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ELECTRICITY MARKETS & POLICY

Community Centered Solar Development (CCSD) Case Study Interviews

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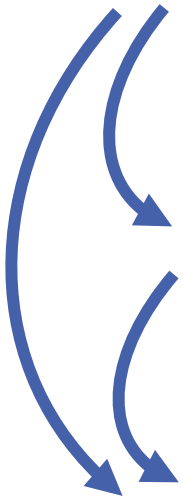
Contents

Background

CCSD Project Task Details

The case study interviews described herein represent the first task in a series of tasks, which make up a comprehensive and interdisciplinary mixed-methods research project intended to facilitate "Community Centered Solar Development," or CCSD.



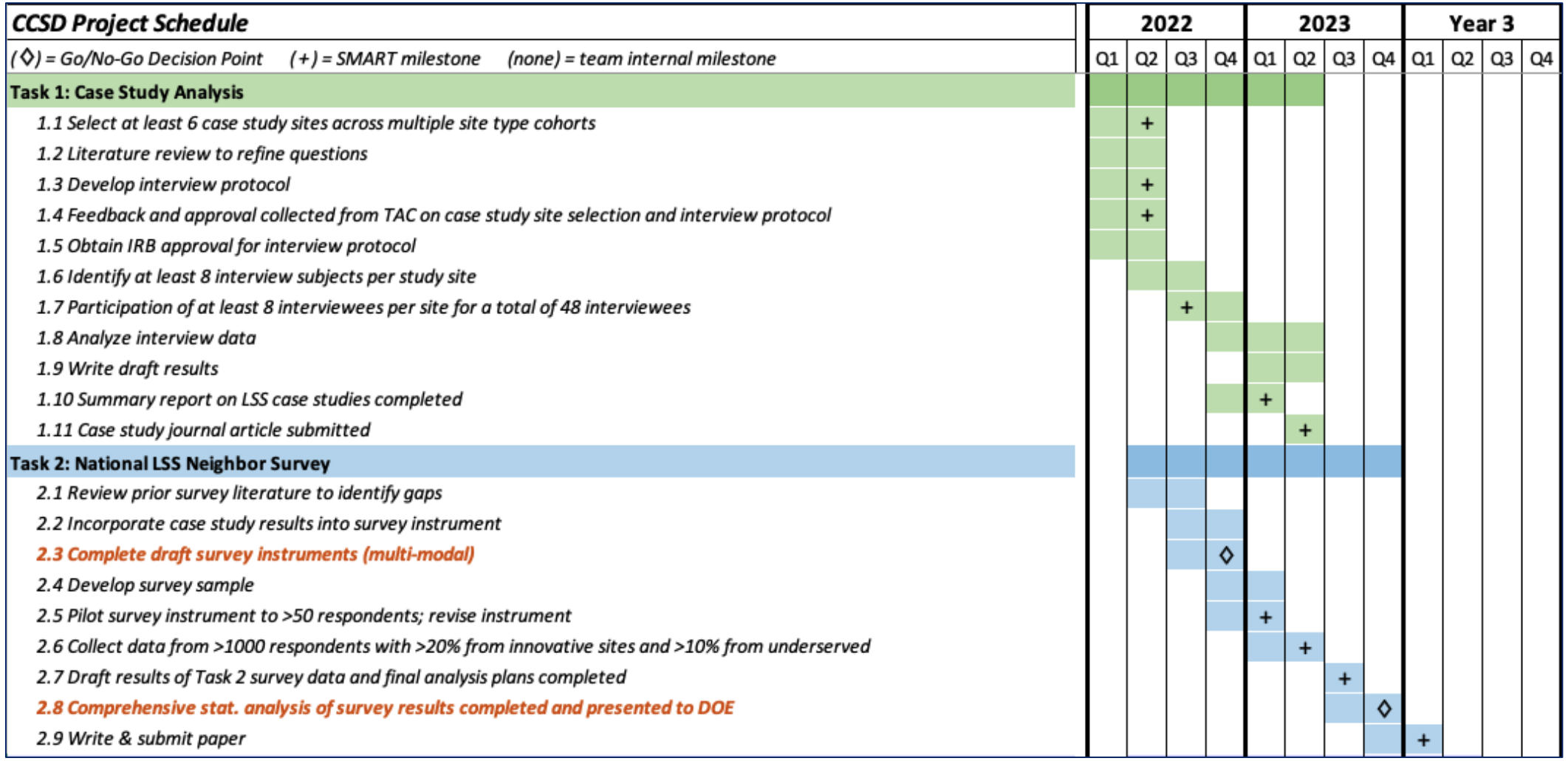
- **Case Study Analysis:** Analyze seven existing Large-Scale Solar (LSS) projects (brownfield, agrivoltaic, and greenfield, with a focus on underserved communities) by executing interviews to uncover the key factors that led to project success or threatened failure.***….Results feed into subsequent tasks.***
- **National LSS Neighbor Survey:** Conduct a national random survey of at least 1,000 LSS project neighbors, oversampling among site types, to reexamine case-study findings at a broader empirical scale enabling national generalization.
- **Community-Based Solutions & Visioning:** Engage in planning with six potential LSS host communities to utilize information from the previous tasks to develop community-centered and audience-specific plans for prospective LSS developments. Produce a guidebook and checklist for a broader audience.

Key Research Questions Engaged in these Case Studies

Answers to the research questions below are intended to inform subsequent tasks in the CCSD research project and facilitate CCSD more broadly.

1. What are the key positive and negative drivers leading to support and opposition to LSS projects?
2. To what extent do LSS projects exacerbate or mitigate perceived inequities and marginalization within hosting communities and how can those inequities be mitigated going forward?
3. What strategies can communities employ to align LSS development with local land-use plans and community needs and values?
4. How can community members take a larger role in local LSS development?

CCSD Case Study Interview and National Survey Timeline



★ Community visioning begins in Year 3

Case Study Site Selection Criteria Suggested & Reviewed by Technical Advisory Committee (TAC)

Key Factors	
Unique Site Types	Greenfield Agrivoltaic Superfund Previously contaminated land (“brownfield”)
Unique Ownership Structures	Utility (Investor-owned, Public Power, Municipal) Developer/Independent Power Producer (IPP) Community (Owned or Subscriber-model)
Variety of Zoning Levels	Local State Hybrid (depends on capacity)
Recent Completion Date	Post-2020 or In construction
Variety of Project Sizes	Small (<10 MW) Large (> 10 MW)
Different Phases	Single Multiple
Battery Electric Storage Systems (BESS)	Yes No
Unique Topography & Geography	Distribution across US (West, Southwest, Midwest, Southeast, Northeast)
Environmental Justice Communities <1 mile	Yes No
Renewable Portfolio Standard	Yes No

Ideally Differentiated Factors	
Variety of Project Attributes	Setbacks Buffers Heights Visibility
Unique Policies in Effect	State Laws & Regulations (Carbon electricity target) Utility decarbonization targets/policies
Variety of Processes & Designs	No. and type of meetings Ordinance development Utilization of non-traditional designs/methods
Multiple Experiences	Non-participating landowners Participating landowners Local Officials Developers Public Power/Municipal Utility personnel Underrepresented minority groups/organizations Media
Variety of Economic Impacts	Tax structures/revenues; PILOT Community benefits packages Schools Employment

To ensure a diverse sample of case study sites and participant perspectives, we developed a list of factors describing different LSS sites, prioritizing certain “Key Factors.”

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Use of Case Studies in Research

Qualitative case studies are crucial for examining complexity, uniqueness, and causal relationships!

