# Bringing Power to Disadvantaged Communities: Leveraging Federal Solar PV Assets to Sustain Communities during Extreme Weather Events

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**ABSTRACT**

There are thousands of commercial solar PV systems nationwide. The vast majority of these systems go offline when power is lost from the serving utility. Utility power is lost most often due to and during extreme weather events, leaving affected communities without the means to sustain basic household functions and critical life-sustaining medical equipment. The large installed base of existing PV systems represents an important asset that could be harnessed to provide energy services to communities during an emergency event.

Community spaces are often used during or after extreme weather events to provide essential needs. However, spaces sited in disadvantaged communities may not have the resources to provide clean backup power. Our team is seeking to understand how public and private sector commercial solar PV systems, with a particular focus on federal solar PV systems, might be able to provide support to co-located disadvantaged communities during disasters or power shut-off events. Based on previous literature and stakeholder engagement, this paper first identifies potential use cases and considerations at site, community, and state levels for using commercial solar systems to provide emergency support to communities. The paper also discusses potential barriers and benefits identified through engagement with federal sites, including sites' accessibility and relationship with the surrounding community. Finally, we map 837 locations, many of which are rural communities, where federal sites with renewable energy could provide this support. These findings highlight the opportunity for federal solar PV systems to address resilience in areas historically underserved by existing emergency management processes.

## Introduction

Extreme weather events have been increasing in their frequency and impact over the past few decades. Between 2000 and 2021, over 80% of major power outages in the U.S. were caused by weather-related events (Climate Central 2022). These extreme weather events are forecasted to increase, bringing with them a substantial increase in heat waves and cold snaps (USGCRP 2009). The pairing of extreme weather and grid outages threatens the safety of community members, highlighting the need for safe spaces within communities where members can access core needs such as heating and cooling.

For certain communities, the effects of extreme weather events and grid outages can be exacerbated due to existing inequities in the distribution of socioeconomic, environmental, and health burdens. Socioeconomic status plays a role in power outage duration as well as physical and psychological harm from natural disasters (Fothergill and Peek 2004; Lievanos and Horne 2017). In addition, residents in older housing stock tend to experience longer outages, dangerous indoor temperatures, and lack of access to cooling facilities, resulting in higher burdens of chronic disease (Maliszewski and Perrings 2012; Do et al. 2023). Socially vulnerable or disadvantaged communities (DACs) often live in areas with high natural disaster risks, highlighting the need to focus on energy resilience solutions for these communities (Cutter, Boruff, and Shirly 2003; World Resources Institute 2021).

Back-up power generation with renewable energy is increasingly seen as key to addressing energy-related challenges faced by DACs. Back-up power systems historically relied on fossil fuels, as in diesel generators (Schweikert et al. 2019). Previous interconnection rules inhibited the use of renewable energy for back-up power. This changed in April 2018 with IEEE Standard 1547-2018, which enabled intentional islanding (Narang et al. 2020). Intentional islanding allows on-site generation, such as a solar system, to temporarily isolate from the grid and be used during a power outage. Renewable energy distributed generation and microgrids also have the potential to mitigate carbon emissions (Mohamed et al. 2019). Several case studies have highlighted the benefits of renewable energy microgrids, including sustaining critical operations during power outages, addressing peak power, and providing a cleaner alternative to back-up diesel generators (Coeckelenbergh, Medina, and Broten 2022; Zhang et al. 2020; Koolbeck, Shaver, and LeZaks 2022). These benefits would be particularly important to prioritize in DACs which disproportionately face environmental and health burdens.

Renewable energy microgrids and distributed generation face a range of technical, cost and policy barriers that are important to consider for DACs. These include design complexity, lack of incentives and inequitable structure of net metering schemes for recovering costs (Mohamed et al. 2019; Norouzi et al. 2022). The cost-related barriers particularly can hinder implementation in DACs given the comparative lack of financial resources. For example, Freeman and Hancock (2017) identified that aging infrastructure and a lack of policy focus impeded microgrid development for underserved rural and regional communities in Australia. Even where microgrids have been developed in DACs there may be issues with cost recovery. Hills, Michalena, and Chalavtzis (2018) found a Pacific Island community microgrid's low tariffs, designed to be affordable for low-income households, were unsustainable to cover initial costs and ongoing maintenance costs.

