural hurdles.

[36] Excerpt from EPA, *Opportunities for Siting Renewable Energy Production While Addressing Environmental Site Issues,* https://www.epa.gov/re-powering/siting-re-powering-projects-while-addressing-environmental-issues#renewable_energy_project_development_process [accessed July 2016].



It may be most effective for developers to concentrate on markets where community solar projects of 1 MW or more may likely be the norm (e.g., Xcel Energy territory in Minnesota and Colorado; SCE, PG&E, and San Diego Gas & Electric territory in California).[37]

National patchwork of community solar program designs: Each state with community solar legislation, and each utility with an active community solar program, can have its own unique set of goals, timelines, and participation processes. While best practices are emerging, community solar programs are implemented individually. This adds programmatic complexity to the physical complexity of properly managing development of RE-Powering sites.

As a general principle, RE-Powering sites will do best where clear, well-established community solar rules are in place.

Site owner and community action: A common issue identified by project developers (including utilities developing their own projects) is that site owners are often not interested in or aware of the potential for solar development. They may also be concerned about incremental liability.

Landfill site owners, in general, may have a better understanding of the opportunities for hosting solar projects, as demonstrated by a higher percentage of successful projects at available sites, the availability of tailored products (including ballasted systems and solar-integrated landfill membranes), and specific state or utility programs for this market segment.

Rates and financing for low-income customers: Often, low-income customers have special electricity rates and/or subsidies for affordability reasons. While this provides needed financial assistance, it can decrease the effective power costs offset by community solar. In such cases, community solar subscriptions may exceed the household's conventional power costs, and financing for community solar may not be available due to credit criteria. Under some subsidized housing programs, there are also split incentives with any savings from solar going to the property manager or to a reduction in the overall government subsidy, rather than partially or fully accruing to the tenant. Similar issues can arise outside of subsidy programs if the potential community solar subscriber is a renter and does not directly pay its electric utility costs.

When determining actual LMI benefits from community solar, it is critical to know whether residents (who typically spend a far greater percentage of their disposable income on utilities than high-income individuals) are achieving direct financial savings from community solar.

[37] See Xcel Energy Minnesota, Solar*Rewards Community®, *Frequently Asked Questions*, page 4, https://www.xcelenergy.com/staticfiles/xe/Marketing/Files/MN-SRC-FAQ.pdf [accessed July 2016] and PG&E, *Green Tariff Shared Renewables Marketing Implementation Advice Letter*, page 1, http://www.pge.com/nots/rates/tariffs/tm2/pdf/ELEC_4638-E.pdf [accessed July 2016].



5. Discussion Questions

This paper connects the opportunities for renewable energy development on formerly contaminated lands, landfills, and mine sites with the national growth of community solar projects. The discussion highlighted the benefits and barriers for such projects as well as the opportunity that community solar development offers households and businesses that cannot otherwise host solar. Furthermore, the paper highlighted how opportunities for both community solar and RE-Powering projects could be targeted to help LMI communities.

We hope you consider ways in which RE-Powering sites in your area can be developed for community solar and ways in which the motivation and incentives for such projects can be enhanced through questions such as:

- Is there an interest in your area for community solar projects?
- Are formerly contaminated lands, landfills, and mine sites being considered to host such projects?
- How might community solar opportunities at formerly contaminated lands, landfills, and mine sites be enhanced?
- How might estimates of future community solar projects on RE-Powering sites be improved?
- How can the RE-Powering America's Land Initiative facilitate more community solar development on formerly contaminated lands, landfills, and mine sites?
    a. Greater collaboration with other agencies, states, or other stakeholders?
    b. Greater dissemination of success stories and best practices?
    c. Greater support of:
        i. Standardized program implementation?
        ii. Streamlined permitting reviews?
        iii. Explicit incentives for redevelopment on formerly contaminated lands, landfills, and mine sites?
    d. Greater engagement and marketing of opportunities to LMI communities? To commercial electricity users? To others?

Please let us know at: cleanenergy@epa.gov.

6. Appendices

Appendix A: Bibliography

For more information on the EPA RE-Powering America's Land Initiative, including renewable energy development-related data on more than 80,000 contaminated sites, case studies, risk mitigation guidance, and other resources, please visit https://www.epa.gov/re-powering.