- A case study is a comprehensive, typically qualitative, *description* of a particular case, its complexity and uniqueness, and analysis (Simons, 2009; Starman, 2013).
- Our research questions aim to identify perceived drivers of support and opposition, inequities, and means of improving LSS development processes. Case studies are uniquely adept at capturing the *subjective* experience of individuals and identifying variables, structures, and orders of interaction between participants, as well as assessing the performance of work or progress in development (Mesec, 1998).
- Case studies also generate "context-dependent knowledge," which aids researchers in developing a "nuanced view of reality" (Flyvbjerg, 2006), and case studies are regularly used to refine concepts, derive hypotheses, and explore causal relations (Starman, 2013)—work that is difficult to accomplish via quantitative research methods.
- Case studies have been criticized for lacking external validity (generalizability), relying on insufficient and unreliable sources of information, and researchers influencing and biasing design (Diefenbach, 2008). To address these criticisms, our case study:
  - Informs a representative quantitative survey
  - Relies on 7 sites chosen via a rigorous site selection process described on the next slide, and numerous stakeholder groups
  - Uses previous large-scale solar and wind acceptance case studies to inform, along with a TAC review to assess and improve, our interview protocol and research design.

Diefenbach, T. (2009). Are case studies more than sophisticated storytelling?: Methodological problems of qualitative empirical research mainly based on semi-structured interviews. *Quality & Quantity*, *43*, 875–894.

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry*, *12*(2), 219–245.

Mesec, B. (1998). Uvod v kvalitativno raziskovanje v socialnem delu. Ljubljana: Visoka šola za socialno delo.

Simons, H. (2009). Case study research in practice. London: SAGE.

Starman, A. B. (2013). The case study as a type of qualitative research. *Journal of Contemporary Educational Studies/Sodobna Pedagogika*, *64*(1).

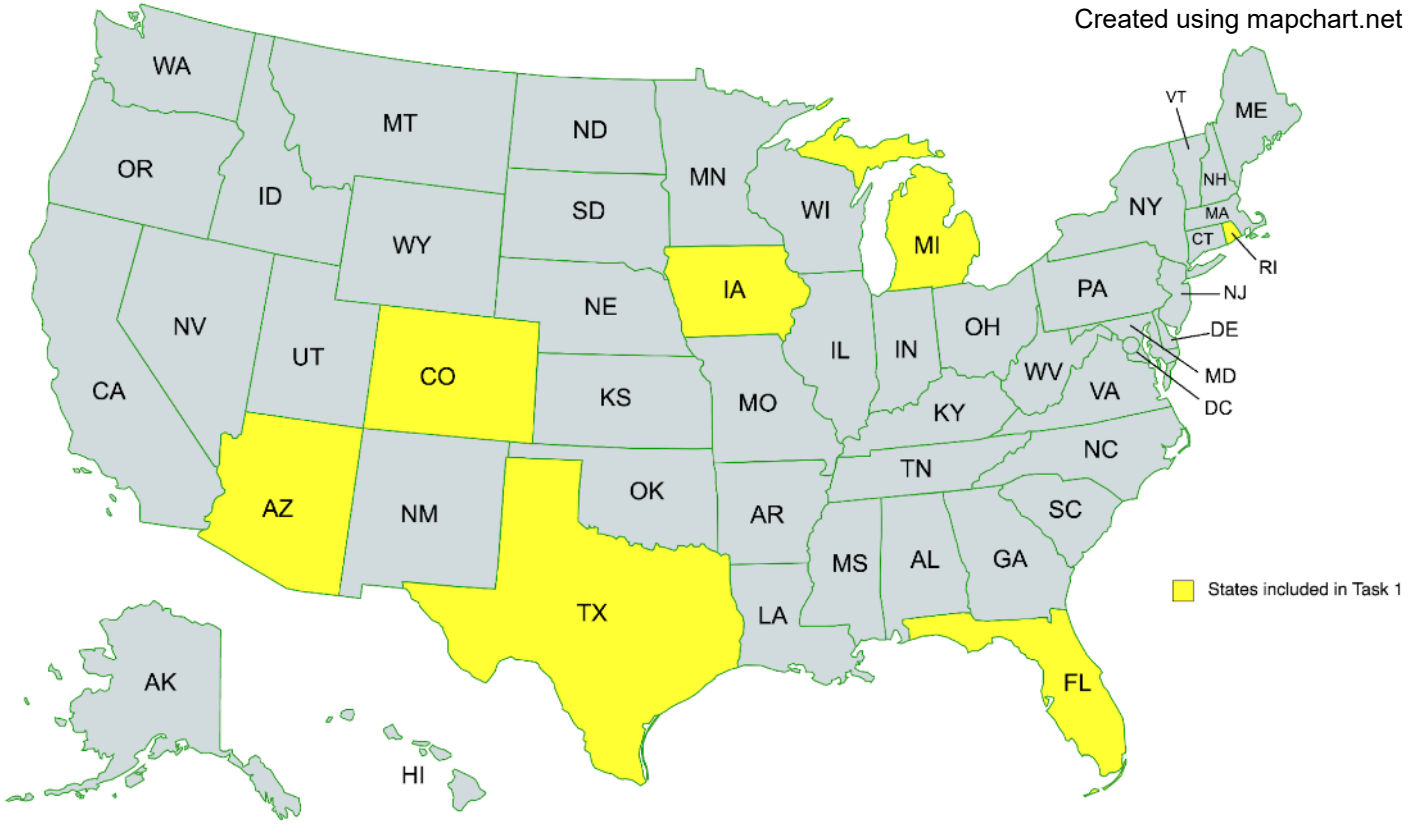
Case Study Site Selection Process

- To develop a diverse sample of LSS sites and experiences, i.e., capture our key factors, we:
  - Elicited site suggestions from subject matter experts
  - Collected national and regional media accounts of successful projects
  - Performed media keyword searches using site selection criteria
  - Reviewed existing datasets and relevant GIS mapping tools, including:
    - inSPIRE Agrivoltaics Map
    - CEQ Climate and Economic Justice Screening Tool
    - RePowering Mapper 2.0 (now 3.0)
    - ArcGIS EIA Large-scale PV Solar Sites
    - EIA-860 data
  - Reviewed over 125 individual sites for potential inclusion
- Fifteen sites were selected for discussion among our team members and TAC. Seven were ultimately selected as case study sites.

Climate and Economic Justice Screening Tool

7 Sites Selected

Identifying site data is being withheld to protect participant confidentiality.