Given that DACs urgently need energy resilience, but current technologies may be difficult to finance and implement, we investigate how existing renewable energy systems already installed in these communities can contribute. With funding from the Federal Energy Management Program (FEMP), our study focuses specifically on federal sites, which mostly have commercial applications such as office buildings, courthouses, and national park sites. FEMP already tracks renewable energy system installation on sites owned and operated by federal agencies. Federal agencies may be interested in how their sites can support DACs following the federal government's recent Justice 40 Initiative, which aims to deliver 40% of the benefits of clean energy investments to DACs. In line with this initiative, the Council on Environmental Quality released the Climate and Economic Justice Screening Tool (CEJST) identifying DACs according to the federal government definition (CEQ 2022). In this paper, we make use of the existing datasets from FEMP and the CEJST as well as engagement with federal agencies and related stakeholders to address the following questions:

(1) What are the potential use cases for sites to support community energy resilience?
(2) What conditions at the state, local, and site level affect a site's ability to provide this support?
(3) What locations currently offer the most suitable conditions for this support?

In answering these questions, our aim is to improve the understanding of emergency management processes and logistics at federal sites and more generally, commercial sites and how existing systems could support the needs of DACs during weather-related and other events that impact the grid.

## Methods

To understand how existing renewable energy systems on federal sites can support DACs during power outages, we use the following steps summarized in Figure 1:

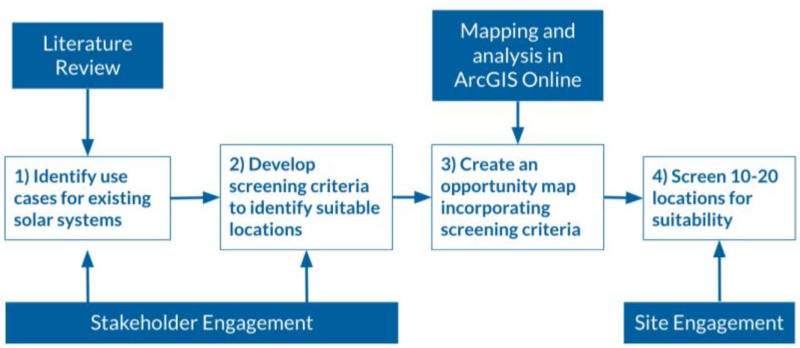


Figure 1. Diagram of methods (in dark blue) used to inform the development of project deliverables including use cases, screening criteria, and opportunity map for supporting community resilience using existing renewables

First, we reviewed academic literature, government documents, and reports for a deeper understanding of existing emergency management processes and the stakeholders involved. This helped to identify (1) where a site with renewable energy could fit into existing processes and (2) potential stakeholder groups that could be engaged for feedback on this concept.

Stakeholder engagement was critical to understanding barriers and opportunities in using existing renewables to support community resilience. Preliminary conversations with representatives from the Federal Emergency Management Agency (FEMA), state resilience and energy offices, community-based organizations and utility companies helped us develop potential use cases for using existing systems to address community energy needs during outages. Stakeholder feedback also shaped screening criteria for suitable states, communities and sites.

To better define the opportunity for using federal sites to support community resilience, we used ArcGIS software to find suitable locations. The mapping incorporated the dataset of zip code locations that contained federal sites with renewable systems, location of DAC census tracts from CEJST, and part of the screening criteria for suitable states developed in step 2. For this study, we focused specifically on federal sites with solar systems rather than other renewable energy systems due to the abundance of solar on these sites compared to other types of renewable energy. Mapping analysis identified zip code locations within or adjacent to DACs where state regulations, utility experience and presence of federal sites with solar may be most conducive to retrofitting existing systems with temporary islanding capabilities.

