GUIDANCE FOR

SCALING COMMUNITY RESILIENCE HUBS

IN MICHIGAN

5 lakes energy

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Prepared By

Primary Authors
Moksha Menghaney
Douglas Jester

Contributing Team
Andy Draheim
Rick Bunch
Julielyn Gibbons
Ben Dueweke

About 5 Lakes Energy

5 Lakes Energy is a public-interest consultancy supporting nonprofits, businesses, and government agencies in their pursuit of clean energy goals, design and implementation of climate solutions, and delivery of economic, public health, and other benefits to the people they serve.

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The findings presented in this report build upon the perspectives of a diverse array of stakeholders, including community leaders, frontline organizations, local government officials, and 211 staff. We sincerely thank them for generously sharing their time, insights, and lived experiences throughout this project. Their knowledge has been invaluable in helping us align this work with the real-world needs and strengths of Michigan communities.

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Executive Summary

Michigan residents experience some of the most frequent and prolonged power outages in the United States, with many left without electricity for days during severe weather events. These disruptions pose serious health and safety risks, particularly for residents who depend on reliable electricity to power their medical devices and vulnerable population groups—children, seniors, individuals facing housing and food insecurity, and those living in underserved neighborhoods.

Community resilience hubs—trusted, community-informed physical spaces that strengthen local capacity to prepare for, respond to, and recover from disasters—offer one mechanism to alleviate some of these impacts. These hubs offer programming during blue-sky days or normal conditions to strengthen community capacity, such as food and clothing distribution, legal aid, educational programs, health and wellness classes, emergency preparedness trainings, etc. On black-sky days, i.e., during disaster and power outage events, hubs offer safe, heated or cooled gathering spaces with access to power stations for personal devices and medical equipment charging, distribute food and other emergency supplies, provide refrigerated storage for perishable food and medications, coordinate disaster response with local emergency personnel, and share trusted information about response and recovery efforts. See Michigan community resilience needs for further discussion on risk exposure, vulnerability, and blue- and black-sky programming.

While the concept of community resilience hubs is flexible, hubs anchored in trusted local institutions are best positioned to engage residents and build lasting community infrastructure. Across Michigan, many frontline organizations—food pantries, community centers, places of worship, VFW posts, and nonprofits—already deliver key resilience services. Strengthening their capacity through shared learning, emergency supplies, technical assistance, and investment in resilient infrastructure such as solar, battery storage, and efficiency upgrades can significantly improve local resilience. See Where to site them? for a further discussion for additional guidance on hub suitability and siting criteria.

A networked approach to planning and operating these hubs—connecting multiple small and large hubs within a region—can further amplify impact. The network allows hubs to share information, coordinate programming and fundraising, harvest economies of scale, and distribute services across neighborhoods more effectively. The success of these networks relies on their ongoing engagement, communication, and planning before a disaster occurs, which requires sustained capacity. Philanthropies have expressed interest in funding positions that coordinate such networks at the local and regional levels.

Resilient power systems, such as solar and battery storage systems, are a core component of community resilience hubs. They reduce a hub's operating costs during blue-sky days by exporting excess solar generation and provide backup power during black-sky days, enabling it to continue providing its resilience services. Using the NREL REopt tool, 5 Lakes Energy modeled solar and battery energy storage systems for four common Michigan community resilience hub use cases—food pantries, soup kitchens, small and large community centers, and nonprofit offices. Findings from this technical analysis (see Technical assistance toolbox) include:

- ***Energy demands depend on the hub's ability to cook and serve warm meals, as well as the overall size and hours of operation.*** Hubs with full-service kitchens require significantly more energy due to cooking loads (electricity or gas depending on stove type) and increased HVAC needs. Differences across non-food programming have little impact on overall power needs.
- ***Solar-only systems provide significant utility bill savings and are financially viable across all use cases.*** All hubs should conduct solar feasibility studies and identify opportunities to install onsite solar systems.
- ***Solar and battery storage systems are not typically cost-effective, solely on an energy cost savings basis, in Michigan under current utility rate structures.*** However, when resilience benefits—such as avoided costs from outages—are accounted for, their value becomes more evident.
- ***Battery sizes depend on critical load profiles, solar system size, and outage duration.*** The shape and peak of critical loads—i.e., which appliances or loads require power, when, and for how long—are central to battery design. Sizing also depends on how much of that load solar can meet directly versus what must be stored in a battery. Longer outage durations generally require larger batteries, though sizes tend to stabilize beyond 48 hours.
- ***Resilience optimized batteries are inherently oversized for day-to-day operations and leave financial value on the table.*** These batteries are optimized to meet the maximum electricity demand a hub might have during the outage duration. Existing utility tariffs don't incentivize them to export energy to the grid, and they sit underutilized, with more than 70% charge at least half of the time. Tariff reforms or utility aggregation programs could unlock these stranded value streams and improve project economics.
- ***Alternate front-of-the-meter battery proposal reduces hub capital costs while supporting grid services.*** Under this proposal, the battery remains onsite but is owned and dispatched by the utility for grid services during most times, except storm events when power outages are expected. Then, the battery provides backup power to the hub in exchange for a fixed 'resilience charge.'

Establishing these hubs typically requires a blended 'capital stack' combining grants, loans, tax credits, and private or philanthropic contributions. Successful fundraising depends on aligning the hub's value proposition with the distinct priorities of various potential funders—such as CDFIs, green banks, impact investors, government agencies, foundations, and local donors—by clearly demonstrating how the hub advances systemic resilience, financial sustainability, and long-term community well-being. See Funding community resilience hubs in Michigan for examples on how to frame your hub investment across these different groups.

Most critically, to ensure lasting impact, community resilience hub development must be rooted in local leadership and guided by those most affected by outages and climate-related risks. Meaningful community engagement is essential throughout every stage—from siting and design to fundraising and implementation—to ensure that hubs reflect local priorities, foster trust, and serve the most vulnerable.

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Introduction

The increasing frequency and intensity of climate-related severe weather events are amplifying the stresses on infrastructure capacity, power grid reliability, and, ultimately, public health and safety. An analysis of power outages between 2000 and 2023 by Climate Central found that 80% of all major US power outages affecting more than 50,000 people were due to weather-related events[1]. More than 50% of these were caused by severe summer weather, including high winds, rain, and thunderstorms, while winter weather events, such as snow and freezing rain, accounted for an additional 23%. These trends are worsening; the U.S. experienced approximately twice as many weather-related outages in the final decade of the analysis as it did in the first ten years.

As electricity increasingly becomes essential for fulfilling fundamental human needs, such as food production, clean water, sanitation, education services, health care, and social services, these disruptions are significantly impacting community welfare, necessitating the need to build resilient spaces that support the community before, during, and after such events. In response, many state and local governments are developing programs and resources to facilitate the widespread deployment of community resilience hubs, and we are witnessing their widespread emergence across the US[2]. Notable examples include Baltimore City Community Resiliency Hub Program, Colorado's Microgrids for Community Resilience Program, California's Community Resilience Centers Program, Houston's Resilience Hub Network, and Minneapolis' Resilient Minneapolis Project in partnership with Xcel Energy, among others.

WHAT ARE COMMUNITY RESILIENCE HUBS?

Community resilience hubs are trusted physical spaces that increase a community's capacity to respond to, withstand, and recover from disasters. Informed by community needs and often led by community-based organizations, they serve residents throughout the year by providing essential services to underserved populations, resource distribution, and knowledge sharing. They also help reduce disparities in emergency preparedness by coordinating information flows and providing training opportunities, such as emergency plan development assistance, general emergency preparedness, and multi-party mock disaster tabletop exercises. During and after disasters, they support the community through disaster response, communication, and recovery coordination[3,4]. Resilience Hub Collaborative outlines the multiple benefits a community resilience hub can provide.

No two community resilience hubs are the same. Through their ongoing programming, they can address various physical, ecological, and social goals specific to their community's needs. Common services provided by these hubs include food and clothing pantries, legal assistance with federal programs, utility bills, afterschool programming, internet access, STEM tutoring, ESL classes, financial literacy and wealth-building classes, job training and workforce development programs, mental health counseling and support, addiction support, walk-in clinics, wellness classes, community gardens, green infrastructure demonstrations, temporary sheltering during extreme hot/cold days and so on.

5 FOUNDATIONAL AREAS FOR COMMUNITY RESILIENCE HUBS

The Urban Sustainability Directors' Network (USDN) outlines five foundational areas for community resilience hubs: *resilient services and programming* that build relationships, promote community preparedness, and improve residents' health and well-being; *resilient communication systems,* ensuring the ability to communicate year-around and especially during disruptions; *resilient building(s)* that meets operational goals in all conditions; *resilient power systems that* provide reliable backup during a disruption while improving cost-effectiveness and sustainability of operations; *resilient operations, personnel, and processes* in place to operate the facility year-round and during disruptions.

> *While disaster response and emergency preparedness are essential elements for a community resilience hub, it is the meaningful community engagement and programming that foster trust and build the social adaptive capacity critical to a cohesive resilience strategy. Effective hubs are guided by local knowledge, trusted institutions, and community-defined priorities.*

These hubs generally provide services and programming under two modes of operation: *blue-sky days*, or regular operation days with no significant disruptions to hub power and the ability to serve the community, and *black-sky days*, or rare disaster days with significant disruption to hub power and the ability to provide regular programming. On black-sky days, the hub focus realigns to disaster communication, response, and recovery.

Resilient power solutions, such as solar and battery energy storage systems (BESS), harvest energy cost savings and continue providing services to the community during disasters and power outages. In some instances, communities may decide to have a secondary fossil-fuel-powered generator or an electric vehicle (EV) with bidirectional charging infrastructure to improve the system's ability to power larger loads or serve as a secondary backup during a power outage. A hub's decision to include various technologies is dependent on its environmental, social, and economic goals.

During blue-sky days, these systems provide energy cost savings through solar energy generation and participation in grid management programs for batteries, if available. During black-sky days or power outage events, they provide backup energy generation to power the facility's critical loads, including heated or cooled common spaces, power outlets for charging devices, a few refrigerators, kitchen space (if available), and other essential communication equipment.

Different municipal and state efforts define community resilience hubs differently and support a wide variety of projects through them; for this report, we take a narrow approach. ***Community resilience hubs differ from:***

- ***critical community-serving locations*** such as fire and police stations and hospitals, which are vital for timely disaster response but are generally unnatural places for people to congregate. Additionally, some community members might not feel welcome at these locations or lack trust in these institutions. However, community resilience hubs can alleviate some burdens on the services provided by these critical community-serving locations by promoting better community preparedness and enhancing coordination and communication among mutual aid networks.

- ***emergency shelters or long-term housing solutions*** for those displaced during disasters. While some larger hubs may provide a few cots for first responders, hub coordinators, or vulnerable community members during a crisis, housing individuals is not a primary function of community resilience hubs. Housing insecurity can significantly impact people's ability to withstand and recover from disasters and is an important consideration. However, significant building design, security, programming, and resource demands accompany the provision of round-the-clock shelter and can hinder a location's ability to provide other resilience services to its community effectively. Targeted solutions that provide affordable housing or post-disaster shelters should be developed in coordination with community resilience hubs.