The following list of references can help readers wishing to explore community solar policy and market development issues further. Inclusion of a document on this list or in a footnote in this paper does not suggest EPA endorsement of the document or its authoring organization(s). While the web links provided were accurate and the documents were publically available as of the dates indicated in this paper, they may not remain so, and EPA does not update the links on an ongoing basis.

GTM Research and Solar Energy Industries Association, *U.S. Solar Market Insight Executive Summary: 2015 Year in Review*, http://www.seia.org/research-resources/solar-market-insight-2015-q4 [accessed November 2016].

Interstate Renewable Energy Council, Shared Renewables, http://www.irecusa.org/regulatory-reform/shared-renewables/ [accessed November 2016].

National Renewable Energy Laboratory (NREL), *A Guide to Community Shared Solar: Utility, Private, and Nonprofit Project Development*, May 2012, http://www.nrel.gov/docs/fy12osti/54570.pdf [accessed November 2016].

NREL, *Shared Solar: Current Landscape, Market Potential, and the Impact of Federal Securities Regulation*, April 2015, http://www.nrel.gov/docs/fy15osti/63892.pdf [accessed November 2016].

NREL, *Community Solar: Status, Trends, Legal, and Financial Issues*, March 2016, https://www.epa.gov/sites/production/files/2016-03/documents/webinar_20160309_oshaughnessy.pdf [accessed November 2016].

Rocky Mountain Institute, *Community-Scale Solar: Why Developers and Buyers Should Focus on this High-Potential Market Segment*, March 2016, http://rmi.org/Content/Files/RMI-Shine-Report-CommunityScaleSolarMarketPotential-201603-Final.pdf [accessed November 2016].

Solar Electric Power Association (now Smart Energy Power Alliance), in conjunction with Solar Market Pathways, *Community Solar: Program Design Models*, http://www.solarelectricpower.org/media/422095/community-solar-design-plan_web.pdf [accessed November 2016].



Appendix B: Glossary

Community solar – Solar generation facilities (projects) that allow multiple subscribers to purchase a portion (on a per-kW or per-kWh basis) of the project's electricity output. Community solar facilities are typically "off-site" (i.e., not located on the properties of residential or commercial subscribers) and are often 50 kW to 2,000 kW in total capacity. Community solar facilities may be owned by electric utilities or cooperatives, or by independent power developers, but are usually within the same utility or electric cooperative territory as their subscribers. Community solar program availability and rules differ by utility or electric cooperative territory.

Contaminated lands – Sites with previous or potential environmental contamination, which may include Superfund sites, brownfields, Resource Conservation and Recovery Act sites, and other state sites.

Environmental justice communities – Definitions differ across the United States, but they often share characteristics similar to that of California: "where residents are predominantly minorities or low-income; have been excluded from the environmental policy-setting or decision-making process; are subject to a disproportionate impact from one or more environmental hazards; and experience disparate implementation of environmental regulations, requirements, practices and activities in their communities." See http://www.energy.ca.gov/public_adviser/environmental_justice_faq.html [accessed November 2016].

Landfill – A facility for disposing of waste that is separated from the surrounding area. Municipal solid waste landfills are a common type and contain "waste generated by households and commercial establishments" that is collected by governmental bodies. Other types of landfills include industrial, construction, and demolition landfills. See http://cluteinstitute.com/ojs/index.php/JBER/article/download/7364/7432 [accessed November 2016]. Solar facilities are often located on closed, capped landfills, as opposed to active, open landfills.

Low- to moderate-income (LMI) household – A residential retail electricity consumer with an income equal to or less than 120% of the area median income. For only *low-income households*, the threshold is defined here as household income below the Section 8 low-income limit established by the U.S. Department of Housing and Urban Development. That limit varies by market, but is generally 80% of the area median income. In practice, there is substantial variation in how individual community solar programs define LMI or other disadvantaged populations.

LMI area – A census tract in which at least 51% of all households have incomes less than 120% of the area median family income, adjusted for household size. A *low-income area* is a census tract in which at least 51% of all households have incomes less than 80% of the area median family income.

Mining sites – Abandoned, closed, and other types of sites with former mining activity.