Finally, we applied the screening criteria to several federal sites in the identified zip codes to further understand conditions that affect a site's potential to support community energy needs.

## Stakeholder Identification and Engagement

The following section presents a summary of findings from our literature review and stakeholder conversations. We use this information to define what types of emergency events can be addressed, what stakeholders need to be considered, and what use cases can leverage existing renewable energy systems for community resilience.

### Stakeholders Involved in Emergency Management

Understanding the key stakeholders and how they interact during emergencies helps to identify points of collaboration for integrating a federal site with renewable energy. At the federal level, disasters can be categorized as declared, wherein events receive additional funding and support from the federal government, or undeclared events, which do not receive as much federal financial support (FEMA 2023). Undeclared events, such as Public Safety Power Shutoffs (PSPS), small forest fires, heavy rain, high winds, or extreme weather events tend to involve more local actors such as local governments and community organizations. The type of events we consider in this study encompass both declared and undeclared events to include any situation where power access is limited or cut off, including earthquakes, hurricanes, wildfires, PSPS, and periods of extreme temperature.

Figure 2 illustrates relevant stakeholder groups involved in responding to these events and the levels (federal, state, or local) at which they operate.

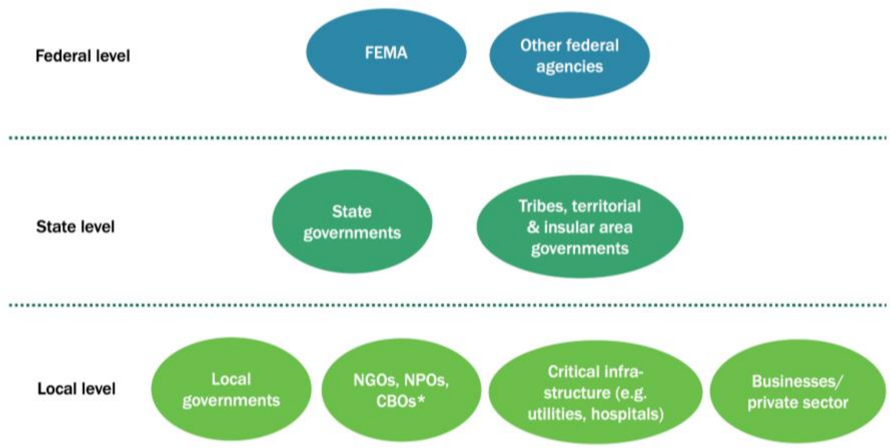


Figure 2: Stakeholders involved in emergency management.
*Non-governmental organizations, nonprofits and community-based organizations

The federal government's involvement mostly relates to declared disasters as outlined in the previous section. FEMA plays a main role in coordinating planning, response, and recovery efforts between multiple agencies for incidents requiring federal support. FEMA also engages with stakeholders at the local and state levels, for example by providing funding assistance to community organizations for resiliency projects. In addition to FEMA, different federal agencies are responsible for various emergency support functions, such as the Department of Energy for the energy support function. The federal government does not play as significant a role in undeclared disasters. Outreach to FEMA and federal agencies helped with understanding potential resiliency use cases and conditions affecting feasibility at the federal site level.

State governments step in when an incident threatens to expand beyond the local jurisdiction, or when local officials request aid. Each state has an emergency management agency that is responsible for maintaining and executing emergency plans. Consideration of back-up power solutions such as microgrids and distributed generation varies in different states' policies. Only a few states such as California, Hawai'i, and Connecticut have established financing mechanisms or interconnection rules that facilitate microgrid adoption (National Conference of State Legislatures 2022). We engaged with stakeholders at the state level to better understand the rules and regulations that enable an existing solar system to come back online during a grid outage.