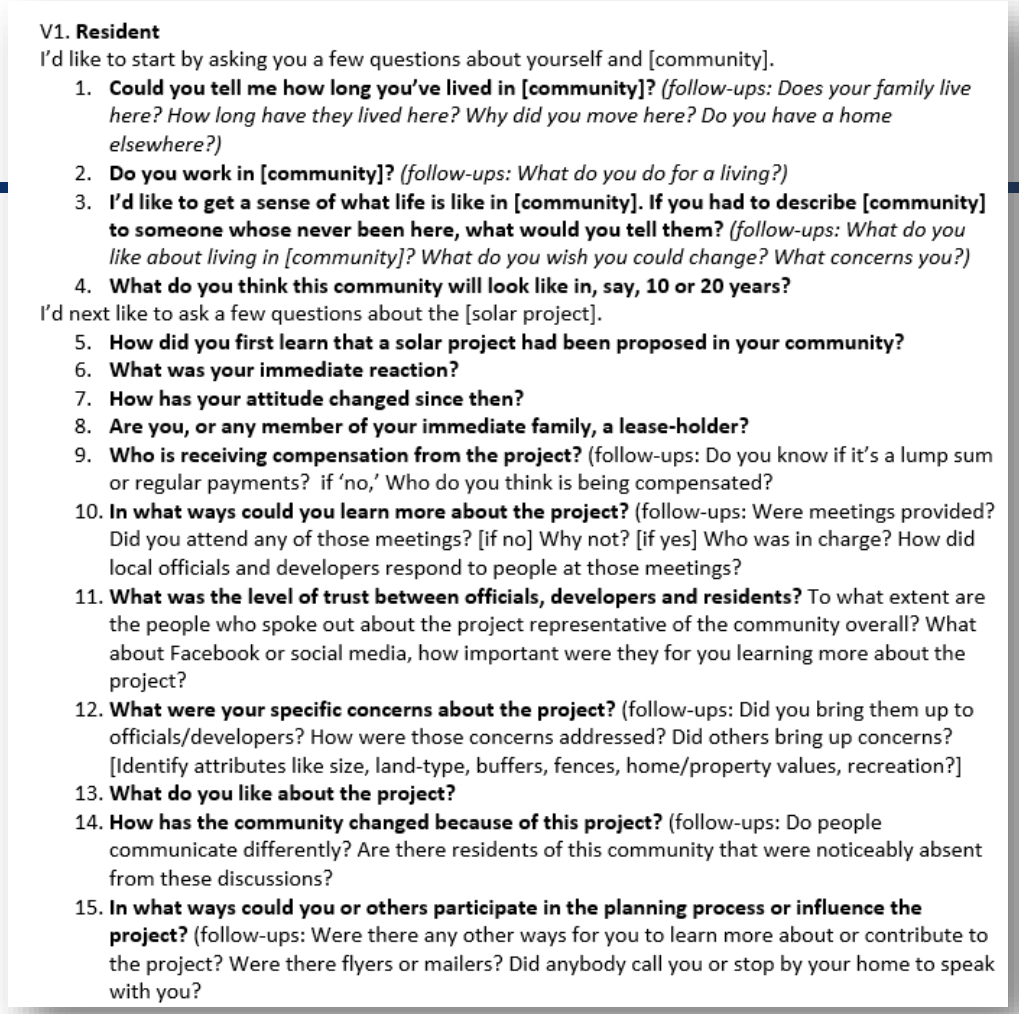


No.	Type	Year_Completed	Ownership	Zoning	Size_MW_ac	RPS	Justice40 < 1 mile
1	Agrivoltaic	2020	Community (Subscribed)	Dual (Local & State)	1	YES	NO
2	Greenfield	2021	IPP	Hybrid (Local < 25 MW)	137.5	EXPIRED	NO
3	Greenfield	2020	Municipal	Hybrid (Local < 75 MW)	74.5	NO	YES (in 3 categories)
4	Greenfield	2020	IPP	Hybrid (Local < 100 MW)	100	YES	YES (in 2 categories)
5	Brownfield	2018	IPP	Local	1.3	YES	YES (in 2 categories)
6	Brownfield	TBD (est. 2023)	IPP	Local	50 + 2	YES	YES (in 6 categories)
7	Superfund	2020	Community (Subscribed)	Hybrid (Local < 40 MW)	3.5	YES	NO

*All completed sites were constructed in 1 phase and without BESS.

CCSD Interview Protocol

- Conducted a literature review of large-scale solar studies that used interviews (e.g., Crawford et al., 2022; Moore et al., 2022; Pascaris et al. 2021; Nilson & Stedman, 2022)
- Developed 3 linked interview protocols for i) residents, ii) developers, and iii) local officials, eventually adding a fourth protocol for iv) public works and municipal utility personnel
- Interview protocols were reviewed by TAC and approved by MSU, UofM and LBNL Internal Review Boards



V1. **Resident**

I'd like to start by asking you a few questions about yourself and [community].

1. **Could you tell me how long you've lived in [community]?** *(follow-ups: Does your family live here? How long have they lived here? Why did you move here? Do you have a home elsewhere?)*
2. **Do you work in [community]?** *(follow-ups: What do you do for a living?)*
3. **I'd like to get a sense of what life is like in [community]. If you had to describe [community] to someone whose never been here, what would you tell them?** *(follow-ups: What do you like about living in [community]? What do you wish you could change? What concerns you?)*
4. **What do you think this community will look like in, say, 10 or 20 years?**

I'd next like to ask a few questions about the [solar project].

5. **How did you first learn that a solar project had been proposed in your community?**
6. **What was your immediate reaction?**
7. **How has your attitude changed since then?**
8. **Are you, or any member of your immediate family, a lease-holder?**
9. **Who is receiving compensation from the project?** (follow-ups: Do you know if it's a lump sum or regular payments? if 'no,' Who do you think is being compensated?
10. **In what ways could you learn more about the project?** (follow-ups: Were meetings provided? Did you attend any of those meetings? [if no] Why not? [if yes] Who was in charge? How did local officials and developers respond to people at those meetings?
11. **What was the level of trust between officials, developers and residents?** To what extent are the people who spoke out about the project representative of the community overall? What about Facebook or social media, how important were they for you learning more about the project?
12. **What were your specific concerns about the project?** (follow-ups: Did you bring them up to officials/developers? How were those concerns addressed? Did others bring up concerns? [Identify attributes like size, land-type, buffers, fences, home/property values, recreation?]
13. **What do you like about the project?**
14. **How has the community changed because of this project?** (follow-ups: Do people communicate differently? Are there residents of this community that were noticeably absent from these discussions?
15. **In what ways could you or others participate in the planning process or influence the project?** (follow-ups: Were there any other ways for you to learn more about or contribute to the project? Were there flyers or mailers? Did anybody call you or stop by your home to speak with you?

Crawford, J., Bessette, D., & Mills, S. B. (2022). Rallying the anti-crowd: Organized opposition, democratic deficit, and a potential social gap in large-scale solar energy. *Energy Research & Social Science*, *90*, 102597. https://doi.org/10.1016/j.erss.2022.102597

Moore, S., Graff, H., Ouellet, C., Leslie, S., & Olweean, D. (2022). Can we have clean energy and grow our crops too? Solar siting on agricultural land in the United States. *Energy Research & Social Science*, *91*, 102731. https://doi.org/10.1016/j.erss.2022.102731

Pascaris, A. S., Schelly, C., Burnham, L., & Pearce, J. M. (2021). Integrating solar energy with agriculture: Industry perspectives on the market, community, and socio-political dimensions of agrivoltaics. *Energy Research & Social Science*, *75*, 102023. https://doi.org/10.1016/j.erss.2021.102023

Nilson, R. S., & Stedman, R. C. (2022). Are big and small solar separate things?: The importance of scale in public support for solar energy development in upstate New York. *Energy Research & Social Science*, *86*, 102449. https://doi.org/10.1016/j.erss.2021.102449

CCSD Interview Protocol

- Protocols included questions regarding:
  - Initial attitudes toward solar and attitude changes
  - Methods, timing and effectiveness of communication and resident participation
  - Trust between residents, officials and developers;
  - LSS Site design elements and zoning,
  - Community values and experience with development,
  - Residents' likes and dislikes of LSS project.
- Interviewers focused on identifying:
  - Best practices of, lessons learned from, and key challenges of developing community-centered LSS,
  - Advice for future communities undergoing LSS development,
  - Recommended research for improving LSS design and development

V3. Developer

I'd like to start by asking you a few questions about yourself and [community].

1. **How long have you worked for [company]?**
2. **Could you tell me when you first arrived in [community]?**
3. **Why did [company] select [community] for a project?** (follow-ups: Could you tell me about that process?)

Now I'd like to ask a few questions about the [solar project].