- ***buildings housing vulnerable populations***, such as multifamily units, senior housing, foster care facilities, hospice residences, and correction facilities, which are not designed to serve the broader community. A portion of these buildings, such as a common area, can function as a resilience hub for its residents, where they can receive information and resources during disasters.

While community resilience hubs are an important tool in improving community resilience, they are ***limited in their ability*** to serve people with limited transportation or mobility options or those who are prone to stay put, such as young families, seniors, people with disabilities, and caretakers, or those who can't reach the hub due to downed trees, power lines, impassable roads, and/or other safety concerns related to severe weather (or those that impact the community more generally). Partnerships with mutual aid networks can help identify these community members and mobile resource distribution programs can be expanded or put in place to alleviate some of these concerns. However, this might not always be economically feasible or safe, especially in rural areas, where distances are large. This limitation means we will have to meet some of these vulnerable population groups' needs where they are — through targeted distributed generation deployment and microgrid solutions — which require significant policy changes, capital investment, and time.

Beyond direct impacts due to a weather-related power outage event, an individual can also be exposed to indirect effects due to community-wide power outages of critical infrastructure such as water pumping and sewer stations, or critical community-serving facilities like police, fire stations, and hospitals and priority locations such as grocery stores, urgent care clinics, transit stations, and so on. All of these must be upgraded with resilient infrastructure and power systems to build multiple circles of resilience around an individual. It requires developing a coordinated state and local cohesive resilience strategy, of which community resilience hubs, the focus of this guide, are one prong.

Figure 1 *Community impact of a power outage and the need to develop a cohesive resilience strategy*

The Michigan Context

Michigan ranked second in major power outages between 2000 and 2023. This, combined with Michigan utilities' poor restoration times (ranking fourth worst nationally), means that many Michiganders are without power during severe weather events for much longer than their neighbors in other Midwestern states. Customers of DTE and Consumers Energy, Michigan's largest utilities, were out of power on average for up to 10 and 8 hours, respectively[5]. Under catastrophic conditions in which many electric utility customers lose power, it is common for tens of thousands of customers to be without power for more than 4 days. During the most recent ice storm in Northern Michigan, 34,000 people were without power for more than 9 days[6].

These long-duration power outages have significant health and safety impacts in Michigan. The state has one of the nation's largest populations of electricity-dependent individuals[7]—residents who depend on reliable electricity to power their ventilators, oxygen generators, infusion pumps, dialysis machines, and/or electric wheelchairs, or those who are particularly vulnerable to extreme heat and cold, such as children and the elderly[8,9]. In rural areas with no municipal water lines and people relying on wells and pumps, long-duration outages can severely impact customers' ability to get water for drinking, cooking, flushing the toilet, feeding the animals, and so on[10]. These outages also impact refrigeration and lead to food and medication loss, which can be severely detrimental to the food-insecure[11,12]. According to the USDA, after a 4-hour power outage, refrigerated perishable foods such as meat, poultry, fish, eggs, and leftovers should be discarded[13]. A survey conducted by the Michigan Attorney General of utility customers found that 90% of them "lost between $100 to $500" and 35% "lost between $500 to $1,000" due to a power outage[14]. Some of these costs include hotel charges for those who could afford to relocate during the outage, an option not available to many. Beyond these individual and household-level impacts, power outages can also disrupt public transportation, communication systems, and municipal service provision, creating a cascade of system-level impacts leading to delays in disaster response and recovery.

Michigan communities have started responding to these needs by establishing community resilience hubs. Among the many such initiatives that have emerged across the state, for example, the Eastside Community Network, in partnership with the City of Detroit, Brilliant Detroit, and Elevate, has launched the Resilient Eastside Initiative (see Spotlight one) – a pilot network of hubs designed to support residents during climate-induced emergencies[15]. The City of Ann Arbor has also set up two resilience hubs and is developing two more in partnership with local community-based organizations (CBOs). Beyond these formal initiatives, numerous cornerstone community institutions across the state have been providing resilience services to their residents for years. Strengthening the capacity of these frontline institutions—through technical assistance, investments in resilient infrastructure, and support for collaborative, community-rooted leadership—can amplify their ability to enhance community resilience. The strategy has been gaining momentum, and

Michigan communities have secured more than $80 million in the EPA's Community Change Grants program for community-driven investments across the state, with a significant share of that funding committed to implementing community resilience hubs and resilient neighborhood initiatives[16].

Caption: *Michigan Lt. Gov. Garlin Gilchrist II joined faith and community leaders in Detroit to announce $20 million in grants to create 15 climate resilience hubs throughout the city. Source: Episcopal News Service, Hobson Media Group.*

PROJECT BACKGROUND

The State of Michigan engaged 5 Lakes Energy to develop a guide that fosters the statewide establishment of community resilience hubs. With various states and cities undertaking similar initiatives, a range of resources, including USDN's Guide to Developing Resilience Hubs and C2ES' Resilience Hub Toolkit for a Climate-Ready North Front Range, provide detailed guidance for communities to establish a resilience hub. To avoid repetition and be additive, this document focuses on the Michigan context and provides insights on utilizing solar and battery storage as resilient power systems for community resilience hubs. The following pages outline the resilience needs of Michigan communities, the programming needed to support them, input on building and site considerations, technical guidance on resilient power systems, and funding opportunities. To inform this work, 5 Lakes Energy conducted outreach with community leaders across local governments and community-based organizations through three focus groups and several one-on-one interviews. We also visited the City of Detroit's Community Center at AB Ford (Spotlight four), a participating site in the Resilient Eastside Initiative, accompanied by city staff, and learned about the building's design, program offerings, and project development process. This work, in conjunction with a review of existing hubs, led to the development of four use cases for community resilience hubs in Michigan and a technical analysis for appropriately sizing solar and battery storage systems to meet their electricity needs, which is covered in the Technical assistance toolbox section.

SPOTLIGHT ONE

Resilient Eastside Initiative, Detroit

The Resilient Eastside Initiative (REI) is a network of currently 12 community resilience hubs across Detroit's Eastside, aiming to enhance climate resilience in the face of increasing extreme heat or cold events, flooding, poor air quality, and power outages. These hubs provide essential services, including heating and cooling centers, internet access, transportation services, and the storage and distribution of food, water, and medical supplies during blue- and black-sky days. They also support residents with health and wellness services, assist with accessing disaster recovery resources, such as those provided by FEMA, and offer other social services.

Caption: *Map of 12 sites participating in the Resilient Eastside Initiative*

Launched in 2021 with three hubs through a partnership between ECN, Elevate, the City of Detroit's Office of Sustainability, and Brilliant Detroit, REI officially expanded in 2023 with support from the Kresge Foundation. An ECN-appointed Neighborhood Resilience Manager now coordinates the network and helps organizations scale their impact through streamlined resource sharing, robust wraparound services, and knowledge building.

The network has also leveraged its collective power to apply for grants for technical assistance, feasibility studies, energy efficiency, and solar and storage upgrades. It has also established strategic partnerships with foundations and universities to enhance its capacity for coordinated emergency planning and asset mapping.

Michigan Community Resilience Needs

RISK EXPOSURE

Michigan community leaders rated increased flooding, recurring power outages, extreme heat, winter/ice storms, infrastructure failures, and housing insecurity as their top risks and hazards of concern. Some noted that the loss of roads and downed power lines following extreme weather events significantly slows response and recovery efforts, especially in rural parts of the state. Besides these challenges, communities also reported being increasingly concerned about windstorms, tornadoes, water quality issues, aquifer levels, and wildfire risk in the Upper Peninsula.

Caption: *Flooding in Dearborn Heights in 2021. Source: Junfu Han, Detroit Free Press, Aug 12 2021 (left). Downed power lines block road in Otsego County during the March ice storm. Source: John Russell, Special to The Detroit News, March 31, 2025 (right).*

Apart from weather-related risks, some also raised concerns about increasing social and political risks such as increasing misinformation and disinformation, medical skepticism, and targeting of specific groups such as immigrants with insufficient documentation, members of the LGBTQI community, etc. It affects community cohesion and the sense of safety, thereby impacting disaster response and recovery efforts. Collectively, the increasing incidence of extreme weather events across the state, long-duration power outages, and their ensuing effects on vulnerable populations were among the most cited risk factors.

VULNERABILITY

Michigan community leaders identified a broad swath of socially, physically, and economically vulnerable population groups that need additional support and resources to ensure that response and recovery from extended power outages and other disasters is effective and equitable. Some of these population groups are:

- food insecure
- housing insecure
- seniors/elderly (including those with childcare responsibilities)

- those dependent on durable medical devices such as wheelchairs, hearing and visual aids, oxygenators, dialysis machines
- working families falling under ALICE classification (asset-limited income-constrained employed) i.e., ones who are unable to afford the basics
- single parent households
- essential workers, who are often required to continue their jobs during emergencies
- all-season workers, who often live in substandard housing and are not well integrated into the local community and its communications networks
- people with mobility constraints
- people with disabilities
- socially vulnerable groups such as immigrants, non-English speakers, incarcerated and returning populations, people with mental health challenges, members of the LGBTQ community

RESILIENCE NEEDS AND PROGRAMMING

Michigan community resilience needs are highly diverse, especially during the blue-sky days when there is no power disruption. Many Michiganders already turn to trusted, neighborhood-based frontline organizations for meeting these needs through resource distribution, service provision, and knowledge-building programs. The list below reflects insights shared by these local leaders about the types of services and programming they believe community resilience hubs should offer. While each hub should undertake its own community-driven needs assessment and design process, blue-sky programming may include elements of:

- ***Trust-building and cohesion activities***, such as providing a place to connect, listen to music, read, learn art, and work together. It can also be a space for kids to play and hang out safely, and/or a place to host breakfast days, movie nights, wellness and cooking classes, and targeted programs for vulnerable populations such as people with disabilities, seniors, incarcerated or returning people.
- ***Resource distribution programs***, like clothing drives, formula and diaper banks, providing access to nutritious food and regular meals through food pantries and soup kitchens, and tool libraries.
- ***Technical assistance services and referrals*** for issues relating to high utility bills, legal aid, disaster recovery forms, immigrant services, financial literacy classes, and so on.
- ***Filling gaps in service provision***, such as through Head Start classrooms, afterschool programming, tutoring, walk-in health clinic, workforce development training, mental health support, access to free internet and computers, etc.
- ***Culturally relevant programming***, including ensuring materials are available in multiple languages, English classes for non-speakers (ESL), festival celebrations, culturally appropriate food provision such as kosher or halal meals, etc.

- ***Preparing community for disasters and emergencies***, including CERT training, CPR training, first aid equipment, debris removal training, distributing emergency kits, and so on. Hubs should utilize blue-sky days to develop relationships with emergency personnel and networks of mutual aid organizations to identify what resources are generally available where and how they can be shared. They should identify trusted communicators that can share information with seniors and other people with mobility difficulties in their homes or at places they frequent.

Blue-sky programming helps build trust and familiarity with the space and staff, which is crucial for ensuring that people will utilize the space on a black-sky day. Diverse groups should feel comfortable accessing a particular hub, meaning the programs should be tailored to their specific needs. It requires grounding hub programming in the lived experiences of those most at risk—through active listening sessions, participatory design workshops, and culturally responsive engagement methods.