For the majority of incidents, local stakeholders are most heavily involved in planning for and responding to community needs. Local stakeholders are highly knowledgeable about their communities, and so are well suited to identify and coordinate the distribution of resources and aid. These stakeholders include local governments, non-profit, community-based, and faith-based organizations, and private sector entities such as businesses, utilities, and hospitals. Local governments act as liaisons between communities and state governments, requesting aid from the state if local capacity is insufficient to respond to the incident. Outreach to local-level stakeholders was key to developing screening criteria for communities that may be most in need of back-up power solutions and appropriate use cases for federal sites that can address community needs in a relevant and equitable way.

Preliminary conversations with stakeholders highlighted that their roles can be highly dependent on the type of disaster or emergency and on the needs of the specific community. Because of this variability, we developed a variety of potential use cases rather than choosing one specific use case on which to focus our project.

## Resilience Hubs

The usage of renewable energy systems to support communities should build upon energy resilience solutions that already exist. Our literature review and stakeholder conversations revealed that federal and local governments are already trying to address community needs through developing resilience hubs in collaboration with local stakeholders.

A resilience hub connects residents to resources and services to help communities prepare for disruptions (DOEE n.d.). According to the Urban Sustainability Directors Network, resilience hubs provide opportunities to "efficiently improve emergency management, reduce climate pollution, and enhance community resilience" (Baja 2019a). Resilience hubs provide an array of services and are intended to support communities year-round in three different modes: everyday, disruption, and recovery. During everyday or non-disruption mode, the hubs are used as trusted community spaces and provide services based on community-identified needs, such as access to food, water, and childcare (Baja 2019b). A resilience hub moves into disruption mode when a disruption, such as a hurricane or snowstorm, impacts the majority of the community (Baja 2019b). During this time, communities' needs are often harder to meet due to limited access to resources. To address this, resilience hubs provide basic needs including shelter, food, water, and communication. The hubs can also serve as a drop-off location for necessary supplies and connect community members with services and resources. Hubs may also provide a certain percentage of normal power load to help meet community needs (Baja 2019b). In recovery mode, most resilience hubs connect community members to necessary recovery resources and work towards returning to everyday mode.

There are five foundational areas of resilience hubs (Baja 2019b):

1. Service and Programming
2. Communications
3. Building and Landscape
4. Power Systems
5. Operations

The Power Systems area is intended to ensure "uninterrupted power to the facility during a hazard while also improving the cost-effectiveness and sustainability of operations in all three resilience modes" (Baja 2019b). In this project, we consider not just how federal sites can contribute directly to resilience hubs' power systems resilience in disruption mode, but also how use cases may support other foundational areas such as communications.

Conversations with federal, state, and local entities indicated that although interest in implementing resilience hubs exists at multiple levels of government, they face funding challenges that can be difficult to overcome. Resilience hubs in DACs may find it difficult to finance solar and storage systems and may not have the space or building infrastructure to support an onsite solar installation. Renewable energy systems on federal sites have the opportunity to partially alleviate the burden of providing backup power to these sites. Since these hubs are already trusted spaces that community members seek out during disasters and power outages, our use cases focus more on enhancing the services of any existing resilience hubs in the area rather than developing the site itself into a resilience hub.

## Use Case Development

Sites with solar systems could support community resiliency by addressing basic needs during disasters. In terms of directly addressing power systems resilience, power can be provided to existing shelter facilities via mobile storage or electric buses. Use cases related to the support of other resilience hub services include using the site as a place to host and power communications equipment, as an area for vehicle staging and charging, or food and medicine storage and refrigeration. Table 1 illustrates a variety of potential ways the site could be used based on community needs during outages. The ultimate decision on a site's usage for resiliency should involve discussion with stakeholders both in the community and at the site.