4. **At what point did you publicly announce the proposed project? How did you do that?** (follow-ups: When did you start having discussions with possible lessors / landowners?)
5. **What was the community's initial reaction to the project?** (follow-ups: Local officials? Residents?)
6. **How has their attitude changed since then?**
7. **What contributed to this project being successful?**
8. **Were you to propose another project, or do this one all over again, what would you have done differently?**
9. **What means did you provide for residents to learn more about the project?** (follow-ups: [if meetings] Did you attend those meetings? Why/Why not? Who contributed at those meetings? Who was in charge? What was the mood at those meetings? How did you respond to people at those meetings?)
10. **In what ways did you provide residents to learn and engage BEYOND what was required by the local/state siting board?**
11. **What did people like about this project?**
12. **What were their specific concerns?** (follow-ups: Identify attributes like size, land-type, buffers, fences, home/property values
13. **What measures did you take to address people's concerns?**
14. **To what extent do you think that the people who spoke out about the project are representative of the community overall?** What about Facebook or social media, how important were they for residents learning more and communicating about the project?
15. **In what ways could residents participate in the planning process or influence the project?** (follow-ups: Were there any other ways for residents to learn more about or contribute to the project? Were there flyers or mailers? How meaningful was the community's input into the decisions made regarding this project?)
16. **How do you think things would have gone had this been a wind project?**

CCSD Interview Process

- Initial internet searches of developer, city, township, county, media, and utility websites identified potential respondents
- Site maps and Google Earth were used to identify neighbors of projects (focusing on homes with a view of the project)
- Email and telephone invitations, follow-up reminders (after 1 week) and post-cards were used to schedule initial interviews
  - All outreach material approved by Institutional Review Board (IRB)
  - Letters of consent were provided to all participants either on paper or via email

Photo by D. Bessette

CCSD Interview Process

- Interviews took place via telephone (n = 3), Zoom (12), MS Teams (1), or In-person (38) during site visits
- Site visits, along with pre-arranged meetings and door-knocking, occurred over the course of 2 to 4 days at each project in Summer and Fall 2022
  - Interviews were conducted using semi-structured interview guide
  - Telephone, Zoom, and MS Teams interviews were often recorded; In-person interviews were rarely recorded
- Follow-up calls and snowball sampling were used to reach additional interviewees, as needed

Photo by D. Bessette

CCSD Interview Counts

**Interviewee counts are accurate across sites, but site numbers have been redacted to protect participant confidentiality

	Interviewee Counts						
Site No.	**Landowner**	**Developer**	**Resident**	**CBO**	**Government**	**Utility**	**Subtotal**
-			8		1		9
-		2	8		1		11
-		3	3		2		8
-	1	1	3	1	2		8
-		2	1			2	5
-			9			1	10
-						3	3
Subtotal	**1**	**8**	**32**	**1**	**6**	**6**	**54**

- 54 interviews were conducted; 104 individuals contacted (not counting resident doors)
  - Interviews were conducted by Bessette (5 sites), Hoesch (1 site), White (1 site), and Hoen (1 site)

CCSD Interview Analysis

- Recorded interviews were transcribed and detailed notes describing interviews that were not recorded were prepared immediately following in MS Word or Excel
- Interview notes and transcriptions were analyzed thematically by the Case Studies lead (Bessette)
  - Thematic analysis (TA) involves systematically organizing, identifying, and deriving themes to provide meaning across interviewee's responses (Rubin & Rubin, 2011)
  - TA allowed us to summarize data, highlight key features and identify insights that help answer the five RQs
- Interview results were discussed by the project team following the first site visit, and interview protocols were iteratively revised as themes were identified across subsequent site visits

Photo by D. Bessette

H.J. Rubin, & I.S. Rubin, Qualitative Interviewing: The Art of Hearing Data, Sage, 2011.

CCSD Interview Results

- Interviewees and quotations are identified using a randomly assigned number between 1 and 54, e.g., (“43” = participant 43). The order of numbers is not associated with the order or timing of interviews or sites visited.
- Quotations followed by multiple numbers are attributable to the first number
- Quotations and interview numbers provided are not intended to be exhaustive, but instead illustrative

Key Research Questions Engaged in the Case Studies

1. What are the key positive and negative drivers leading to support and opposition to LSS projects?
2. To what extent do LSS projects exacerbate or mitigate perceived inequities and marginalization within hosting communities and how can those inequities be mitigated going forward?
3. What strategies can communities employ to align LSS development with local land-use plans and community needs and values?
4. How can community members take a larger role in local LSS development?

RQ1: What are the key positive and negative drivers leading to support and opposition to LSS projects?

- Key drivers identified are associated with development processes or perceived impacts from project development.
- **Process Drivers include:**
  1. Information Dissemination
  2. Community Influence and Understanding of Project Attributes
  3. Community Subscription
- **Impact Drivers include:**
  1. Direct and Indirect Economic impacts
  2. Visual and landscape impacts
  3. Environmental impacts, and
  4. Impacts at the Rural-Urban Divide

Photo by D. Bessette

Process Drivers

Process Driver 1: Information Dissemination

1. **Developers and officials identify that disseminating information about LSS to residents remains a challenge**
   - An official in Texas noted, “We had a bajillion meetings with the community,…[but] there are always people who didn’t, ‘I never heard about this, why didn't you ask me, why didn't you tell me?’” (45)
2. **Residents not receiving compensation from a project feel uninformed, while residents receiving or having been offered compensation feel informed**
   - A resident living within view of a project in Arizona urged, “If they had put up signs or sent letters to me, I didn’t see them, but I also didn’t go online to look for any.” They described their experience this way: the first time they learned of a project was the building of a road, then nothing, then the developer removed a ton of mesquite trees, and then there was a sign. (19)
   - A resident in Iowa living next to a project urged, “We didn’t know anything about it until construction started. We aren’t leasing anything to them, so they didn’t talk to us.” (36)
   - On the other hand, two residents who had sold a parcel of their land to a solar developer to build a substation identified, “Yes it was fair, people had a say…and we don’t blame them for making money.” (34, 53)

Photo by Karl Hoesch

Process Driver 1: Information Dissemination

3. **Required processes (e.g., public notices, town hall/community meetings, and signage) are often thought insufficient for raising awareness of LSS projects**
   - Many project neighbors reported being unaware of projects or their status until construction began. (35, 36, 12, 16, 17, 18, 19, 27, 28, 41, 49, 50, 51)
   - One resident in Arizona argued, “[my neighbor] could tell you how many doors they knocked on that they didn't even know that solar was planning to go in over there, because they didn't tell people there. You know they put a little sign up, and all they have to do is put an alert in the newspaper…who reads the newspaper?” (14)
4. **Residents prefer direct engagement with developers (i.e., door-knocking), rather than formal town halls or written notices**
   - Developers stressed that distance between homes and low population density make in-person efforts expensive and inefficient; however, they still attempted direct engagement whenever possible (21, 47)
   - Residents who had direct engagement with developers appeared to perceive projects more favorably (5, 7, 34, 38, 53, 9, 10, 4). A business owner adjacent to a project in Florida appreciated the developer stopping by and personally introducing themselves prior to development (26)

Photo by Karl Hoesch

Process Driver 1: Information Dissemination

5. **Projects that engage residents early on and provide more opportunities for feedback are perceived more favorably**
   - Officials in Texas identified grass-roots community efforts and involvement were key to moving their project forward (45, 46)
   - Artistic renditions (e.g., watercolor paintings), informational meetings, and tours were identified as especially helpful by community members at multiple sites (5, 7, 9, 47, 11)
   - Conversely, residents upset about projects desired earlier notification to initiate organization of opposition. One neighbor in Arizona urged, “Had we known it was going in, I would have gone to the neighbors and got signatures, started to protest.” (17)
   - Evidence exists of widespread use of social media by opponents of renewable projects for organizing and distributing information (Fergen et al., 2021; Crawford et al., 2021); however, officials avoided using social media to disseminate information.
6. **Virtual public meetings (often held as a result of Covid-19) may not attract more or allow for more widespread participation**
   - Conversely, the lack of high-speed Internet in many rural areas and EJ communities may have contributed to less participation (46)