See Spotlight two for how the Webster Community Center offers programs across health and wellness, youth activities, entrepreneurship, and arts and culture.

- ***Revenue-generating opportunities***, such as space rentals, commercial waste collection, and fee-based programming such as fitness classes or summer camps.
- ***Green demonstration projects***, such as rainwater harvesting systems, heat pumps, EV chargers, composting, etc.
- ***Outdoor programming***, like nature walks, community gardens, outdoor camps, and park cleanups.

Caption: *Blue-sky outdoor programming at Brilliant Detroit Chandler Park. Source: Brilliant Detroit*

While blue-sky programming will naturally vary from hub to hub, ***during a black-sky day*** or a disaster, all community resilience hubs should strive to:

- ***Provide access to well-lit, warm/cool, safe space for ALL people to congregate:*** Increasing weather-related power outage events, coupled with rising energy burdens and housing insecurity, means that many Michiganders are at higher risk of heat or cold

exposure. Cooled/warm spaces at community resilience hubs can provide temporary relief from severe weather for these individuals. A hub should put policies and practices in place that ensure the safety of populations vulnerable to cultural or political backlash and targeting, such as people experiencing homelessness, mixed-status households or people with insufficient documentation.

- ***Provide access to power outlets for people to charge their devices:*** A hub should be equipped with multiple different kinds of power outlets to charge a variety of devices such as phones, wheelchairs, C-PAP batteries, power banks, and so on.
- ***Provide access to refrigerated space to store food and medications:*** Food loss and medication spoilage was the most consistent concern raised by community members and mutual aid organizations. Community resilience hubs should be equipped with refrigerators. These can be either a few standalone refrigerators or a walk-in refrigerator at places with full-service kitchens to provide people with space to store critical perishable items. Locations with no refrigerators can partner with other organizations and private businesses in mutual-aid networks such as a grocery store to share their space with community members temporarily.
- ***Serve warm meals or distribute non-perishable food:*** Nearly 40% of Michiganders live with economic insecurity and rely on resources and services provided by community-based organizations or mutual aid networks to meet their daily essential needs, such as access to nutritious food, healthcare, childcare, and education[17]. Disruption in these services, especially food provision, can significantly impact their ability to recover from disasters and should be maintained as much as possible. Hubs should evaluate their food provision ability, especially if they operate in areas with low fresh food availability (i.e., food deserts), or serve a significant number of food-insecure individuals. Hubs with full-service kitchens such as soup kitchens or large community centers can cook and provide warm meals, whereas smaller locations with small to no kitchen space can distribute catered or boxed meals, or non-perishable items. Food provision can impose significant demands on a hub's building infrastructure, power needs, and

Caption: *First responders in Dearborn distribute free dry ice at the Ford Community & Performing Arts Center to 3,000 residents impacted by power outages and flash flooding. Source: Rodney Coleman-Robinson, Detroit Free Press, Aug 12, 2021*

staff capacity. Thus, it was noted that not all hubs will be able to serve food. As an alternative, they should partner with other hubs that do provide food service and/or local restaurants, coffee shops, taverns, etc. that community members frequent and trust.

- ***Share trusted information about disaster response and recovery:*** A hub should be equipped with robust communication systems such as satellite phones and internet, and radios to communicate with first responders, other hubs, and disaster response personnel for when regular modes of communication are down. A hub should also put programming in place to share all emergency communications and materials with community members in multiple languages and in formats understandable for those who are hearing and vision impaired.
- ***Coordinate disaster response and distribute emergency supplies:*** A hub should have ample emergency resources to share with community members including bottled water, power banks, common medications, and muck-out kits. Larger hubs with space and capacity to host emergency personnel can also act as disaster response centers.

To ensure a smooth transition from a blue-sky to black-sky day, all hubs should:

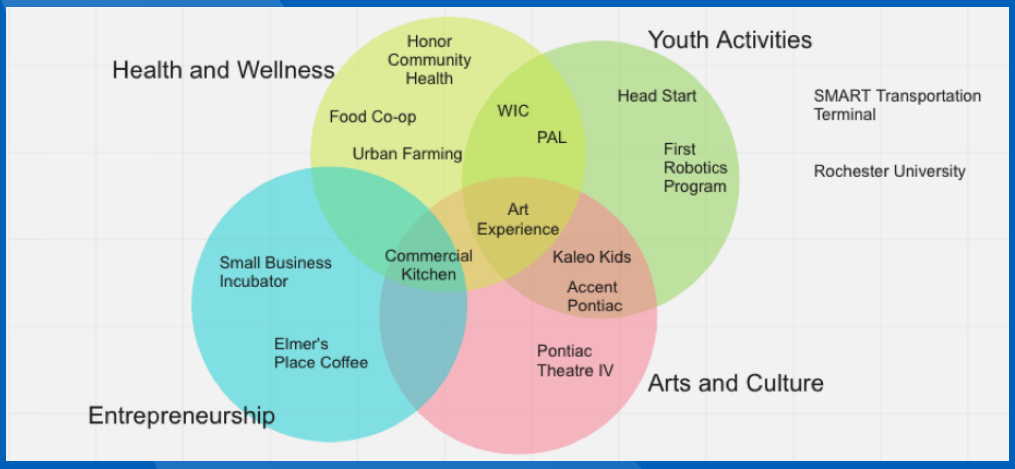
- develop mechanisms for flexibility and nimbleness, such as organizing common spaces for multiple uses and training staff to lead programs on both blue- and black-sky days.
- have trained staff to work with different kinds of groups, including people with disabilities.
- develop a shared understanding with the community of the facility's operations during both blue- and black-sky events, so people know what to expect.
- develop policies and practices to ensure the safety of all people.
- build networks of mutual aid and trusted communicators who know what's available and where.

SPOTLIGHT TWO

Webster Community Center, Pontiac

The Webster Community Center, opening in November 2025 in Pontiac, will repurpose the former Webster Elementary School, which closed in 2007 after serving the community for over 80 years.

It will host 12 organizations, filling many service gaps. Key features include a Federally Qualified Healthcare Center, a Head Start program (OLHSA), free or low-cost youth enrichment programs, adult education and workforce training (Rochester Christian University), a commercial kitchen led by Micah 6 Community to support food entrepreneurs and expand their food distribution into a co-op. These services were shaped by a community survey and engagement conducted before development.



Caption: *Venn diagram illustrating how initiatives intersect across Center's four focus areas. Source: Micah 6 Community*

Location: The Center is neighborhood-based, with many community members living within walking distance. It is also accessible by a major bus route, features an indoor bus stop, and is located near a major thoroughfare.

Funding: The nonprofit has assembled a series of grants, loans, and donations since first announcing the project in 2016, including grants for brownfield cleanup and remediation, a $7.6 million Michigan Community Revitalization Program performance-based loan, a $5 million Revitalization and Placemaking grant from the Michigan Economic Development Council (MEDC) and another $2 million in ARPA funding from Oakland County.

Resilient power system: The hub currently doesn't have solar and battery storage, but has conducted feasibility studies for solar and is planning backup generation to power its kitchen space, healthcare clinic, a bank of refrigerators, and several common areas, which amounts to approximately 50% of the building's load during black-sky days.

Where To Site Them?

Many Michigan community leaders identified existing, well-utilized municipal or community-owned spaces, such as community centers, places of worship, recreational facilities, fieldhouses, food pantries, soup kitchens, and local non-profit offices, as good candidates for siting community resilience hubs in urban areas. For suburban and rural areas where similar mutual aid networks might be sparse, additional recommendations included VFW posts (Veterans of Foreign Wars), American Legion posts, and county buildings. These locations already provide a host of resilience services to their community members. Enhancing their capacity to continue providing these services during black-sky days can strengthen overall community resilience.

In some instances, even community-frequented private businesses, such as the town restaurant or tavern with strong community ties, can be suitable locations for disaster response and coordination, especially given their experience in dealing with different people and serving food. However, it is essential to ensure that all people feel welcome and comfortable accessing these locations during black-sky days.

Schools and libraries, with their proximity to population centers, can also be considered candidates for housing community resilience hubs. Libraries particularly provide numerous resilience services to their communities, especially in rural areas[18]. However, given their existing funding shortfalls and capacity constraints to meet their ongoing programming and needs, communities should consider other locations first. In one conversation, a librarian shared that much of their staff lacked the training to provide hub services during severe weather-related events, and they can't expect all staff to participate in such instances; it would have to be a volunteer effort. Libraries are often shut down during such events to ensure staff safety. A change in these protocols will require significant training, staffing resources, and a cultural shift, which may be challenging to implement.

> *Across all conversations with community leaders, there was less emphasis on who owned the building—whether it was community-owned, a municipal building, or a private business—and more focus on the community's trust in the location, its accessibility and ability to serve community needs, staff availability to provide services in evening hours and during black-sky days, and safety for all groups.*

When assessing multiple sites or identifying locations for a new build, project teams should identify well-known, trusted, neighborhood-based locations with low hazard exposure and high multimodal accessibility, including good walkability, public transit access, ample parking, and proximity to major roads. The buildings should have the necessary facilities to meet community needs and have high renewable energy potential. Before site selection, each community should:

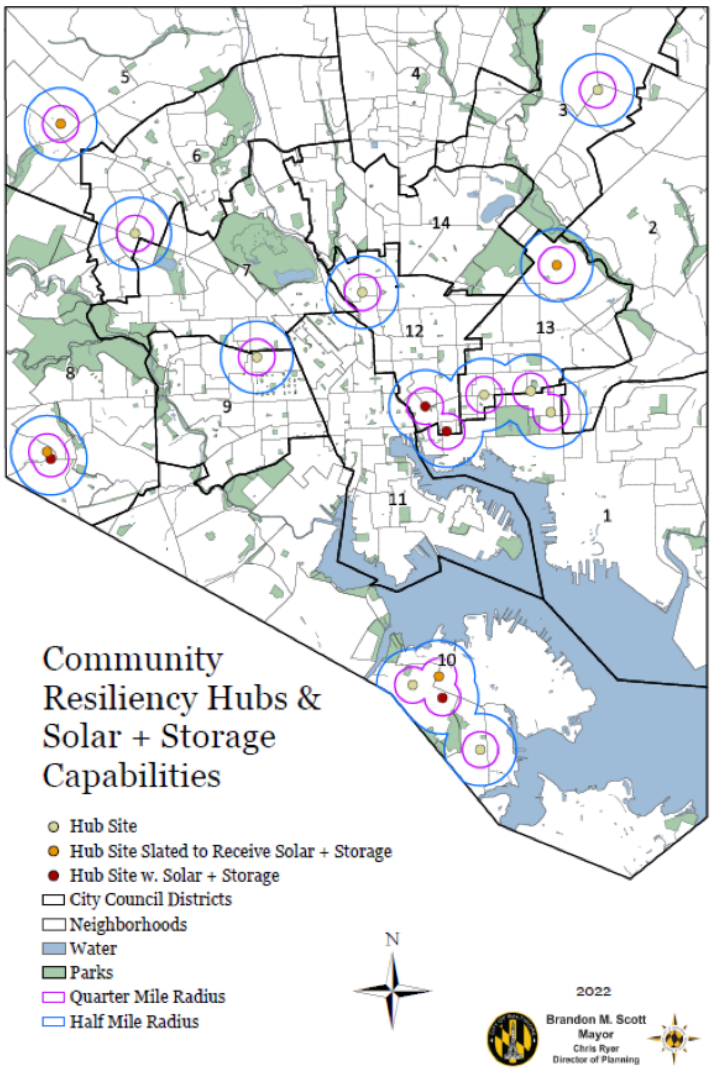
- ✓ identify the hazards they are most concerned about and conduct vulnerability assessments, overlaying them with population density and transportation assets to identify potential suitable site locations. Some communities set accessibility goals, such as within a 15-minute walking distance, 0.25 miles away, or a 10-minute drive for a certain percentage of community members. Towns with high summer tourism and seasonal population fluctuations should account for changing patterns to identify locations where the need will be highest across different seasons.