Table 1: Potential Use Cases for Commercial Sites

| **Community Need** | **Use Case** |
|---|---|
| Shelter | Provide power to existing resilience hubs / shelters through mobile storage or electric buses |
| Food | Store and refrigerate food (for an aid providing organization such as an NGO) |
| Water | Provide power for water purification and heating (for an aid providing organization such as an NGO) |
| Medical / Health | Store medicines needing refrigeration (for an aid providing organization such as an NGO) |
| Safety | Provide site for public safety personnel or others to stage and charge vehicles |
| Communications | Host and power communications equipment |
| Staging | First responder staging |

We note that our use cases avoid bringing community members directly to the site; we decided on this approach in response to feedback from community-based organizations. Community members may have mixed associations with federal sites, and many communities already have resilience hubs or shelters that are trusted spaces people can go to during emergency events. Several of the use cases therefore need close coordination with an aid-providing organization, such as a community-based or non-profit organization. For example, site staff could power water purification technologies with the onsite solar and coordinate with aid-providing organizations to distribute purified drinking water to the surrounding community.

## Screening Criteria Development

To better understand and assess conditions that impact the feasibility of using federal solar for supporting community energy needs, we developed screening criteria for states, federal sites, and communities. These criteria were developed using the solar technology expertise of staff members supporting the Federal Energy Management Program as well as stakeholder input on each level of screening.

Each set of screening criteria can be used to rank sites and states most conducive to retrofitting solar for temporary islanding, as well as communities that may benefit most from such support. Table 2 and Table 3 display the criteria used to screen for ideal conditions in states, sites, and communities. A location that scores all points would be considered a location to prioritize for this type of support, however, a location with a lower score need not be excluded from consideration unless an answer to the criteria results in a "No Go" decision. To ensure project feasibility, we initially screened states before focusing on specific sites and communities. This allows us to prioritize states with a higher likelihood of successful implementation. Given that we have only been able to reach stakeholders across a limited number of states and locations, these criteria are intended as a starting point rather than a comprehensive list of conditions to consider. Additionally, we acknowledge some of these responses could vary depending on the type and manner of information we convey to stakeholders. For instance, a community organization initially skeptical of this idea could change their response from 'not interested' to 'interested' if we are able to answer their questions and concerns, or if we are able to point to a successful pilot project. Early successes in demonstrating this concept could therefore increase the potential scale of deployment.

Table 2: Screening criteria for suitable states

| **State Screening** | |
|---|---|
| **Is Islanding legal in the state or utility district?** | Yes (+1)<br>No (No Go) |
| **Do any of the utilities in the state have experience interconnecting to microgrids or islanding?** | Yes (+1)<br>Some experience (+.5)<br>No (+0) |
| **Does the state have mature emergency planning?** | Yes (+1)<br>No (+0) |
| **Is one of the utilities open to collaborative emergency planning?** | Active in collaborative emergency planning (+1)<br>Open to, but not active in collaborative emergency planning (+.5)<br>No (+0) |

Table 3: Screening criteria for suitable sites and communities

| Site Screening | | Community Screening | |
|---|---|---|---|
| **Does the site have an existing solar PV system?** | Yes (+1)<br>No but interested in installing solar (+.5)<br>No (No Go) | **Is the community interested in participating?** | Yes (+1)<br>Interested with additional information (+.5)<br>No (No Go) |
| **Is the system used in a microgrid to supply resilient power to the agency?** | No (+1)<br>Yes (No Go) | **Is there staff available for coordination with community sites?** | Yes (+1)<br>Based on funding availability (+.5)<br>No (No go) |
| **Are there any site access complications?** | No (+1)<br>Some complications, but can be overcome (+.5)<br>No access available (No Go) | **Are there any pre-existing resilience hubs and/or community centers?** | Yes (+1)<br>No (+0) |
| **Where is the Balance of System Equipment located?** | Outdoors or ground level (+1)<br>Roof top or indoors (+0) | **Is there solar installed at the resilience hub/community center that meets community needs during natural disasters/emergency events?** | No solar installed (+1)<br>Solar installed but does not meet needs (+.5)<br>Yes (+0) |
| **Does the inverter have curtailment/clipping capabilities?** | Yes (+1)<br>No (+0) | **Can power be delivered to the sites?** | Yes (+1)<br>Yes with some difficulty (+.5)<br>No (+0) |
| **Is there staff available to assist and/or be training to assist during emergency events?** | Yes (+1)<br>No (+0) | - | - |
| **Distance from DAC** | <1 Miles (+1)<br><10 Miles (+.5)<br>>10 Miles (+0) | - | - |