RE-Powering site – Landfill, contaminated land, or mining sites in the United States that are appropriate for some form of renewable energy development. A screening database of such sites is maintained by the EPA RE-Powering America's Land Initiative, which supports sustainable re-use of the sites. This paper further specifies that a RE-Powering site must have the technical potential for a solar project of at least 500 kW in capacity to be included in the example screening analysis in **Section 3.3** and that one solar project of no more than 2 MW of capacity (or 3 MW in Southern California Edison territory) could be developed per RE-Powering site.

Renewable energy certificate (REC) – An accounting mechanism for characterizing the environmental attributes of electricity generated from a renewable source. One REC = 1 megawatt-hour (MWh) of renewable power generation. RECs are often the mechanism used to track adherence to renewable portfolio standards or similar compliance requirements in states where tracking is mandatory. RECs can also be purchased in voluntary markets without association to state requirements. RECs and other types of environmental attributes are distinguished from the physical electricity generated from renewable energy generation facilities, which can be thought of as equivalent to the physical power from traditional (fossil fuel and nuclear) generation facilities.

Shared solar – Another name for community solar. Such solar projects are often called "solar gardens."

Solar developer – A firm that is responsible for coordinating the overall creation of a solar project. Solar developers provide or coordinate some or all of the following activities: site technical, environmental, and financial assessment; engineering, procurement, and construction, including any additional remediation or protective measures required; financing; contract negotiations with the land owner/responsible party, utility, local jurisdictions, and off-taker (buyer) of the project's physical power and RECs; final testing and commissioning; community solar program administrative duties; ongoing operations and maintenance; and system decommissioning at contract conclusion. Community solar program rules and developer preferences will determine which of these duties the firm performs itself, coordinates through other organizations, or does not formally address.

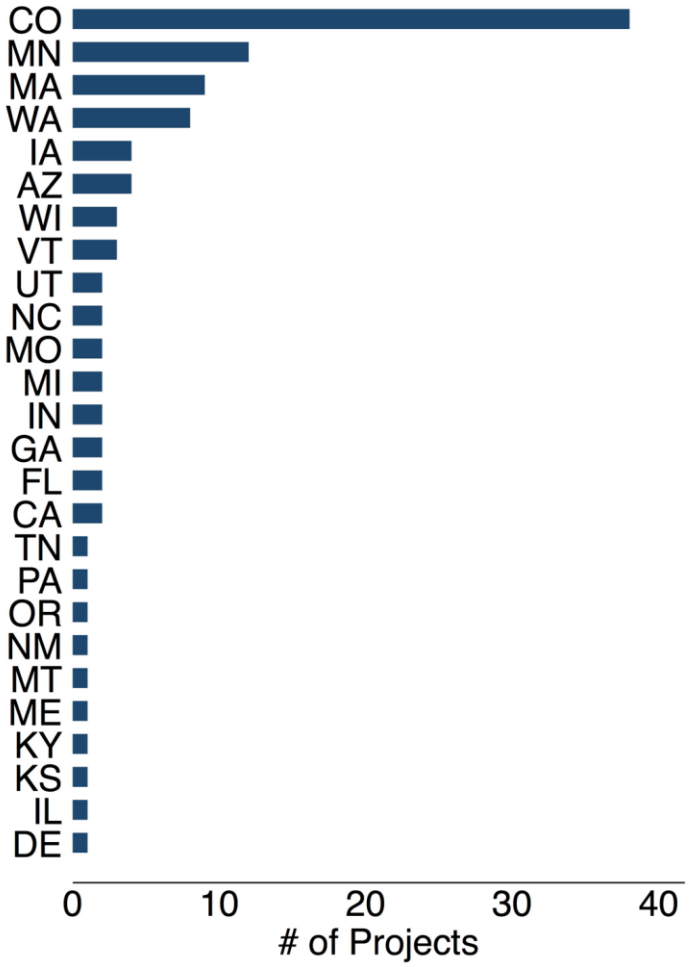
Subscription – The mechanism for an electricity end-user to participate (buy or invest) in a community solar program. Participants are often called "subscribers."



Appendix C: Community Solar Project Data at the State Level

Figure 8 shows the deployment of community solar projects by state as of March 2016. As explained earlier in this paper, the number of community solar projects and their penetration across states is expected to grow significantly between 2016 and 2020.