✓ conduct a site performance assessment determining the building's ability to meet community needs under both blue- and black-sky days.

✓ for installing solar energy systems, conduct roof suitability and solar feasibility studies. Any costs associated with roof upgrades must be taken into consideration before selecting a particular site. Communities should also consider conducting energy audits to identify any opportunities for efficiency upgrades and demand reduction strategies.

While there is flexibility in the types of buildings or organizations that can host a community resilience hub, it is essential to engage community members early on and get their input on site selection and facility design (for new buildings and upgrades) to build trust and develop buy-in. Across all conversations with community leaders, there was less emphasis on who owned the building—whether it was community-owned, a municipal building, or a private business—and more focus on the community's trust in the location, its accessibility and ability to serve community needs, staff availability to provide services in evening hours and during black-sky days, and safety for all groups.

TAKE A NETWORKED APPROACH TO BUILDING COMMUNITY RESILIENCE



Communities have numerous needs, and it can be challenging for a single hub to address them all, even within small communities and neighborhoods. A coordinated network approach to planning and operating community resilience hubs where multiple hubs operate as a part of an ecosystem can enhance resource and knowledge sharing, standardize program design, provide economies of scale for technology upgrades, mobilize funds, and improve disaster response by streamlining communications across hubs and with first responders, emergency personnel, and humanitarian aid workers.

This network can take the form of a **hub-and-spoke model**, like the Houston Resilience Hub Network, where large, central locations like municipal community centers act as the focal point for sharing

Caption: *Baltimore City 2022 community resiliency hub partner locations. Source:* Baltimore Office of Sustainability

SPOTLIGHT THREE

Coordinated response through County Response Consortiums

Gryphon Place 211's Community Resilience Program Manager currently chairs the Kalamazoo County Response Consortium and Calhoun County Response Consortium. These consortiums are local iterations of Voluntary Organizations Active in Disaster: a group of otherwise unaffiliated agency partners who gather regularly to share information, resources, and needs within the community before, during, and after disasters. They have a formal relationship with local emergency management personnel, 211, County, City, and public health departments.

During blue-sky days, they facilitate collaboration across entities and provide emergency preparedness training, both for individual entities and for the network as a whole. During disaster events or black-sky days, the consortium can organize and mobilize volunteers and resources and share trusted information. They currently do not provide direct services themselves or offer any financial management support, such as applying for grants on behalf of their members.

The consortiums were initiated and are currently funded through a United Way grant in response to specific disaster events, recognizing the need for a greater degree of pre-event coordination and collaboration for more effective and efficient community responses to emergencies, crises, or disasters.

Caption: *A team of volunteers in hi-vis vests cleaning up downed trees (left), Staff unpacking a trailer full of donated items to consolidated Donations Management Center. Source: United Way South Central Michigan*

resources and information and coordinating response with other smaller, often community-based super-spots and spots during black-sky days. Alternatively, the Baltimore City Community Resiliency Hub Program takes a **distributed approach**, where community-owned hubs operate independently but partner with the City to receive grant funding and technical assistance for technology upgrades, emergency preparedness supplies, and training. Both enable flexibility and redundancy. The number of hubs in a network depends on the variability and specificity of communities' needs, population density and seasonal patterns, locations of existing hubs, and a hub's capacity to serve these needs.

At least two such efforts are currently operating in Michigan:

- The Resilient Eastside Initiative (REI) in Detroit, is a collective, neighborhood-based approach to addressing climate planning and building resilience by addressing environmental justice issues. The City of Detroit's Office of Sustainability is a partner and owns and operates one of the hubs. Wayne County is also currently planning a network similar to REI on the west side of Detroit.
- The County Response Consortiums (CRCs) in Kalamazoo and Calhoun County, a county-wide effort of otherwise unaffiliated agency partners with a focus to improve coordination during disaster response and recovery.

While both REI and CRCs facilitate collaboration, establish mechanisms for information exchange, and provide emergency preparedness training and support, there are a few differences. REI, with its roots in neighborhood-based planning, focuses on coordinated program development, builds strategic partnerships for capacity building, such as with universities, and applies for grants on behalf of the network members to support technical assistance, feasibility studies, and clean energy upgrades. CRC, on the other hand, focuses on volunteer and resource coordination and currently doesn't support fundraising efforts for upgrades or program development. However, it has more formal ties with local OEMs and the county, which allows for a effective county-wide response.

Like a community resilience hub, there is immense flexibility in how its networks operate. Each hub should evaluate its capacity and the strength of the mutual aid networks within its community to build and participate in similar networks. We recognize it can be challenging to develop such a network across organizations with different missions, operating models, and goals without a designated office, person, or resources. It can become further complicated when the network involves municipal locations and private establishments and requires engagement with local OEMs, 211, county, and city departments.

We recommend engaging a full-time staff member at the network level to coordinate this effort. For Baltimore City, their Office of Sustainability plays this role. Philanthropies have shown interest in facilitating such networks; both REI and CRCs have a full-time Program Manager in this role, currently funded through philanthropic grants. The success of these networks lies in their ongoing engagement, communication, and planning before a disaster occurs, and that requires sustained capacity.

Technical Assistance Toolbox

All community resilience hubs should aim to install resilient power systems, such as solar and battery systems, that can generate cost-savings during blue-sky days and enable them to continue providing resilience services during black-sky days. Hubs can reinvest the cost savings from these systems to enhance their services and programming, reduce bill costs for their energy-burdened neighbors, fund other energy upgrades, and so on.

The technologies included in these systems can vary from one hub to another and from one community to another, depending on their environmental, social, and economic goals. For example, mission-driven organizations and communities with a high preference for meeting their sustainability goals may prioritize clean energy systems with appropriately sized solar and batteries that can meet all their resilience needs. Some might also decide to include solar canopies and EV chargers, while others can invest in EVs with bidirectional capabilities to utilize them as a backup during black-sky days. However, each technology has trade-offs. Canopies and large batteries can become expensive quickly, and utilizing vehicle-to-building capabilities with EVs requires installing bidirectional chargers and additional operational systems. However, EV infrastructure can also provide additional blue-sky services such as rideshares.[1]. Communities with a higher preference for harvesting cost-savings might choose to moderately size their batteries to meet most of their resilience needs and pair them with a fossil-fuel-powered generator to handle larger loads on the rarest days. These generators also require regular maintenance, rely on fuel availability, generate pollution, and can have adverse impacts on public health. Each technology has tradeoffs, and before embarking on designing a resilient power system, each hub should clearly outline and prioritize its objectives for the system.

In this section, we build upon previously outlined Resilience needs and programming and model solar and storage microgrids to power the four most common use cases of community resilience hubs in Michigan. The use cases are primarily delineated across two themes:

- ***Whether the hub can cook and serve warm meals:*** A full-service kitchen that can cook and serve warm meals can significantly alter a building's energy needs. This includes the additional consumption of electricity or gas for cooking, depending on the stove type, as well as increased electricity demand for extra fans and HVAC needed for ventilation and air circulation.
- ***Building size:*** Differences in non-food programming across hubs have little impact on their overall power needs. Instead, building size, hours of operation, and type are the biggest drivers of energy demand. For example, a small hub housed in a place of worship with a few rooms and open spaces, offering limited programming during evening and weekend hours of operation, will have very different energy needs than a repurposed primary school building now serving as a community center where multiple organizations are housed and provide services throughout the day.

Accordingly, the four analyzed use cases for community resilience hubs in Michigan are:

[1] There may be limitations on how EVs can be utilized as a backup source to prevent accelerating battery capacity degradation[19]. While vehicle-to-building or vehicle-to-load capabilities are becoming increasingly available, developing unified standards for vehicle-to-grid technology is currently in its early stages, making it challenging for existing systems to communicate and operate seamlessly with them[20]. Research on vehicle-to-grid technology is rapidly expanding, and there is a need to implement more pilots and large-scale demonstrations, including under resilience conditions, to address some of these barriers. However, given the technology's nascent stage and the associated high upfront costs, it might not be suitable for all community resilience hubs.

Use Case 1 ***Reducing food insecurity through non-perishable food distribution:*** community-owned locations like food pantries that are often housed in small buildings with storage space for dry food and generally don't have full-size kitchens or refrigeration, though they are likely to have a few standalone refrigerators to store small amounts of perishable items.

Use Case 2 ***Reducing food insecurity through regular hot meal service:*** community-owned locations like soup kitchens or private businesses such as the local restaurant in rural areas that have large refrigerators and a commercial kitchen with at least a few stovetops to cook meals.

Use Case 3 ***Fostering community cohesion through resilient community centers:*** community or municipally owned, existing, or repurposed abandoned or new buildings that essentially provide a wide range of programming for different groups, serving the broader neighborhood. These can vary widely in size, ranging from community centers with a few rooms and a small kitchen to primary-school-sized locations with multiple wings, a commercial-sized kitchen, and showers. For technical analysis, two subgroups were evaluated, UC3a and UC3b, corresponding to small and large community centers based on their size.

Use Case 4 ***Improving energy resilience of existing community-service locations:*** government-owned or community-owned administrative offices that provide services to specific groups dependent on their mission, such as young families, young adults, incarcerated or returning populations, veterans, etc. They typically have no kitchen facilities and are housed in small, office-type buildings.

For further details on each use case, its space needs, general blue-sky programming, black-sky functions, see Appendix 1: Use case descriptions. See Table 1 for modeled building sizes, annual electricity usage, and estimated solar and battery storage sizes.

MODELING SOLAR AND BATTERY STORAGE SYSTEMS

A community resilience hub can install an on-site, grid-connected solar[2] and battery storage system with microgrid controls to generate energy cost savings during blue-sky days and backup power during a black-sky day. As previously discussed, hubs can opt to incorporate additional technologies into their resilient power systems. For this analysis, we only focus on on-site solar and battery systems.

During blue-sky days, the system utilizes solar generation to meet its on-site energy needs during the day, charges the battery for evening use or for periods with high-inflow-rate (for customers with time-of-use rates), and sends any excess generation to the grid, thus reducing its overall energy inflows and costs. The battery can then be discharged for self-consumption during evening or high-inflow-rate periods to further reduce the hub's energy inflow and costs. During a black-sky day, the system provides energy to the building or certain critical loads—essential electrical systems that must remain operational to ensure health, safety, and basic comfort—so that the hub can continue providing services to the community.