## Mapping Community Resilience Support Opportunities

We used ArcGIS Online software to identify potential locations for a federal site supporting DAC resilience with existing solar systems. The mapping incorporated elements of the screening criteria presented in the previous section to identify ideal conditions at the state level. The following map data in Table 4 were overlaid to identify optimal locations:

Table 4: Data used to create opportunity map

| Criteria / Consideration | Description | Data Type | Data Source(s) |
|---|---|---|---|
| **Disadvantaged Community (DAC) Status** | Census tracts with an associated value based on White House definition, which classifies a community as disadvantaged if it meets the threshold for one of eight burden indicators and one of two socioeconomic indicators | Binary value of 0 (non-DAC) or 1 (DAC) | Climate and Economic Justice Screening Tool from the White House Council on Environmental Quality (CEQ 2022) |
| **Renewable Energy Zip Codes** | Zip codes that contain at least one federal site with renewable energy. Each identified zip code may have more than one site | N/A | Federal Energy Management Program (FEMP) provided database;<br>USA Zip Code Boundaries from ESRI |
| **Utility Interconnection Experience** | Utility service territories with an associated value based on whether the utility has experience with interconnecting microgrids or distributed generation with temporary islanding | Either 0 (no experience), 0.5 (some experience, but may have been a one-off case such as a military facility), 1 (implemented microgrid/islanding project), or blank (utility not evaluated) | Electric Retail Service Territories from the Department of Homeland Security;<br>Web-based search for microgrid/islanding projects by state |
| **State Islanding Regulations** | U.S. states with an associated value based on whether the state has regulations allowing temporary islanding | Either 0 (does not allow), 1 (allows temporary islanding), or blank (state was not evaluated) | Interconnection and documents from states; National Conference on State Legislatures (2022) Microgrid Rules and Regulations data |

## Identifying Disadvantaged Communities

We use the federal government definition and mapping tool to identify disadvantaged communities (DACs). The Climate and Economic Justice Screening Tool (CEJST) was selected to align the definition of DAC in this project with the most recent definition used by other federal agencies for the Justice 40 initiative, since the intended primary audience of the mapping results were federal agencies. The CEJST definition provides a useful starting point for examining the opportunity for community resilience projects to benefit DACs. However, the definition of DAC used here has several limitations. To be considered disadvantaged, a census tract need only meet the threshold of one of the eight burden indicators and one of two socioeconomic indicators. The tool does not consider cumulative burden, or the number of burden indicators met by a census tract. In addition, a community often must be considered low income to qualify as a DAC, which does not account for communities that experience multiple environmental or health burdens that are not low income (World Resources Institute 2023). We advise that even where sites are not located within or near a DAC according to the CEJST, they should still consider how their site can strengthen community resiliency.

**Identifying Suitable States**

In order for an existing solar PV system at a federal site to operate during a power outage, it needs to be able to island temporarily from the grid. However, not all states allow this type of temporary or hybrid islanding. We evaluated a total of 18 states' interconnection policy documents and found 16 states where temporary islanding was permitted. The following states in Table 5 were selected for screening based on the frequency and scale of extreme weather events and states with a high number of federal sites with renewable energy.