Photo by Doug Bessette

Fergen, J. T., Jacquet, J. B., & Shukla, R. (2021). Doomscrolling’ in my backyard: Corrosive online communities and contested wind development in rural Ohio. *Energy Research & Social Science*. https://doi.org/10.1016/j.erss.2021.102224

Crawford, J., Bessette, D., & Mills, S. B. (2022). Rallying the anti-crowd: Organized opposition, democratic deficit, and a potential social gap in large-scale solar energy. *Energy Research & Social Science*, *90*, 102597. https://doi.org/10.1016/j.erss.2022.102597

Process Driver 2: Community Influence and Understanding of Project Attributes

1. **Residents desire opportunities to influence specific project design elements**
   - These elements include the types and placement of fencing, vegetative screening and buffers, mowing and landscaping schedules and contractors, setback distances, and physical attributes not limited to the PV array itself including substation infrastructure (12, 13, 21)
2. **When not acted on, residents feel their feedback is ignored**
   - A landowner and cattle rancher in Arizona urged the developer and planning commissioners to not plant oleander as a vegetative screen, as oleander can be toxic to livestock. Nevertheless, oleander was planted (see inset photo) (12)
   - A project neighbor in Rhode Island attended the public meeting due to their concerns about noise; despite reporting satisfaction with the developers' answers, they remained suspicious (29)
3. **Residents are often unaware of which entity is responsible for different stages of project development, operation, and eventual decommissioning, particularly in underserved communities**
   - A local official in Texas identified that distrust can build as timelines expand, "I think they are just wanting a guaranteed timeline and, like, when is it actually happening? So many times in our underserved communities we mention things that are coming and they never really get to see implementation of those things, or it takes so long in the pipeline that it causes a lot of discourse and distrust" (46)

Photo by Doug Bessette

Process Driver 2: Community Influence and Understanding of Project Attributes

Photo by Doug Bessette

4. Residents' understanding of some project attributes and objectives is often limited or skewed by misinformation

- The purchaser of electricity is often misidentified (e.g., argued to be an out-of-state or more liberal entity) (36, 12, 16)
- Landowner solar lease payments were sometimes underestimated, (e.g., $72/acre) (35)
- A developer (48) identified that one community worried about radiation caused by the panels harming cows; residents at another site confirmed this worry, "What their solar panels do to my horses, my family, my kids, my grandkids growing up. I'm in the middle of a- it's radiation! Radiation's what powers those panels! Nothing else." (14, 15)
- Another developer identified, "we also hear crazy things, like the solar panels use up the sun's energy, and there's just a lot of misinformation, or the solar panels are leaching toxins,…that's again why it's important to have these open houses, to send them mailers" (21)
- Two residents provided a laundry list of mis- and dis-information, e.g.,
  - "If you actually look at some of the studies, they say that it will change weather patterns, rain, everything…when it's radiating that heat back up into the environment, the storm clouds ain't gonna come through here" (12)
  - "You put that in there there's a strong possibility it will sterilize the soil, and you cannot grow trees" (12)
  - "You know these horses can sell anywhere [from] 50 to $150,000. Well, what if you start having problems? You know your mares start aborting foals and stuff. That affects how you make a living." (15)

Process Driver 3: Community Subscription

1. **Community subscription or ownership may generate support in areas of high electricity bills**
   - A local official in Texas noted, “a lot of residents suffer from high electricity bills because their homes are not weatherized, and, you know, they don't have very many options, and their incomes are fixed, or are very much below the AMI, so offering them an opportunity to just be able to buy into, from, or even partially own a [solar] system that would result in lower cost for them, I think, was also a little positive in the community” (46)
2. **The distance between homes and low population density around projects make community subscription efforts expensive and inefficient.**
   - A project may lack or have too few neighbors for project operators to efficiently target for subscriptions, necessitating acquiring subscriptions from a broader pool of customers (42, 43)
   - While promoted as a way to improve local support for LSS projects (28, 29), focusing subscriptions on communities adjacent to the project may discriminate against LMI and environmental justice communities further away, in urban areas, or lacking their own solar development opportunities (43)
3. **Information regarding and opportunities to participate in subscription for nearby residents are absent at project sites (even those sites requiring subscription)**
   - Neighbors to a site in Rhode Island were unaware of a subscription offer; an official there identified subscription as “an afterthought” (32). Upon learning about the lack of local subscriptions, a developer identified he may cease relying on a third party and resume customer acquisition (42)

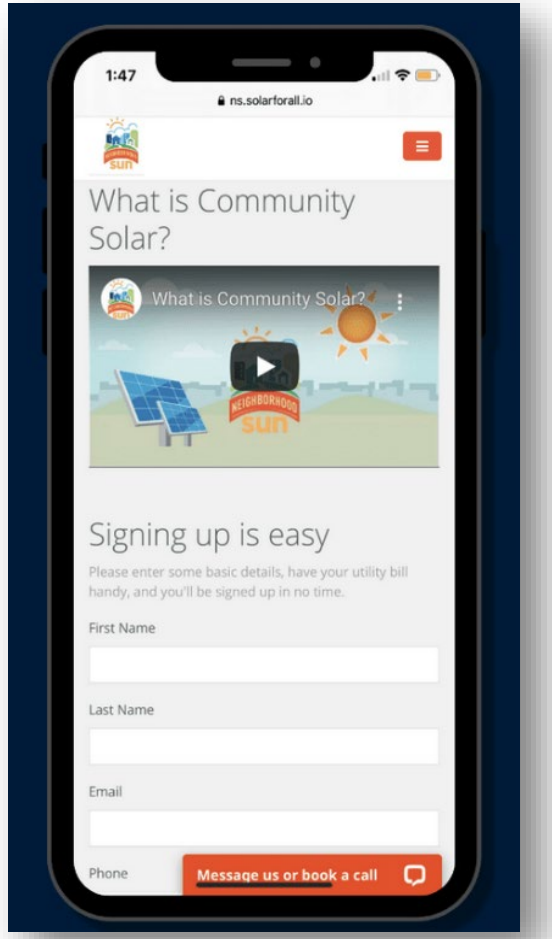


Photo c/o Neighborhood Sun, LLC. https://neighborhoodsun.solar/

Process Driver 3: Community Subscription

4. **Third-party software and companies are used to fulfill subscriptions in potentially distant areas (often urban areas located within the same utility service territory) and meet LMI requirements**
   - Regarding their use, one developer urged, “[solar] projects like [relying on third parties] because it's a lot cheaper to have a software company doing the acquisition and customer management than them kind of doing it with, you know, hamsters in a cage or something” (43)
   - This may limit community solar’s reach however, particularly if businesses or larger entities begin dominating subscription, as a local official in Colorado argued, “[regarding community solar], so you have some of the co-benefits associated with that [project], whether that's, you know, pollinator friendly, CSA, community oriented, and that's what we were willing to pay a higher price point on, because the benefits are really the selling point of community solar, right? you didn't want it to get co-opted by by large firms who don’t care about communities’ priorities and values” (5)