[2] Subject to 110% of annual consumption and 550kW limits.

We recommend the following critical loads must be powered through the backup generation during a black-sky day:

- ✓ heating and cooling needs for common spaces and a few offices
- ✓ internal and external lighting
- ✓ power for charging multiple devices including phones, power banks, wheelchairs, hearing aids, etc.
- ✓ hot water for restrooms (and showers, if available)
- ✓ power for a couple of standalone refrigerators
- ✓ if the building has a full-service kitchen, additional power for cooking, HVAC, hot water, and large walk-in refrigerators

When the system is providing backup power to the building during an outage, it is vital that it can island itself using microgrid controls according to the utility requirements so that utility staff working to repair the grid outage are not put in danger due to the hub's active power.

MI DISTRIBUTED GENERATION REGULATORY CONTEXT

Solar generation: Michigan utilities offer a distributed generation program for customers who install on-site, grid-connected solar energy systems. These systems may generate up to 110% of a customer's electricity consumption in the previous 12 months and must be no larger than 550 kW[21].

Customers participating in this program are subject to the "Inflow/Outflow" billing mechanism, which determines a customer's bill based on the inflow, or energy drawn from the grid, and the outflow, or the excess energy generated by the system that is not used on-site and sent to the grid. Customers are charged the full retail rate for inflow and compensated for outflow at a lower rate. Outflow credits are based on the power supply component of the customer's retail rate, minus transmission charges. It incentivizes customers to utilize as much of the energy they produce on-site as possible.

Battery generation: There are no restrictions on customers installing on-site battery systems that provide power for self-consumption. Current utility tariffs in the state don't incentivize energy exports from the battery to the grid.

Microgrids: Only single customer microgrids, systems that can isolate themselves from the grid, are allowed in Michigan. Multiple customer microgrids that can isolate themselves from the grid and provide backup power to, say, multiple homes or multi-family units during a disaster aren't allowed under Michigan's current statutory framework[22].

For each of the four use cases outlined, we modeled solar and battery energy storage system single customer microgrids using sample building electricity use profiles and NREL's REopt tool. We optimized the sizes for these hypothetical systems under the following conditions:

1. only rooftop solar systems were included.
2. battery can only be charged from the onsite solar energy system, using excess solar generation. It is not allowed to draw electricity from the grid for charging. Any additional solar energy generated after meeting the building's self-consumption and battery charging can be exported to the grid.
3. during blue-sky days, the battery is allowed to discharge until its state of charge reaches 10%. It means the battery can provide power for self-consumption during evening hours (or periods with high inflow rates) until it reaches 10%, after which it will stop discharging and will wait to be recharged when excess solar generation is available. During black-sky days, the battery can fully discharge and reach 0%.
4. power outages last for 48 hours, meaning the hub is reliant on the modeled system for backup power to provide resilience services for 48 hours.
5. critical loads are estimated to be 80% of the building's total electricity needs. For residential modeling, the critical load percentage is generally much lower, at about 10%. However, in the case of community resilience hubs, one can expect higher usage during a black-sky day, and thus, we set the default critical load percentage at 80%. It is particularly applicable to smaller hubs, which might utilize most of their space as either gathering spaces or office space for disaster response coordination. We also modeled a 50% critical load for large community centers (over 50,000 sq ft), where potentially some wings can be completely powered down during outages.

We tested sensitivities for 24- and 72-hour outage durations, 100% critical load, and grid charging, meaning the battery can charge itself from the grid or from excess solar generation.

Across all modeled systems, we compared the system sizes, their financial viability, and net resilience benefits (or costs). Key findings are:

- Solar-only systems deliver significant cost savings across all use cases and under different utility tariffs. Solar system size is limited by the roof size (for roof-mounted systems) and shading on the property.
- Solar and battery systems are not currently financially viable (based on lifecycle costs and only accounting for energy cost savings) for most systems modeled in Michigan.
- The viability of solar and battery systems improves as one starts to account for the resilience costs and benefits. Resilience costs include microgrid costs estimated at 30% of total system costs. Resilience benefits are quantified using avoided outage costs at $5/kWh. The net resilience benefits-cost-analysis for a modeled system is = system cost + microgrid costs - avoided outage costs.

Caption: *Parishioners and supporters of New Mount Hermon Missionary Baptist Church celebrate the installation of a solar panel system. The church is located in one of the most polluted ZIP codes in Michigan, Source:* Michigan Advance

- Resilience benefits-cost-analysis was positive for multiple use-cases under both 24- and 72-hour outage conditions. For the 24-hour condition, this is primarily due to the lower battery costs resulting from the smaller batteries required to meet resilience needs for a shorter duration. See Table 1 and Table 2 for modeled solar and battery sizes under 48 and 24 hour outage conditions, respectively. For 72-hour simulations, battery sizes stabilize, and the avoided outage costs begin to outweigh the overall system cost.
- Battery sizing is dependent on the:
  - critical load profile that needs to be powered during an outage. Both the shape (when is the peak energy demand in kW) and total energy needed (in kWh) are important. These depend on what systems need to be powered, during what times, and for how long to provide resilience services.
  - percentage of the load served by solar, meaning how much of the peak demand, and total energy can be served directly by the solar generation vs. needing to be stored in a battery to be discharged later.
  - the outage duration, whether the system should last for 24 vs. 48 hours. This generally impacts the battery energy capacity with longer durations leading to higher battery capacity, although we observe sizes stabilizing for outage durations exceeding 48 hours. See below for a discussion of battery power and energy capacity.

UNITS FOR SOLAR (KW) AND BATTERIES (KW/KWH)

Solar systems are rated in terms of their power in kilowatts (kW). It generally refers to their peak output capacity, meaning the maximum power the system can produce in any instant if the panels are receiving peak sunlight.

Batteries are rated both in terms of their power in kilowatts (kW) and energy capacity in kilowatts-hour (kWh). Similar to solar systems, the former measures the maximum power the system can provide at any time. The power rating of your battery will depend on the peak of your critical load profile -- the maximum power you will need to keep all your critical loads running at any time.

The energy capacity measures the total amount of power consumed over time (kWh), basically how long you can power your load. It depends on the power consumed and the outage duration. A higher kWh rating means the battery can store more energy and run load for a longer period before needing to be recharged. Both power and energy capacity are important in determining the appropriate battery size.

For example, a 5kW/10kWh lithium battery can power a 1kW appliance for 10 hours or a 5kW appliance for 2 hours. Battery costs are proportional to both battery power capacity (quoted as $/kW) and battery energy capacity (quoted as $/kWh).

- Battery sizing results were similar for powering a 100% load during a 24-hour duration vs. powering 80% of the load during a 48-hour outage, indicating that for similar costs, a hub can improve its capacity to serve the community longer by reducing its overall critical load.

- Optimal battery power rating and energy capacity sizes indicated a duration range from 7 hours to 14 hours.
- Battery sizes optimized for resilience performance are generally oversized compared to a building's needs under blue-sky days. That's primarily because they are optimized to support the peak critical loads that a building might need during a power outage (the maximum electricity demand a building might have) for the outage duration. That increases battery costs; however, as these batteries don't export energy to the grid (current tariffs don't incentivize it), they are underutilized. Opportunities should be developed to leverage the value batteries can provide to the grid and improve their financial viability. Across all use cases, batteries optimized for 48-hour outages with an 80% critical load had a median state of charge of over 70%. This means that more than 50% of the time, the batteries were at least 70% charged. See Appendix 2: Technical analysis results for the distribution of battery state of charge for both 24- and 48-hour simulations.

Table 1: Optimal solar and battery sizes to meet 80% critical load during 48 hour outage across use cases

	UC1: Reducing food insecurity through non-perishable food distribution	UC 2: Reducing food insecurity through regular meal service	UC 3a: Fostering community cohesion through *small* community centers	UC 3b: Fostering community cohesion through *large* community centers	UC 4: Improving energy resilience of existing community-service locations
In layman terms	Food pantry	Soup kitchen	Small community center	Large community center	Local non-profit office
Building size (sqft)	4,000	15,700	8,600	53,000	2,140
Has a kitchen?	No	Yes	Yes	Yes	No
Roof size (sqft)	2,388	10,800	4,410	35,760	780
Annual electricity usage (kWh)	30,000	141,700	52,000	430,000	15,300
Solar size (kW)	20	108	44	358	8
Battery power (kw)	10	23	14	115 (69 for 50% load)	10
Battery energy (kWh)	67	190	156	1334 (457 for 50% load)	143

KEY TAKEAWAYS FOR DESIGNING RESILIENT POWER SYSTEMS

Takeaway 1: Establish environmental, social, and economic goals that you are trying to accomplish through the resilient power system. We assume all systems will provide a certain level of resilience (addressed in takeaway 4 through 6) and minimize lifecycle costs for the system that best achieves its goals. Each hub should engage its staff, partners, energy advisors, and community members in conversations that can answer questions like: do we want to maximize reducing our utility bills, or do we want to maximize community resilience benefits, or do we want to install a full clean energy system and demonstrate multiple clean energy technologies, do we have blue-sky needs that the system can support such as EVs for rideshares or resource distribution programs, and so on.

Takeaway 2: Prioritize your goals and identify the appropriate technologies for your resilient power system. Commonly used technologies in this context are onsite solar (roof- or ground-mounted) and battery energy storage systems, EVs with bidirectional charging capabilities, and fossil-fuel-powered generators.

- Despite their limited resilience benefits, solar-only systems deliver significant cost savings and should be actively considered as a tool to reduce a hub's operating costs. All community resilience hubs in Michigan should conduct solar feasibility studies and identify opportunities to install onsite solar systems.
- For backup power, as previously mentioned, battery storage systems, EVs, and fossil-fuel-powered generators can all provide backup power to the hub during power outages; however, each has its own tradeoffs. While battery storage systems can have significant upfront costs, fossil-powered systems create pollution and provide intermittent service. They often require regular maintenance and can also be costly to maintain and operate. Integrating Utilizing EVs with bidirectional capabilities as a backup requires the installation of a bidirectional charger and may add operational complexities. However, given they also provide transportation services during blue-sky days, their additional benefits can justify the upgrades. Some communities may decide to include more than one of these, or they may already have one and want to supplement it.

Takeaway 3: Reducing overall energy demand and peaks is the best way to reduce energy inflows and system costs. All community resilience hubs should conduct energy audits to investigate opportunities for energy efficiency upgrades and demand reduction.

Takeaway 4: Identify critical loads that must be powered during outages. Critical loads and their shapes, meaning what appliances and services must be powered and at what times to effectively provide resilience services, primarily drive battery power capacity (kW) and costs. Each hub should outline its resilience needs and map them to relevant load profiles.

Takeaway 5: Establish an outage duration target for which the hub should provide resilience services. Battery energy capacity (kWh) and associated costs are proportional to the outage duration for which the system is expected to power critical loads. In modeled solar and battery storage systems, battery sizes started to stabilize for durations longer than 48 hours, meaning there were small differences in a system designed to provide services during 48 vs 72 hours of power outage.