Figure 8: Community Solar Projects by State[38]



[38] NREL, *Community Solar: Status, Trends, Legal, and Financial Issues*, March 2016, page 7, https://www.epa.gov/sites/production/files/2016-03/documents/webinar_20160309_oshaughnessy.pdf [accessed July 2016].



Appendix D: Technical Potential of RE-Powering Sites near Urban Areas in the 26 States with Community Solar Projects

To offer perspective on the proximity of RE-Powering sites appropriate for community solar to urban areas, **Figure 9** results cover the 26 states with existing community solar projects.[39] These results apply one additional filter to the *RE-Powering Screening Dataset* beyond the four filters described in **Section 3.3**: that the RE-Powering site must be within 3 miles of an urban area.[40] More than 92% of the sites across these 26 states that pass the prior four filters also pass the urban area filter. This indicates that the vast majority of RE-Powering sites that are technically suitable for community solar are also near cities and towns and, thereby, may offer additional local economic development benefits.

Figure 9: Technical Potential of RE-Powering Sites for Community Solar Development within 3 Miles of an Urban Area across the 26 States with Existing Community Solar Projects

Type of Site	Number of Sites	Cumulative Solar PV Capacity (MW_{DC}) of Sites	
		2 MW_{DC} Maximum Individual Project Size	1 MW_{DC} Maximum Individual Project Size
Landfills Only	688	1,309	681
All Other RE-Powering Sites	8,061	12,636	7,461
Total	***8,749***	***13,945***	***8,142***

[39] **Figure 8** lists the 26 states with existing community solar projects. As noted earlier in the paper, the existence of a community solar project in a state does not imply that community solar is necessarily allowed in all utility markets within that state. However, community solar-enabling legislation and projects are expanding rapidly across the United States, and this 26-state list is used for the very broad purposes of characterizing the market segment.

[40] The definition of "urban area" applied is from EPA's *RE-Powering Screening Dataset*: "The closest 'urban area' as defined by the U.S. Census Bureau. In general, this territory consists of areas of high population density and urban land use resulting in a representation of the 'urban footprint.' There are two types of urban areas: urbanized areas (UAs) that contain 50,000 or more people and urban clusters (UCs) that contain at least 2,500 people, but fewer than 50,000 people (except in the U.S. Virgin Islands and Guam which each contain urban clusters with populations greater than 50,000)."



Appendix E: Technical Potential of RE-Powering Sites near Urban Areas in Southern California Edison Territory