Photo by Doug Bessette

Impact Drivers

Impact Driver 1: Direct and Indirect Economic Impacts

1. **Residents may lack awareness of tax revenue generated by projects or perceive its generation and/or use by local or state government negatively**
   - Per a developer, “there just isn't the money in the project to, like, build a new school or something, you know. It's not like the way an old coal power plant was, where it would come in and there would be 500 permanent jobs…super boost the tax revenue…solar just doesn't do that. The money's not there in those projects to do that, and it's one of the unfortunate things about our energy transition, which is making people understand that that is the case, like, if you're used to the last big energy project that built you a new school…solar is just not going to do that.” (48)
   - A local official in Iowa identified confusion about the increase and timing, “Ok, taxes. Everybody says well they're not paying taxes anymore on that land, and that is true, what the solar sits on, it is called an excise tax, so we get an excise tax back from the state. It takes 18 months once you start to get it back. That property out there…the value of land tax to the county was $36,000, that's all, for 800 acres because it's a reduced rate because it's agricultural. We're estimating anywhere from $200,00 to 350,000 coming out as excise tax back to the community, that's a lot of difference.” (39)
2. **Residents and officials may be more aware of landowner payments and indirect economic impacts including increased economic activity and local employment**
   - Neighboring residents perceived increases in business during the LSS construction phase (26, 39): “We had a farm store up here that probably sold them $50,000 of tools to start out, and it overwhelmed them.” (39)
   - Local electricians and landscapers were used at multiple sites (1, 4, 6); one local official identified that, “one of the desires of the community is that jobs from this urban solar farm go to direct residents” (46)

Impact Driver 1: Direct and Indirect Economic Impacts

3. **Residents voiced concerns about the use of federal tax subsidies to support LSS development**

Photo by Doug Bessette

Impact Driver 2: Visual and landscape Impacts

1. **Developers and officials focusing on aesthetic and landscape fit and minimizing environmental impacts can improve residents' perceptions**
   - Residents and officials noted that the a LSS site constructed on the east side of a road and not disrupting the mountain views to the west was key to resident support in Colorado (3).
   - A local official in Michigan required an out-of-state developer to use crushed rocks rather than build atop existing concrete and weeds as foundation; they did this because they were a resident of the neighborhood and identified they "didn't want to have to dodge people at the store" (4)
   - Developers working in-state identified need to maintain local support (6, 21)
2. **Design elements like fencing, screening, and landscaping significantly affect resident support**
   - Project neighbors in Arizona mentioned the lack of fencing around project without prompting and preferred fencing block the project from view (16, 17, 19, 20). One resident argued, "it would have been nice if [the developer had] put a fence up, so you didn't have to look at [the solar], but other than that, I think it's good."

Photo by Doug Bessette

Impact Driver 2: Visual and landscape Impacts

Photo by Doug Bessette

- A local official in Florida identified the importance of vegetative screening, “[residents] want shrubs, [we asked] “what kind of shrubs do you want?” and they said, ‘I want bushes where I can't see the fence,” some said, “I don't want it to look like I'm in prison.” (39) A developer identified a project that was rejected due to a lack of screening, “people don’t really want to sit there and look at solar panels all day.” (48) A resident in Arizona argued, “they are putting in a 25-foot vegetation strip all the way around it, and we've seen their vegetation strips and at all the other ones, they’re pitiful.” (15)
- A developer in Florida identified the value of alternative designs, “in pretty rural areas we've started to do some alternative fencing designs with farm fencing, and building that 6 feet tall…it's the fencing that has the big squares in it…we started to do that after we got some feedback from the local communities that the chain link fencing didn't really blend in well with a very rural area…” (21)

3. Interconnection infrastructure (i.e., substations, overhead lines, pylons) is more visible and can be more intrusive than arrays

- Local officials argued developers were not forthcoming about interconnection details or lacked understanding of utility’s needs (1, 2, 32)
- A developer in Texas identified residents had questions about the placement of power lines (47)

Impact Driver: Types of Fencing

Photos by Doug Bessette

Impact Driver: Types of Fencing

Photos by Doug Bessette

Photo by Wellscroft.com

- Alternative designs, pollinator habitats and animal guard can be used instead of chain-link fencing (3, 21)
- Agrivoltaic project developers must be sure not to void panel warranties; increased height of panels can increase cost and difficulty of project (6)

Impact Driver: Interconnection Infrastructure

Photos by Doug Bessette

Impact Driver: Interconnection Infrastructure

Photos by google Maps

Impact Driver: Landscaping & Mowing

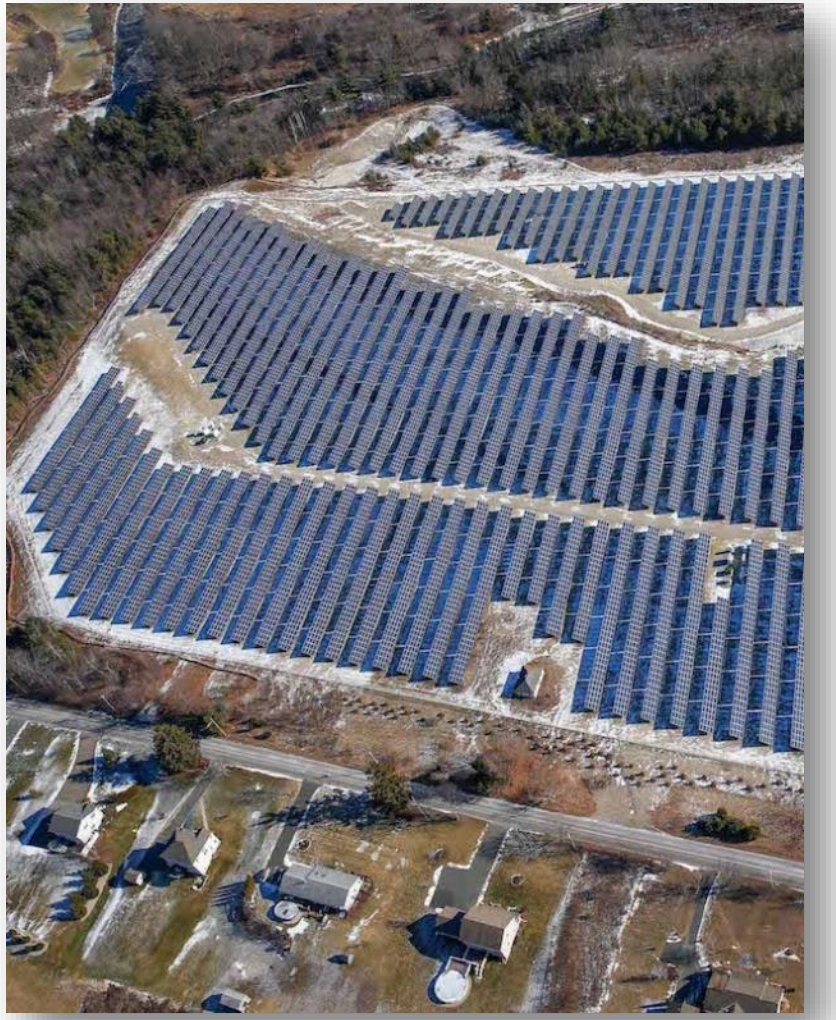
Photos by Doug Bessette

Impact Driver 2: Visual and landscape Impacts

4. **Residents report noise, road construction and increased traffic as significant, mostly negative impacts**
   - Neighbors in Iowa, Colorado, Texas, Rhode Island and Arizona complained about the noise and traffic involved in construction (29, 36, 34, 12, 44, 48, 33) , e.g., semi-trucks speeding to the site. One said, “they said they were going fast because they get paid by the load.” (36) One resident lost road access due to the project (12).
   - One developer noted that project neighbors had complained about the noise of inverters at another site, requiring the developer to retrofit (23), whereas a local official in Iowa argued the inverter was nearly silent, “it sounds like a bunch of bees around 8 o’clock.” (39)
5. **Concerns about projects taking agricultural land out of production are widespread (even amongst supporters of projects); others argue LSS is key to sustaining degraded farmland**
   - A supporter of a project in Colorado said they were concerned that a hay field had been taken out of production and noted, “those are important, I have animals.” (7) A resident in Arizona said, “Why not take the desert? We recognize this land is flat, but soon we’ll have to pay the Chinese for food” (12). An official in Colorado added, “I think that's where the whole rub came, not about the installation itself but the idea that [they were] putting it on ag land that would then take that land out of agricultural use.” (11) Their concerns may be valid as a developer in Florida said, ”95% of our projects are in agricultural use areas.” (21, 53)
   - Alternatively, per a landowner and local official in Iowa, “I was very enthused because we have a lot of farmers that have some ground that's not so favorable for crops, they’re struggling, and with this coming in here they got up the $650 to $850 an acre, maybe more, to not grow crops….I look at solar as farming, they're growing fuel basically by the sun’s rays, not hurting our ground, and taking some land that’s not so productive and turning it into something that we all can benefit from; it's going to lower our dependency on oils and coal…there's always going to be energy in the sun.” (39) Another official in Arizona identified, “That’s why [they developer] chose this...it’s ex-farmland…where the farmlands are no longer operating, perfectly flat, tilled, everything, and where a solar application would just be perfect” (52)