Takeaway 6: Develop a load management plan. There is a tradeoff between hub critical loads and target outage duration. By reducing the services provided, a hub can enhance its ability to provide reduced services for a more extended outage. All community resilience hub operators

should engage with their staff, partners, energy advisors, and community members to develop a load management plan during power outages. It should identify prioritize identified critical loads, and outline load reduction strategies for longer-than-expected outages. It can include strategies such as powering down a portion of the building for a few hours, setting the thermostat higher to reduce AC usage, or closing the hub for a few hours in certain instances, thereby helping to design a system that can continue to provide basic services for longer durations.

AN ALTERNATIVE BATTERY OWNERSHIP PROPOSAL

The solar and battery systems evaluated in the previous section are modeled as onsite behind-the-meter systems, where the building owner, host, or a third party that leases the system to the host owns the system. Under this ownership model, the host reduces its energy inflow from the grid by directly utilizing solar generation, plus storing some in the battery for later use and earning credit for any excess generation. As previously discussed, the battery isn't incentivized to export energy to the grid and is an underutilized resource.

Proposal: We propose an alternative model where the battery system is still installed onsite but as a front-of-the-meter system, where the utility owns the battery. In this instance, the utility will be able to operate the battery as a grid resource and charge and discharge as needed at all times, except during storm events when power outages are expected. See Figure 2 for an illustrative comparison of the two systems.

In return, community resilience hubs would pay a fixed charge to the utilities for battery resilience services. The hubs would continue to own and operate behind-the-meter solar systems to reduce the building's energy costs.

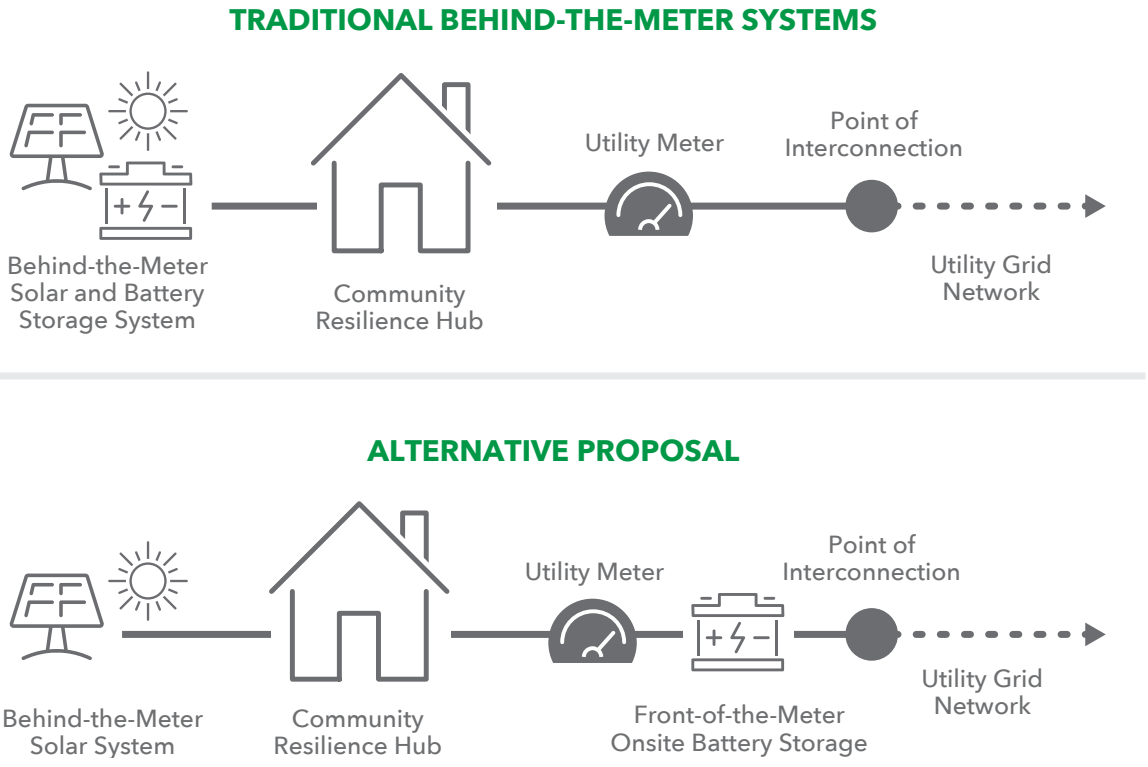


Figure 2: *Behind-the-meter vs alternative proposal system design*

Question: *Why will utilities be interested in this proposal?*

Answer: PA 235 requires that Michigan utilities deploy 2,500 MW of battery energy storage with a minimum of 4 hours duration by 2030[23]. We expect utilities to meet a big portion of this goal through utility-scale projects. We propose a portion could be deployed through distributed resources, such as in front of the meter of community resilience hubs, where they can continue to provide both grid and resilience services. The 'fixed charge' that the hubs will pay for resilience services will reflect the incremental cost of owning and operating distributed battery systems compared to a centralized battery, so it will not come as an additional cost for the utilities.

Question: *Why will the community resilience hubs be interested in this proposal?*

Answer: Unfortunately, the distributed generation policy landscape in Michigan doesn't incentivize batteries to export energy to the grid and improve their financial viability. With uncertainty surrounding battery costs due to tariffs and supply chain concerns, the 'resilience service for a charge' model may be the only financially viable option available under the current policy landscape for many potential hub sites.

Question: *What about third-party DER aggregators?*

Answer: Michigan utilities participate in MISO markets, which won't be ready for the participation of third-party DER aggregators until 2030[24]. Utilities can create their own aggregation programs in the meantime, and our proposal will effectively serve as that.

Question: *What is the anticipated 'fixed charge'?*

Answer: Calculating the differential between the incremental cost of owning and operating distributed batteries vs a centralized battery will require utility expertise and input.

Question: *Can the 'fixed charge' be socialized?*

Answer: Potentially, given that community resilience hubs will serve the community. However, how those costs will be socialized without placing an additional burden on those who are already overburdened is an open question and warrants discussion.

SPOTLIGHT FOUR

Community Center at AB Ford Park, Detroit

The Community Center at A.B. Ford, owned and operated by the City of Detroit, is an 8,600-square-foot recreation facility located on a 34-acre park site. It serves the Jefferson Chalmers neighborhood—a community grappling with recurring basement and street flooding, aging infrastructure, exposure to poor air quality from nearby industrial corridors, and the ongoing impacts of decades of systematic disinvestment.

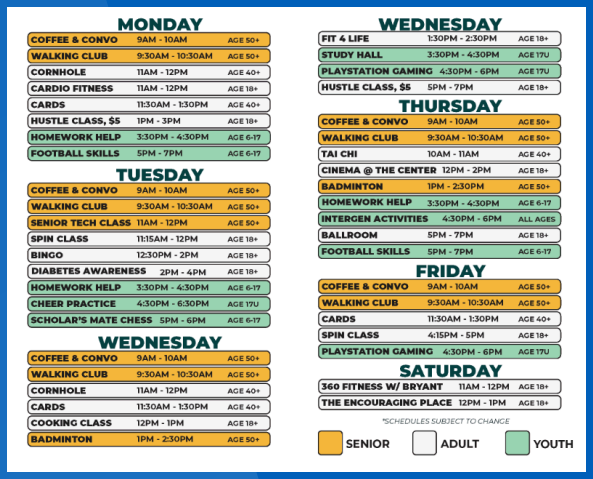
Site and building features: The new building replaces an old community center that sat vacant for a decade. It includes

- a living room/library area with a fireplace,
- a multipurpose kitchen lab/classroom,
- multiple community meeting spaces,
- a large multipurpose recreation and event space with windows overlooking the Detroit River and park,
- indoor and outdoor restrooms
- green stormwater infrastructure

Caption: *One of the multi-purpose rooms that can be used for event rentals, community meeting space, fitness classes, disaster coordination and response. Source: City of Detroit*

The space is ADA accessible and has a large vehicle turnout, allowing buses and minivans to drop off nearby living seniors and children at the hub. The project team initially evaluated retrofitting the existing building, but after extensive facility assessment and a new FEMA floodplain designation, it ultimately decided to build a new structure at the highest point on the site.

Blue-sky programming: The Center offers a range of programs for seniors, adults, and youth aligned with blue-sky themes outlined in Resilience needs and programming, many at low or minimal cost. See right for a sample of their offerings. Additional revenue comes from space rentals, photo shoots, and guided tours. It is a founding hub of the Resilient Eastside Initiative (REI) and actively collaborates with local mutual aid networks on emergency preparedness and neighborhood resilience.



MONDAY

COFFEE & CONVO	9AM - 10AM	AGE 50+
WALKING CLUB	9:30AM - 10:30AM	AGE 50+
CORNHOLE	11AM - 12PM	AGE 40+
CARDIO FITNESS	11AM - 12PM	AGE 18+
CARDS	11:30AM - 1:30PM	AGE 40+
HUSTLE CLASS, $5	1PM - 3PM	AGE 18+
HOMEWORK HELP	3:30PM - 4:30PM	AGE 6-17
FOOTBALL SKILLS	5PM - 7PM	AGE 6-17

TUESDAY

COFFEE & CONVO	9AM - 10AM	AGE 50+
WALKING CLUB	9:30AM - 10:30AM	AGE 50+
SENIOR TECH CLASS	11AM - 12PM	AGE 50+
SPIN CLASS	11:15AM - 12PM	AGE 18+
BINGO	12:30PM - 2PM	AGE 18+
DIABETES AWARENESS	2PM - 4PM	AGE 18+
HOMEWORK HELP	3:30PM - 4:30PM	AGE 6-17
CHEER PRACTICE	4:30PM - 6:30PM	AGE 17U
SCHOLAR'S MATE CHESS	5PM - 6PM	AGE 6-17

WEDNESDAY

COFFEE & CONVO	9AM - 10AM	AGE 50+
WALKING CLUB	9:30AM - 10:30AM	AGE 50+
CORNHOLE	11AM - 12PM	AGE 40+
CARDS	11:30AM - 1:30PM	AGE 40+
COOKING CLASS	12PM - 1PM	AGE 18+
BADMINTON	1PM - 2:30PM	AGE 50+

WEDNESDAY

FIT 4 LIFE	1:30PM - 2:30PM	AGE 18+
STUDY HALL	3:30PM - 4:30PM	AGE 17U
PLAYSTATION GAMING	4:30PM - 6PM	AGE 17U
HUSTLE CLASS, $5	5PM - 7PM	AGE 18+

THURSDAY

COFFEE & CONVO	9AM - 10AM	AGE 50+
WALKING CLUB	9:30AM - 10:30AM	AGE 50+
TAI CHI	10AM - 11AM	AGE 40+
CINEMA @ THE CENTER	12PM - 2PM	AGE 18+
BADMINTON	1PM - 2:30PM	AGE 50+
HOMEWORK HELP	3:30PM - 4:30PM	AGE 6-17
INTERGEN ACTIVITIES	4:30PM - 6PM	ALL AGES
BALLROOM	5PM - 7PM	AGE 18+
FOOTBALL SKILLS	5PM - 7PM	AGE 6-17

FRIDAY

COFFEE & CONVO	9AM - 10AM	AGE 50+
WALKING CLUB	9:30AM - 10:30AM	AGE 50+
CARDS	11:30AM - 1:30PM	AGE 40+
SPIN CLASS	4:15PM - 5PM	AGE 18+
PLAYSTATION GAMING	4:30PM - 6PM	AGE 17U

SATURDAY

360 FITNESS W/ BRYANT	11AM - 12PM	AGE 18+
THE ENCOURAGING PLACE	12PM - 1PM	AGE 18+

*SCHEDULES SUBJECT TO CHANGE

SENIOR ADULT YOUTH

Caption: *Sample A.B. Ford blue-sky programming. Source: City of Detroit*

Black-sky services: The space features multiple rooms where different groups can congregate, multiple power outlets for charging devices, ample restrooms with ADA access, a kitchen equipped to serve catered meals, and refrigerators for storing medications and perishable items. The park staff is experienced in working with various groups. The hub has satellite internet connectivity and can serve as a disaster response center for FEMA and the Red Cross during disasters, coordinating with other hubs.