Table 5: Evaluation of 18 state islanding regulations conducive to retrofitting existing solar systems to allow temporary islanding (score of 1 if temporary islanding allowed; 0 if not)

| State | Islanding Legality |
|---|---|
| New York (NY) | 1 |
| California (CA) | 1 |
| Pennsylvania (PA) | 1 |
| Hawaii (HI) | 1 |
| Maryland (MD) | 1 |
| Minnesota (MN) | 1 |
| New Mexico (NM) | 1 |
| Washington DC | 1 |
| Washington (WA) | 1 |

| State | Islanding Legality |
|---|---|
| Texas (TX) | 1 |
| West Virginia (WV) | 0 |
| Florida (FL) | 1 |
| Georgia (GA) | 0 |
| North Carolina (NC) | 1 |
| South Carolina (SC) | 1 |
| Louisiana (LA) | 1 |
| Nevada (NV) | 1 |
| Arizona (AZ) | 1 |

**Identifying Suitable Utilities**

Another important consideration identified through the screening criteria development is whether the local utility has experience forming interconnection agreements and implementing temporary islanding. We evaluated utilities for interconnection experience based on online web searches for microgrid or distributed generation with temporary islanding projects. Utilities may engage in such projects, particularly with smaller customers, without an online presence, and so we acknowledge the limitation that there may be several utilities for which we assigned a value of 0 that in reality do have interconnection experience.

In total, we assessed 67 utilities for interconnection experience based on locations with the highest percentage of overlap between zip codes containing federal sites with renewable energy and DACs, as well as location in states that permit temporary islanding. As shown in Figure 3, we found 26 of the 67 utilities had experience with projects involving the interconnection of microgrids and/or temporary islanding of distributed generation systems according to web search results. Larger utilities tended to have more experience compared to municipal utilities or cooperatives.

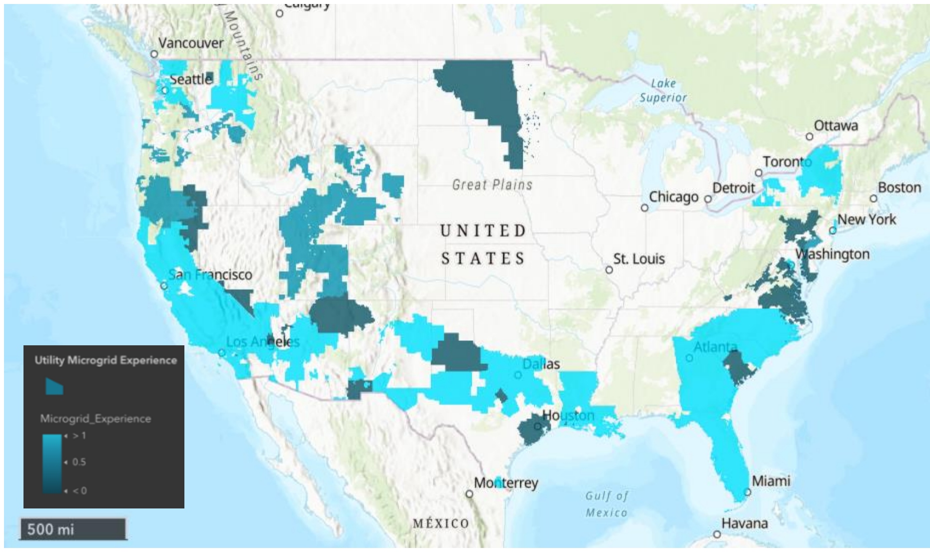


Figure 3. Map showing evaluated utilities and level of experience with interconnecting microgrids and/or distributed generation with temporary islanding. Lighter blue indicates more experience.

## Locations with Potential for Supporting Community Energy Resilience

The zip code data provided for federal sites with renewable energy contained 1,174 zip codes. Due to the sensitive nature of some federal sites' locations, we summarize the results of the mapping rather than displaying the map itself. Of the 1,174 zip codes, we initially identified 837 zip codes which overlapped with DAC census tracts using ArcGIS. Within each zip code there may be several sites that have installed renewable energy. Areas with higher overlap between DACs and the zip codes containing sites with renewable energy were considered more suitable since it would increase the likelihood of finding a federal site within the zip code that is near to a DAC. We therefore filtered for zip codes where the percentage overlap was greater than 60%.