Impact Driver 2: Visual and landscape Impacts

6. **Less concerns were noted with respect to solar development on previously developed or disturbed land and at innovative sites**
   - Agrivoltaic projects may help mitigate land use concerns. An official in Colorado said, " I think the combination of being able to have solar and still maintain some ag use of the land was really critical [to the success of the project]" (11)
   - Some developers, policymakers and residents strongly advocated for increased brownfield development. An official in Texas said, "Every city has a landfill, almost every landfill is in a community like [this] and so if you can do this [here],…you can do it anywhere."(45) A developer in Texas concurred, stated they're turning down more projects than they accept (47). Another identified that most communities are "very pleased to have someone come do something with [brownfield land]" (48)
   - An official in Michigan identified that community members supported the development due to it "being the blight that it was before, you know, a torn-up ground, with graffiti on the fencing; the fencing torn down in areas." (4)
   - An official in Texas identified that the community had a significant role in pushing the project forward (45). A developer (47) urged that the community preferred the project because "it was transformative from an image point of view."



Palmer Airfield, MA. Photo c/o remenergy.com

Impact Driver 2: Visual and landscape Impacts

7. **Despite preference for Brownfield development, it remains complex, expensive and adequate space to meet clean energy goals may be lacking.**
   - Developers and officials argued brownfield sites require more involvement from local and state officials, and utility. Projects require greater experience, more permits, and more collaboration. “Working with cities takes forever…cities aren’t equipped to do this,” said one official in Texas. (45, 47, 48, 46, 32). Developers and officials acknowledge challenges of building solar in light of brownfield remediation and reclamation (48, 46).
   - Municipalities may be restricted from using federal funding to recover or reclaim brownfields. Private firms may be able to act sooner, and developers must manage finding an off-taker to generate financing (45)
   - One official doubted the extent to which decarbonization goals can be met using only disturbed land (32)

Holland, NJ

Impact Driver 3: Environmental Impacts

1. **Residents may be concerned about LSS projects creating "heat islands"**
   - Residents in Arizona voiced concern that local temperatures increased after project construction. (12, 13, 15, 17, 19) One said, "the temperature has gone up so much that the trees do not get a frost now, over there, and they've died." (14)
2. **Residents and officials are concerned about impacts of projects to flora and fauna**
   - Residents in Arizona were upset about the loss of Mesquite trees around projects (12, 14, 15, 17, 18). One resident no longer expected to see desert badgers (19). One resident asked, "What if there's a spotted owl out there or something. We walked up [on a contractor], 'We're looking to see if there's any endangered species out here,' she says. Well, what if you find some, what's gonna happen? 'Well, we'll capture them and move them.' What? What? Leave them alone!" (15)
   - Officials were concerned about gopher tortoises and caracaras (both protected species) and alligators that populated a Florida LSS site (22, 23). A Florida developer identified mitigating impacts to swamps and stormwater runoff as priorities of LSS development (21). A developer in Texas concurred, identifying residents in the Western US worry about water resources and stormwater, both during and after construction, as well as water withdrawals for cleaning panels or building concrete (48)
3. **Climate change mitigation is not always a priority of residents and officials**
   - One official in Colorado noted, "climate change? Not many people care about that…unfortunately" (11, 27). However, an official in Texas identified that Hurricane Harvey was a turning point with respect to residents' concerns regarding climate change: "Harvey was the point in [town] where people were like, 'this is too much, we have to do something' and then there was like a snowball effect of climate events, Harvey, Irma, Maria, fires, snowpocalypses, droughts, right, like we all get climate change now, and so that really helped." (45) Another noted the importance of communicating the impacts of climate change to LSS neighbors, "my piece of this is telling the narrative of the story of this part of the American farmer, right, and it's not good right now, it's not looking so good, and it's continuing to get harder with the context of climate change." (5)

Impact Driver 4: The Rural-Urban Divide

1. **Residents identified concerns or confusion about "where the power goes" and frame electricity as a natural resource - like land, air, or water**
   - Residents noted concern about both their resources being sent away from the community and who benefits (12, 36). One developer in Texas spoke this concern, specifically urging regarding urban brownfield sites, "there's no place better in the entire state to generate electricity" (47)
2. **The preference for brownfields and development on capped landfills may attenuate in rural areas**
   - One developer argued, "From a community perspective, yes brownfield sites are usually a lot better [regarding community opposition], though it really varies. You know, like in a site in a rural location generally the neighbors like living in a rural location, and not an industrial location…you go out to a rural landfill in upstate New York and if it's not fenced and gated people use that as their ATV park and people [are] running all over with their dirt bikes…they're out there hunting, and so sometimes, yeah, you do get some community opposition" (48)
3. **LSS can be seen as a way of reducing suburbanization, maintaining low density**
   - An official in Rhode Island identified solar as a passive temporary land use that "prevents what will ultimately become of all these lands [i.e., subdivisions]" (32)
   - A resident in Iowa said, "There's some people down here, our neighbors, who'd rather have solar panels than a bunch of people, a housing development. Who came out here to be away from people? I mean who would rather have solar panels than people? That's how much you hate people?" (15)
   - A resident was happy that "nobody else was gonna move in, no partying!" (16)

Impact Driver 4: The Rural-Urban Divide

4. Increase in extra-local workers can upset rural economy and community

- One local official identified the challenge of increasing local employment and diversity, “When you bring in 2 to 300 workers and the majority of them are not from around here, some of them have different colors of skin…I think it's just the not knowing, when you're such a small tight knit community, when you bring other people in, it's like a neighborhood watch alarm, what are they doing here?” (redacted)*
- They added, “I think this is where we needed to do a little better here, when they got up at the end of the day, it was 300 people leaving [work] into a community that was already busy enough, we couldn’t keep up with milk and we didn't keep up with the beverages and and snacks and and gas, so it made the stores busier and it made some local people upset because they couldn't buy bread, what the heck, we can't keep bread anymore, I can't keep milk in here.” (redacted)
- That same official identified that the workers came from, “Puerto Rico, Africa, New York, they're from all over because they follow the solar, so they couldn’t just go home on the weekend” (redacted)
- At the same time, two residents in a more diverse area noticed contractors parking nearby and walking up to the project site; neither were bothered (redacted)

Photo c/o Department of Energy Solar Workforce Development

* Due to the sensitive nature of these comments, we have redacted this interviewee’s assigned number

Research Questions 2 - 4

RQ2: To what extent do LSS projects exacerbate or mitigate perceived inequities and marginalization within hosting communities and how can those inequities be mitigated going forward?