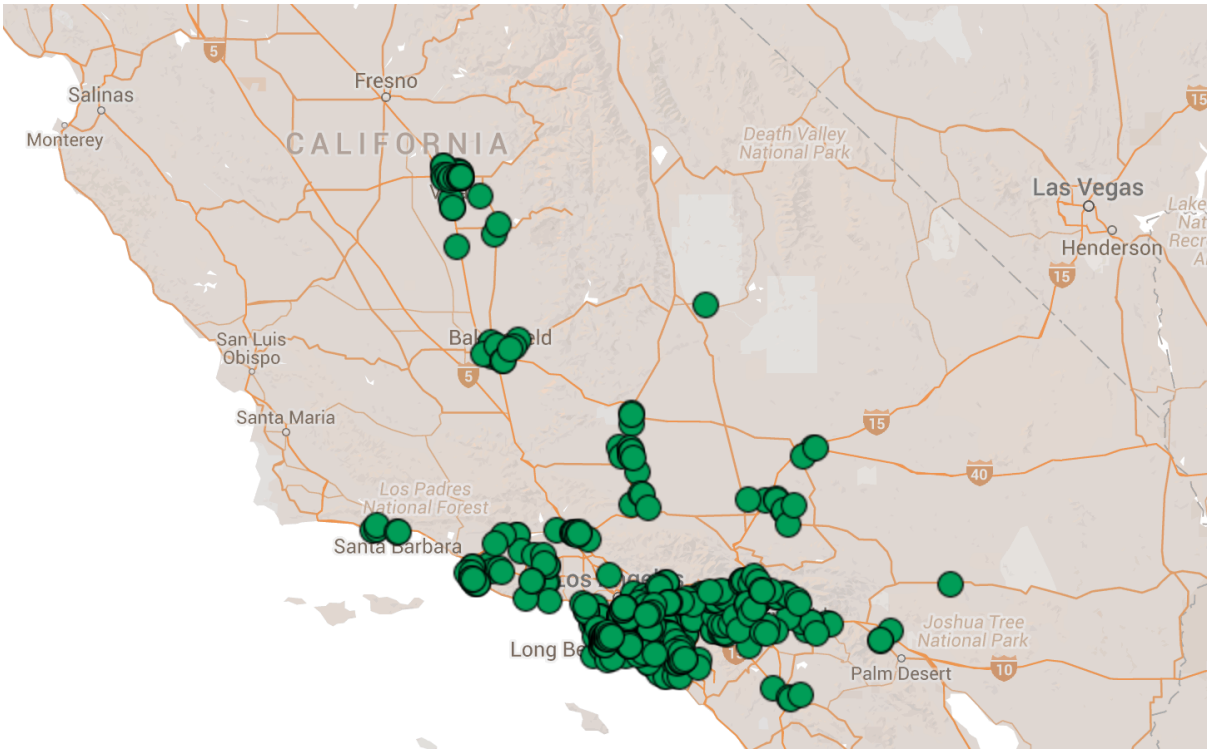
To offer another perspective on the proximity of RE-Powering sites appropriate for community solar to urban areas, **Figures 10** and **11** present results for Southern California Edison (SCE) territory. These results apply one additional filter to the *RE-Powering Screening Dataset* beyond the four filters described in **Section 3.3** for this utility, which is implementing a large community solar program with environmental justice components. The additional filter is that the RE-Powering site must be within 3 miles of an urban area.[41] More than 95% of the sites in SCE territory passing the prior four filters also pass the urban area filter. This indicates that the vast majority of RE-Powering sites in SCE territory that are technically suitable for community solar are also near cities and towns and, thereby, may offer additional local economic development benefits.

Figure 10: Technical Potential of RE-Powering Sites for Community Solar Development within 3 Miles of an Urban Area in Southern California Edison Territory

Type of Site	Number of Sites	Cumulative PV Capacity (MW_{DC}) of Sites		
		3 MW_{DC} Maximum Individual Project Size	2 MW_{DC} Maximum Individual Project Size	1 MW_{DC} Maximum Individual Project Size
Landfills Only	55	149	104	54
All Other RE-Powering Sites	499	1,006	776	466
Total	***554***	***1,155***	***880***	***520***

[41] The definition of "urban area" applied is from EPA's *RE-Powering Screening Dataset*: "The closest 'urban area' as defined by the U.S. Census Bureau. In general, this territory consists of areas of high population density and urban land use resulting in a representation of the 'urban footprint.' There are two types of urban areas: urbanized areas (UAs) that contain 50,000 or more people and urban clusters (UCs) that contain at least 2,500 people, but fewer than 50,000 people (except in the U.S. Virgin Islands and Guam which each contain urban clusters with populations greater than 50,000)."

Figure 11: Map of RE-Powering Sites with Technical Potential for Community Solar Development within 3 Miles of an Urban Area in Southern California Edison Territory





Appendix F: Technical Potential of RE-Powering Sites in Massachusetts

To supplement the earlier screening of RE-Powering sites that was aggregated across all 26 states with community solar projects, **Figures 12** and **13** present results for Massachusetts. This state is profiled because it is a national leader in community solar, has a history of connecting RE-Powering sites with LMI solar purchasers, and has an active program for the sustainable re-use of contaminated sites.[42]

Figure 12 shows results using the same four filters presented in **Section 3.3**, and **Figure 13** is a map of the 711 sites passing those filters in Massachusetts.