Screening for state islanding legality and utility experience within the initial list of 837 zip codes, as well as greater than 60% overlap between the zip codes and DACs, we found that 120 zip codes may offer optimal conditions for using existing renewables on federal sites to support DACs during power outages.

The distribution of the 120 zip codes is concentrated in California, New Mexico and Texas, which matches the abundance of federal sites with renewable energy in these three states. The mapping exercise also revealed that the 120 zip codes tend to be located in rural or less dense areas. This could present a challenge for coordinating disaster relief since the sites could be located far from urban centers where a higher population would need aid. However, during the initial literature review and stakeholder conversations, we found that rural areas tend to be under-resourced when it comes to emergency response, since the response efforts are concentrated in areas of higher population. Federal sites in these locations could therefore have an opportunity to provide aid to communities that have historically received less focus in regional emergency planning.

## Conditions Affecting Site Suitability

We engaged with eight federal agency staff managing or overseeing a total of 18 federal sites located within the zip codes identified during the mapping analysis. This engagement helped us further understand site-level barriers and opportunities. A summary of these site-level conditions affecting whether and how a renewable energy system on a federal site can be used to support community resilience is found in Table 6.

Table 6: Site-level considerations for supporting community energy resilience

| Site Aspect | Considerations |
|---|---|
| Location of solar PV system and equipment | Ground mounted and carport systems tend to have equipment that is easier to access compared to rooftop systems. Accessing the equipment would be necessary during a power outage to turn the system back online. |
| Site security and accessibility | High security and physical barriers to reaching the site present challenges for supporting community resilience, since use cases would likely require at least some coordination with external personnel. Some use cases lend themselves better to sites with higher security, such as hosting communications equipment which could mainly be managed by site personnel. |
| Critical energy needs during outages | Sites with existing critical energy needs, such as data centers and hospitals, may not be as suitable due to more limited energy generation capacity available for supporting community needs during outages. This also depends on the size of the solar system; for larger systems, it may not be as much of a concern. |
| Relationship with surrounding community | A site already conducting community engagement or education activities may be more known or trusted by the community and thus more suitable for providing community resilience support. |

## Concluding Remarks

Utilizing an existing commercial solar system for emergency support to disadvantaged communities (DACs) could potentially address community needs in a more timely manner than other solutions such as microgrids, but this concept has many facets that must be explored to understand its full potential. In this study, we find through the initial literature review and stakeholder conversations that emergency management processes often require coordination with multiple stakeholders at the federal, state and local level depending on the event. Planning and coordination with community-based organizations is critical to ensuring that historically marginalized groups are recognized in energy resilience solutions and that community members actually use the services provided. For this project, conversations with community-based organizations resulted in the important consideration that community members would likely prefer going to a trusted community site than a federal site turned into a resilience hub.

Developing screening criteria for suitable states underscored the importance of interconnection rules and state-level policy for helping communities obtain the benefits of energy resilience solutions without the complexity and cost of a full microgrid. There was also interest from stakeholders in integrating the capability for supporting community resilience into new solar systems that are in the planning process. Pilot or demonstration projects would also help to establish proof of concept and would aid in the development of specifications and guidelines for new solar systems with resilience support capabilities. At the policy level, this could lead to new regulations or considerations for solar siting. Further research could also identify relevant policy recommendations through a broader assessment of state regulations.

The mapping analysis demonstrated that there are numerous - at least 837 - locations across the country where federal sites with existing solar systems are located in or near to disadvantaged communities. In addition, rural communities represent a key opportunity since these areas tend to be underserved by existing emergency management processes yet are also where a significant proportion of the federal sites with solar systems are located. Our findings ultimately highlight the scale of opportunity and several considerations for federal agencies and even commercial entities to support resiliency for DACs, as well as strengthen relationships with their surrounding communities.

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