JUSTICE40

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ENVIRONMENTAL JUSTICE

1. **LSS payments to landowners via leases or land purchases may contribute to inequality**
   - None of the LSS-project land in Arizona was owned by local community members. One landfill on which an LSS project was to be constructed had been leased to a developer for $1, along with a guarantee to the developer of all future profits (45, 46). Officials there argued that instead a community benefits agreement should be designed that matches (at least) the market rate of that land per year. They argued those benefits should amount not “to trash pickup, but significant benefits, true benefits with perpetuity, e.g., employment opportunities, energy rates/costs.” (46)
2. **Community subscription efforts may target Justice 40 communities, but ignore LMI LSS project neighbors**
   - Developers and subscription companies identified that online interfaces allow for greater diversity, equity and inclusion regarding community subscription, but restricting subscription to project neighbors, i.e., requiring geographic proximity, may discriminate against LMI households outside the community (43). However, failing to advertise to or include LSS project neighbors may also be discriminatory, particularly when community subscription offers are used to generate support for a proposed LSS project. (28, 29)
3. **Participation did not improve during Covid or via virtual meetings**
   - While live-streamed public meetings during the Covid-19 pandemic were hypothesized to increase participation, an official noted that in LMI communities, ”solar wasn’t at the top of [residents’] priority list” and attendance declined due to residents often lacking the technology and Internet connectivity necessary to attend virtual meetings (46)

RQ2: To what extent do LSS projects exacerbate or mitigate perceived inequities and marginalization within hosting communities and how can those inequities be mitigated going forward?

4. Tax revenues remain uncertain and abstract to residents

- Excise and property tax revenue and the benefits that accompany increased revenue as a result of LSS development are unclear and often misunderstood or not valued by residents (39, 17, 18)

5. Climate-driven development, subsidies and rhetoric may increase rural resentment

- Developers and officials note that climate change is not a priority in rural communities, and that resentment is high, “the folks who are generally predisposed to not want renewable energy or have poor views about it are the same folks that were saying that we should have shut the DOE down, you know, six years ago, so it's a little bit like, well, there's limits to what you can do, right?” (48). A resident in Arizona demonstrated that resentment, “we actually had somebody who grew up [here], and they went to [university]. They were a climatologist, and they came in and spoke, and that was a big, like, a lot of people were like, wow, this is actually not good and we're totally against it.” (12)
- One project neighbor in Iowa identified, “we have enough cheap coal for 400 years,” government subsidies means “solar is not sustainable” (34)

Photo c/o Doug Bessette

RQ3: What strategies can communities employ to align LSS development with local land-use plans and community needs and values?

1. **Increase direct engagement with LSS neighbors and community residents**
   - Developers and officials should incorporate bus tours, provide classes with residents focused on job training, have coffee with neighbors, establish and meet regularly with community advisory groups (45, 47, 46). They should communicate the pros and cons more readily to the broader community; one official noted, “a couple…decided not to be in the program, which is fine, but I think they just didn’t understand it. That’s what we have to do better, communicate the pros and cons…[the developer] should have gone bigger. They only invited the people that would be looking at the panels. That started the rumor mill. You got several thousands of people not knowing anything about it.” (39) Developers and other officials agree, “the most important thing in the process is making sure the community is brought in…getting community buy-in” (21, 9, 4, 1)
2. **Consider visual impact of ancillary design elements, including interconnection infrastructure, which may precede the LSS project**
   - An official in Colorado noted, “I think [we need] way more communication and visual communication around this type of [project], you can co-locate a lot of different beautiful, synergistic opportunities with renewables and that didn't exist at all” (5)
3. **Include community engagement criteria and experience in bids and Requests for Proposals; require “community engaged design”**
   - One community now requires developers to submit community engagement plans in their LSS proposal (46)
4. **Increase funding to municipalities and local governments for brownfield remediation and LSS development; provide examples of land use code and ordinance language; and encourage community subscription** (3, 32)

RQ3: What strategies can communities employ to align LSS development with local land-use plans and community needs and values?

5. **Include good neighbor agreements or community benefit plans (even with brownfield projects)**
6. **Use a third-party intermediary, i.e., a local partner, to communicate between developer and community**
   - Developers should make sure the local partner “speaks the local dialect, knows the people, and understands the community” (48), and use “community champions,” i.e., “grass-roots leaders that can get the word out about the project” (46). Additionally, developers “[should] talk to not only supervisors but meet the area elected officials and have an informative meeting because that's the people that elected these people to oversee their best interest” (39).
   - One developer argued, ““you know, we get to do what we're good at which is developing solar and we're letting our local development partner do what she's good at which is…[working] with the local community to address their concerns from the developer side, while the government is doing it from the city’s side as well” (48) Local officials and/or law firms may be able to recommend local partners, e.g., interns from local universities (48)

Photo by Doug Bessette

RQ3: What strategies can communities employ to align LSS development with local land-use plans and community needs and values?

7. Share success stories and opportunity costs of restricting LSS development

- Use narratives to describe successful examples and communicate project details, development processes, and future impacts. “We probably should have had [developers] have more town hall meetings…bring people in from the other communities that have been around solar, see what it did to the economy” (39).
- Recognize that not everyone is a skilled communicator, “I think there needs to be the storyteller…farmers are not necessarily like that.” (5), but some are! “[The landowner] shared the narrative…of what's possible on a degraded farm…and sort of his story of growing up here and seeing his parents farm and, you know, struggle from economic times. It was a really powerful vehicle for change in our community, because we were seeing a lot of farmers go through the same types of economic struggle and challenge to continue to make profit on their traditional farms with their degraded farmland…” (5)
- Share with communities the opportunity costs of large setbacks, namely, that they become unutilized land, upsetting lease-holders and community members (39, 21)
- Ensure community members understand that certain pollinator habitats and vegetative screening may require increased water use (21), “people who know what they're talking about on pollinators know that they don't have to be the pretty flowers…and having a a biodiverse grass seed mix is just as important as having those pretty flowers… those bright flowers which are frankly very hard to keep alive depending on the soil you have… how much water they get, because you need to be very diligent on native species that don't need to be watered, because you don't want to be bringing water to a site, you don't want to have to irrigate”
- Communicate that LSS may be an effective way of limiting density and urban sprawl (16, 21, 32), e.g., "in the grand scheme of things, they’re [i.e., LSS] temporary. if they become subdivisions, it will always become a subdivision” (32)

Datong County Solar
Photo c/o Getty Images

RQ4: How can community members take a larger role in local LSS development?

1. **Directly engage with developers and contractors** (45, 46, 47, 21, 9, 4, 1)
   - Community members directly engaging with contractors led to one developer adopting alternate fencing, farm fencing (21). An official in Michigan urged engaging stakeholders beforehand would have improved the development process (4)
2. **Require hiring of local food providers, electrical contractors, cleaning crews, and landscapers and partnering with community colleges** (48, 39, 37, 4, 1)
   - Most projects can employ “pseudo-skilled labor,” which can be local and doesn’t require trade school training or certification (48); developers can use a “Golden Row” technique, which involves using experienced crews to install one row of panels which are then used by less skilled workers as an example of optimal design.
   - An official in Iowa identified locally supplying food to laborers may increase support, “Can we do something where we can cater stuff in to you? Get some townspeople, get them more buy in, set up something, put up a portable building for them, get your townspeople more involved.” (39)
3. **Identify community leaders and champions, self-advocate and conduct grass roots efforts and remain persistent, lead the collaboration efforts and hold developers “feet to the fire”** (44, 46, 47, 32, 4)

Photo by Doug Bessette

Next Steps

- **National LSS Neighbor Survey,** we are conducting a national random survey of at least 1,000 LSS project neighbors, oversampling among innovative site types and nearby-residents, to reexamine case-study findings at a broader empirical scale enabling national generalization, including questions targeting:

  - Tax and landowner revenue perceptions
  - Climate change and energy
  - Local jobs, business impacts and economy
  - LSS contributions to inequity
  - Landscaping, groundcover and screening
  - Timing, sources and quality of information provision
  - Methods and effectiveness of stakeholder participation and influence
  - Roles of local and state government
  - Community benefit agreements
  - Electricity bill credits and community subscription
  - Proper land use and alternate energy uses

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