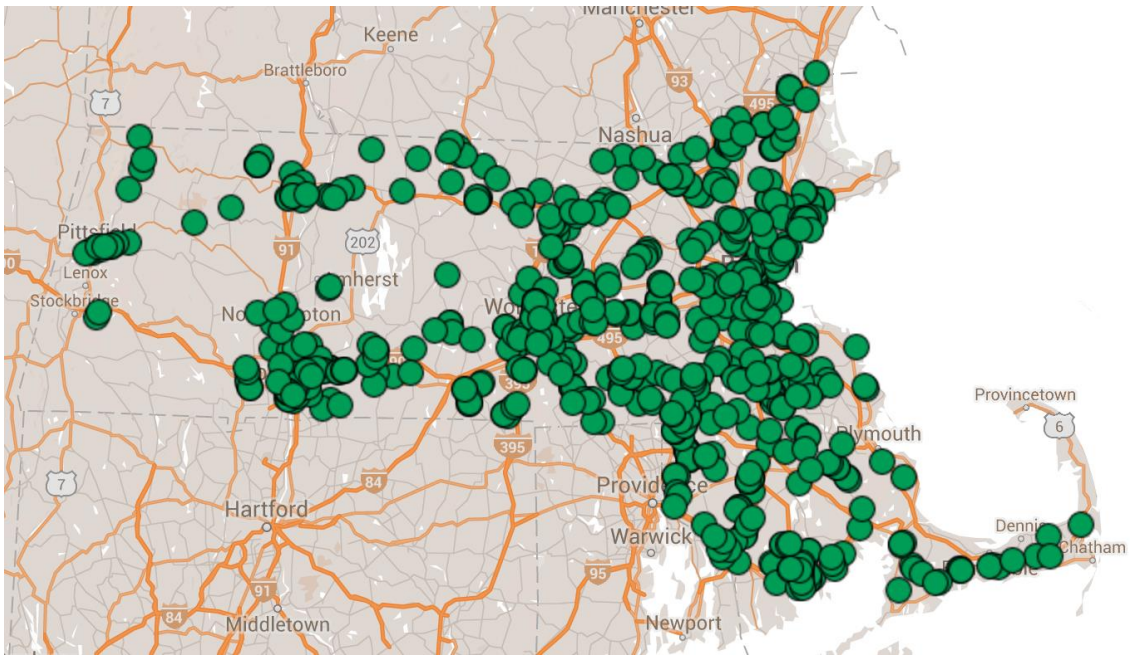
Figure 12: Technical Potential of RE-Powering Sites for Community Solar Development in Massachusetts (without Urban Area Filter)

Type of Site	Number of Sites	Cumulative PV Capacity (MW_{DC}) of Sites	
		2 MW_{DC} Maximum Individual Project Size	1 MW_{DC} Maximum Individual Project Size
Landfills Only	235	414	228
All Other RE-Powering Sites	476	693	429
Total	***711***	***1,107***	***657***

[42] See Massachusetts Department of Environmental Protection, Clean Energy Results Program, http://www.mass.gov/eea/agencies/massdep/climate-energy/energy/ [accessed July 2016].



Figure 13: Map of RE-Powering Sites with Technical Potential for Community Solar Development in Massachusetts (without Urban Area Filter)



Results in **Figures 14** and **15** include the application of one additional filter: that the RE-Powering site must be within 3 miles of an urban area.[43] More than 98% of the sites passing the prior four filters also pass the urban area filter. This indicates that the vast majority of RE-Powering sites that are technically suitable for community solar in Massachusetts are also near cities and towns and, thereby, may offer additional local economic development benefits.

[43] The definition of "urban area" applied is from EPA's *RE-Powering Screening Dataset*: "The closest 'urban area' as defined by the U.S. Census Bureau. In general, this territory consists of areas of high population density and urban land use resulting in a representation of the 'urban footprint.' There are two types of urban areas: urbanized areas (UAs) that contain 50,000 or more people and urban clusters (UCs) that contain at least 2,500 people, but fewer than 50,000 people (except in the U.S. Virgin Islands and Guam which each contain urban clusters with populations greater than 50,000)."



Figure 14: Technical Potential of RE-Powering Sites for Community Solar Development within 3 Miles of an Urban Area in Massachusetts

Type of Site	Number of Sites	Cumulative PV Capacity (MW_{DC}) of Sites	
		2 MW_{DC} Maximum Individual Project Size	1 MW_{DC} Maximum Individual Project Size
Landfills Only	228	408	223
All Other RE-Powering Sites	471	687	425
Total	***699***	***1,095***	***648***

Figure 15: Map of RE-Powering Sites with Technical Potential for Community Solar Development within 3 Miles of an Urban Area in Massachusetts