Resilient power system: It hosts 68.9 kW of rooftop-mounted solar and 110 kW/220 kWh battery energy storage. The project team utilized technical assistance from Elevate and the Clean Energy Group's Technical Assistance Fund to conduct system feasibility assessments and provide construction oversight and support.

Caption: *Project partners on the roof of the A.B. Ford Community Center. From left to right: Patrice Brown, City of Detroit; Tim Skrotzki, Elevate; Shawna Forbes Henry, Elevate; Maria Galarza, City of Detroit; Rebecca Serrano, Michigan Climate Corp Fellow. Source: City of Detroit*

Funding: The General Motors Climate Equity Fund covered the cost of the solar and storage system, and the City covered the building construction costs, with partial funding provided by the Jefferson Chalmers area Strategic Neighborhood Fund (SNF), which in turn received a large donation from the corporate donor, Penske Corporation.

Funding Community Resilience Hubs In Michigan

Establishing a community resilience hub is an investment that will – for most organizations – require several sources of funding to accomplish. Organizations that wish to establish hubs in their communities will need to develop individualized financial plans (or "capital stacks") for their projects that reflect the resources available to them based on their missions, location, organizational type (i.e., local government, Tribe, nonprofit, etc.), and financial capacity. A very simplified example of a capital stack for a project is: 50% grant funds, and 50% loan funds.

There are many different sources of 'capital' that may be able to contribute some form of funding to a capital stack for a hub. These could include community lenders like CDFI's, state or local incentive programs, green banks, tax credits, philanthropy, and more. See Spotlight TWO for how Webster Community Center put together grants, loans, and donations to repurpose an abandoned primary school into a multi-use community center. When considering and engaging these sources, it is important to remember that these community resiliency hubs deliver myriad benefits, any one of which may be of interest to funders, depending on their missions. For example, community resilience hubs:

- Contribute to a more equitable transition to a clean-energy economy and carbon neutrality, which are important to climate and environmental justice organizations.
- Advance community health and safety during power outages and other emergencies, which may attract healthcare funding.
- Enhance the host's underlying blue-sky community services (e.g. childcare, education, food distribution) by keeping them running during outages and delivering energy savings that can be reinvested in core programs, aligning with many mission-driven philanthropies or community lenders.

When approaching any of the sources described below, it is beneficial to consider how you frame and communicate your proposed hub investment as an important contribution to their mission, vision, and values (which you can generally find on their website).

The following summarizes some of the sources that community resilience hubs can consider in assembling resources for their projects.

Community Lenders (e.g., Local credit unions, Community Development Financial Institutions (CDFIs))

What they care about: Risk-mitigated, place-based investment with measurable community benefits.

How to speak to them:

- Stress the hub's physical asset value and potential to stimulate local economic activity.
- Highlight job creation, local procurement, and any ownership models (e.g., cooperatives, hub networks, shared governance).
- Be specific about repayment sources, blended financing strategies, and community-based revenue streams.

"This hub creates both social and economic returns - from reducing household energy burdens to catalyzing local employment pathways in clean energy and disaster preparedness."

Example: The express purpose of Community Development Financial Institutions (CDFIs) is to provide credit and financial services to underserved markets and populations with a focus on the kind of services and programs offered at community resilience hubs. The Michigan CDFI coalition is a great place to start finding a CDFI that is mission-aligned with your organization.

Importantly, CDFIs are target lending institutions for the green capital that was allocated through the IRA's Greenhouse Gas Reduction Fund (GGRF), a $27 billion total federal outlay to spur investment in clean-energy/climate-resilience projects in low-income communities. Unfortunately, the current federal administration has frozen the GGRF funding that was expected to support CDFI green lending. The awardees of that funding are challenging the administration in the courts. If they are successful, CDFIs will gain access to an influx of capital to support projects like hubs. Either way, building a relationship with an appropriate CDFI for your project is a good strategy.

Private Capital / Impact Investors

What they care about: Return on investment (financial and/or impact), innovation, scalability.

How to speak to them:

- Emphasize energy infrastructure (solar + storage), grid services, or EV infrastructure as revenue-generating components.
- Frame your project as a pilot or template for broader resiliency strategies.
- Clarify measurable impact metrics—GHG reductions, resilience benefits, avoided costs.

"This hub combines clean energy infrastructure with community emergency preparedness education—offering an investable climate adaptation strategy with measurable returns."

Example: Michigan is home to the nation's first nonprofit green bank, Michigan Saves, which the state government helped to establish and capitalize. Through its various programs, Michigan Saves can help hub hosts access low-interest financing for clean-energy and climate-resilience investments. For example, it has a bridge financing program to help tax-exempt entities take advantage of federal direct-pay Investment Tax Credits (see Government Grants below), which project owners do not receive for several months after their construction work is completed. Additionally, Michigan Saves is a sub-awardee for a significant amount of the GGRF capital described under Community Lenders above.

Government Grants / Public Programs

What they care about: Policy alignment, public good, compliance, community engagement

How to speak to them:

- Highlight alignment with state and federal priorities (e.g., Justice40, clean energy demonstration and education, extreme heat reduction).
- Emphasize broad community participation, cross-sector collaboration, and data-informed resilience planning.
- Speak to your capacity to deliver services to historically underserved populations.

"We're delivering direct benefits to priority communities while meeting the goals of climate adaptation and equitable service access under state resilience frameworks."

Examples: As mentioned above, a significant amount of federal funding for grants, loans, and other financing tools has been frozen by the current federal administration. The following are some of the most promising government grants and programs for hubs that are currently available (or soon will be) and have not been targeted by termination efforts (at least yet). Run by the Michigan Municipal League, MI Funding Hub is a comprehensive searchable database to help you research other such opportunities as they emerge. Another resource is the MI Healthy Climate Challenge, through which the state will launch competitive grant opportunities aimed at accelerating clean energy deployment, enabling investments in low-income communities, and expanding community access to climate-related funding.

- **MI Solar for All.** The State of Michigan was awarded a $155 million grant through the federal Solar for All program, which is also a component of the $27 billion GGRF mentioned above. MI Solar for All will support investments in residential and community solar projects that deliver major benefits to low-income Michigan households. While it made pilot grants available in Spring/Summer 2025, most of these funds will be re-granted by the State in 2026. Based on the anticipated design for that re-grant program, MI Solar for All should present a very promising opportunity to secure funding for solar installations, battery energy storage systems, and roof repairs/other "enabling upgrades" at resilience hubs.
- **Direct-pay Investments Tax Credits (ITCs).** The IRA established extended ITCs for certain clean-energy investments (including solar and storage systems) to tax-exempt entities like nonprofits, Tribes, and local governments. With a base credit of 30% and potential "adders" based on the location and nature of the project, this program involves a "direct payment" from the IRS to the tax-exempt project owner. To receive the payment, eligible projects must follow applicable IRS regulations and file a tax return (along with other registrations). Importantly, projects do not receive the credit for a matter of months after completing the project (see comment above on a program Michigan Saves offers to help "bridge" that time gap in financing). The Michigan Infrastructure Office provides free technical assistance on direct-pay ITCs to Michigan organizations and Lawyers for Good Government has a particularly comprehensive resource center on the topic.

- **Other rebates and incentives.** Effective and professional clean-energy contractors generally help their customers maximize use of other financial incentives—provided by government agencies, energy utilities, and others—for investments that support the energy resilience of hubs. Be sure to ask those bidding on your project for their knowledge of programs to make your project more financially advantageous.

Philanthropy (e.g., family foundations, community foundations, mission-based regional and national funders)

What they care about: Community impact, equity, systemic change, sustainability, and their established missions.

How to speak to them:

- Show how your hub addresses issues that they support (food security, community health and wellness, community economic development, equity, climate justice, etc.)
- Emphasize long-term community resilience (and benefits) for funders with a place-based focus.
- Frame your project as a model for replicable change and community empowerment.
- Offer clear metrics for community engagement and outcomes.

"Our resiliency hub is a place-based solution to systemic risk—where climate resilience, energy savings, and urgently needed community services meet in a single neighborhood asset."

Example:

- **Philanthropies with strong, local ties:** The Kresge Foundation, a long-standing charitable institution in Southeast Michigan, emphasizes investments in cross-sectoral programs to promote and expand long-term, equitable opportunities in Detroit. It has collaborated with the city, neighborhood-based organizations, and clean-energy nonprofits to develop the Resilient Eastside Initiative, a network of resilience hubs designed to strengthen neighborhood infrastructure and climate preparedness. In a similar vein, United Way of South Central Michigan, a deeply community-embedded organization with a mission to foster flourishing lives for all, leveraged its strong regional partnerships and proven capacity to mobilize local dollars to establish the United Way Disaster Relief Fund during the Covid-19 pandemic to support working families. This fund now sustains the Community Resilience Program Manager at Gryphon Place, who coordinates the Regional Response Consortiums in Kalamazoo and Calhoun counties—advancing preparedness and rapid response across the regions. Identifying and building relationships with similar funders who serve your community may lead to support for your project.
- **National, clean-energy focused organizations:** The Clean Energy Group (CEG) through its Technical Assistance Fund (TAF) has awarded more than 180 technical assistance and capacity building grants totaling $2 million to support community-based organizations serving low-income, environmental justice, and historically underserved communities. These grants help local organizations develop resilient power solutions—such as solar and battery storage systems—for critical service providers that are especially vulnerable during power outages. Beyond funding, CEG offers targeted, one-on-one technical assistance to strengthen community understanding of resilient energy systems and assess project feasibility. This program is an excellent resource for organizations looking to establish a community resilience hub.

Local Residents / Grassroots Donors

What they care about: Local pride, trust, tangible impact.

How to speak to them:

- Focus on storytelling and lived experience: how this hub will protect, uplift, and unite.
- Emphasize shared ownership, participation, and visibility in the space.
- Offer ways to donate, volunteer, co-create.

"This is our community's safe haven and gathering place, powered by clean energy and built with our own hands and dreams."

Examples: The type of organizations who establish their facilities as community resilience hubs tend to be highly resourceful in raising funds to fund the vital services they offer their communities. Their existing generous supporters often will strongly consider a special one-time donation to support a capital investment that will strengthen the organization's programs and deliver long-term savings in low energy bills. In fundraising parlance, such an effort is sometimes referred to as a capital campaign. It gives community members the opportunity to participate and claim a stake in an exciting hub project that will benefit them and their neighbors. As another example, many faith-based organizations or houses of worship borrow money from their members/congregants to cover capital projects. Even in resource-constrained communities, local residents may embrace the opportunity to make a small contribution to the development of this vital community asset. It never hurts to ask.

> *In Michigan, the recently launched Michigan Climate Investment Hub (MCIH, referred to as the Hub henceforth) is a resource for communities and organizations looking to deploy climate and clean energy dollars, for initiatives like community resilience hubs. As it begins its work, the Hub is focused on engaging and educating stakeholders, identifying investable projects, and surfacing aligned sources of capital. They will be a resource to support navigation of the broader climate finance landscape and serve as a connector between local initiatives and potential funding partners. To connect with the Hub, please email connect@miclimatehub.org.*

An update on federal funding and related programs: Through the Inflation Reduction Act (IRA) and other legislation passed earlier this decade, Congress authorized billions of dollars in grants, loans, and other financing tools to support investments in clean-energy and climate-resilience projects (with an explicit focus on low-income communities in many cases). Measures recommended in this Guide are/were eligible for many of these programs.

At the time of this writing (June 2025), however, attempts by the current federal administration to freeze/terminate much of this funding were undermining the promise of this generational investment in community resilience, wealth, and safety. In the preceding paragraphs, we highlighted programs that could provide an unprecedented influx of support for developing community resilience hubs if allowed to move forward. In doing so, we indicate those that appear on track to survive the current challenging circumstances and should be available soon (e.g., MI Solar for All) and those whose fate is less certain and rests in the hands of the federal courts (e.g., other Greenhouse Gas Reduction Fund programs).

Looking ahead, it's important to recognize that while recent federal action was designed to jumpstart investment in climate resilience and clean energy in low-income communities, the scale of need across Michigan still far exceeds the funding currently available. Long-term success will require building strong local partnerships, developing technical and administrative capacity, and assembling flexible capital stacks from a diverse array of funding sources. Organizations pursuing community resilience hubs should view current opportunities as catalytic while also investing in the relationships and capabilities necessary to sustain and grow this work for years to come.

Appendix 1: Use Case Descriptions

This section details the four use cases for community resilience hubs utilized for technical analysis. Each use case focuses on different blue-sky programming; however, during black-sky days, ***all community resilience hubs should:***

- provide access to a well-lit, heated, and cooled gathering space for a few hours' use that is equipped with restrooms.
- provide access to power for charging their phones, medical devices, etc.
- have resources to distribute emergency supplies such as power banks, common medications, and bottled water.
- be equipped with robust communication systems such as satellite phones and radios for when existing modes of communication are down. These systems will allow hub staff to receive and share trusted information with first responders, other hubs, and key personnel involved in disaster response.
- be equipped to receive and share trusted information with their community, ideally in multiple languages.

Some hubs may provide additional black-sky functionalities depending on their capacity. Examples of these are included below, along with each use case. See Resilience needs and programming for a comprehensive discussion of blue- and black-sky needs and programming.

How to translate these use cases to real community resilience hubs? Many hubs offer a wide variety of services and might span across multiple use cases. In that instance, pick the one that best represents the hub's regular function. Let's assume the hub is a place of worship serving as a soup kitchen in a central location in the neighborhood where the community naturally congregates. If the hub primarily cooks and serves meals more than three to four times a week with limited programming outside of that and weekend hours, refer to Use Case 2. However, if it primarily acts as the de facto community center with multiple programs and meal service a couple of times a week, then refer to Use Case 3a as a small community center.

Use Case 1: Reducing food insecurity through non-perishable food distribution

Summary: These community-based locations contribute to reducing food insecurity primarily through dry and non-perishable food distribution, such as via a food pantry. They are often housed in small buildings with storage space for dry food and generally don't have commercial-size kitchens or refrigeration, though they are likely to have a few standalone refrigerators to store small amounts of perishable items. These locations often provide a variety of assistance-based programming to address the root causes of food insecurity and poverty. They partner with other community-based organizations and participate in mutual aid networks. During disasters, they enhance resilience through existing service provision, distributing emergency resources, sharing trusted information, and assisting in disaster recovery efforts.

Space features: Most floor space is used for food storage, staff offices and a few common spaces for people to sit and congregate.

Blue-sky uses: Their programming often includes:

- dry food distribution
- warm lunch/breakfast service once or twice a week, often through catering or small kitchen preparation
- food delivery for homebound seniors and those with mobility difficulties
- assistance with government benefits, housing, healthcare enrollment, legal aid, etc.

Additional black-sky uses:

- a refrigerator to store medications
- distribute catered meals
- coordinate response and recovery efforts with other hubs

Critical power loads: Common space heating and cooling needs, internal and external lighting, multiple charging points, hot water for restrooms and kitchen, standalone refrigerators for perishable food storage and medications.

Use Case 2: Reducing food insecurity through regular meal service

Summary: These community-based locations contribute to reducing food insecurity primarily through regularly serving warm meals, such as via a soup kitchen. They are often housed in buildings with a full-sized or commercial kitchen with at least a few stovetops to cook meals. Depending on the kitchen size, their refrigeration needs might range from a few standalone refrigerators to large-scale walk-in refrigerators. These locations are often housed in places of worship or similarly affiliated buildings and provide weekend and evening programs. They partner with other CBOs and participate in mutual aid networks. During disasters, they enhance resilience through existing service provision, distributing emergency resources, sharing trusted information, and assisting in disaster recovery efforts. Larger locations can also support disaster coordination and response efforts.

Space features: Floor space is used for food preparation and storage, staff offices, and a few common spaces for people to sit, congregate, and eat meals. Large soup kitchens might have a restaurant-style setup with a large area for people to sit and comfortably eat.

Blue-sky uses: Their programming includes

- cooking and serving warm meals a few times a week
- food pantry operations once or twice a week
- food delivery for homebound seniors and those with mobility difficulties
- culturally relevant weekend or evening programs
- depending on their capacity, can also include assistance with government benefits, housing, healthcare enrollment, legal aid, etc.

Additional black-sky uses:

- access to common space where people can eat warm meals

- depending on the kitchen size, access to standalone refrigerators to store medications or in larger kitchens access to cold storage to store food and avoid food loss
- coordinate response and recovery efforts with other hubs

Critical power loads: Common space heating and cooling needs, internal and external lighting, multiple charging points, hot water for restrooms and large kitchen, refrigeration for large-scale food storage, small refrigerators to store medications

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Use Case 3: Fostering community cohesion through resilient community centers

Summary: These can be newly built, existing, or repurposed abandoned, municipally owned, or community-owned community centers that provide a wide range of programming for different groups, essentially serving the broader neighborhood. These can widely vary in size and range from centers with a few rooms and a small kitchen to a secondary-school-sized location with multiple areas, a commercial kitchen, and showers. They provide several community-based, culturally relevant programs and partner with local community-based organizations for service provision and resource distribution. They often demonstrate climate mitigation and adaptation strategies such as bidirectional EV chargers, rainwater harvesting, urban gardens, etc. Owing to their centrality and broader community use, during disasters, these locations often serve as emergency coordination, response, and recovery centers. They coordinate efforts with emergency personnel and larger response organizations such as the Red Cross and FEMA while sharing information with other neighborhood resilience hubs.

Space features: Floor space usage is highly dependent on the building size, but generally, smaller centers include a few rooms for different uses, such as a computer lab, a wellness room, and a small kitchen.

Larger community centers often include multiple areas for different organizations, a common space with a commercial kitchen for meal preparation, multiple restrooms, a few showers, and a large entryway. To improve mobility options, some can feature an indoor bus stop, bike or car share parking, EV charging stations, and so on.

Blue-sky uses: There is a wide range of programming that can be provided at these locations. Some examples include:

- fostering healthy eating through cooking demonstrations, nutrition classes
- improving health through wellness classes, lead abatement classes
- fostering entrepreneurship through coaching, space for hosting small businesses, workforce development classes
- programs for kids and youth such as after school and sports-based programming
- arts and cultural programming
- technology classes
- outdoor programming such as on urban agriculture, composting
- assistance-based programming such as food pantry, formula and diaper bank, etc.
- often also have revenue collection programs such as providing space rental for community events, waste collection and management services

- filling existing gaps in municipal service provision such as by providing space for Head Start classrooms or hosting a walk-in clinic run by a local Federally Qualified Health Center
- preparing the community for black-sky days through CERT training, resilience planning, DIY and tool demonstration classes, CPR and first-aid.

Additional black-sky uses:

- access to a safe, well-lit area for disaster coordination and communication with emergency responders and other community locations
- at larger centers, access to common space where people can eat warm meals, use showers, provide overnight shelter to a few people such as first responders and disaster coordination staff
- depending on the kitchen size, access to standalone refrigerators to store medications or, in larger kitchens, access to cold storage to store food and avoid food loss
- lead response and recovery efforts with other hubs

Critical power loads: Disaster coordination and common space heating and cooling needs, internal and external lighting, multiple charging points, hot water for restrooms (and showers) and large kitchen, refrigeration for large-scale food storage, small refrigerators to store medications

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Use Case 4: Improving energy resilience of existing community-service locations

Summary: These government-owned or community-owned administrative offices provide services to specific groups dependent on their mission, such as young families, young adults, incarcerated or returning populations, veterans, etc. They generally have no kitchen and are housed in small office-type buildings. They participate in mutual aid networks but might not have the capacity to actively participate in disaster coordination and response. They do, however, provide support during disaster recovery.

Space features: Most floor space is used for office staff, few common areas or meeting rooms and storage space for supplies.

Blue-sky uses: Their programming often includes:

- targeted programs such as reentry programs for incarcerated populations or career coaching or workforce development for young adults
- assistance with government benefits, housing, healthcare enrollment, legal aid, etc.

Additional black-sky uses:

- a refrigerator to store medications
- depending on capacity, coordinating disaster response and recovery with other hubs

Critical power loads: Common space heating and cooling needs, internal and external lighting, multiple charging points, hot water for restrooms, standalone refrigerators for medications

Appendix 2: Technical Analysis Results

Table 2: Optimal solar and battery sizes to meet 80% critical load during 24 hour power outage across use cases

	UC1: Reducing food insecurity through non-perishable food distribution	UC 2: Reducing food insecurity through regular meal service	UC 3a: Fostering community cohesion through *small* community centers	UC 3b: Fostering community cohesion through *large* community centers	UC 4: Improving energy resilience of existing community-service locations
In layman terms	Food pantry	Soup kitchen	Small community center	Large community center	Local non-profit office
Building size (sqft)	4,000	15,700	8,600	53,000	2,140
Has a kitchen?	No	Yes	Yes	Yes	No
Roof size (sqft)	2,388	10,800	4,410	35,760	780
Annual electricity usage (kWh)	30,000	141,700	52,000	430,000	15,300
Solar size (kW)	20	108	44	358	8
Battery power (kw)	10	22	13	105	10
Battery energy (kWh)	45	136	59	523	66

Table 3: Battery state of charge distribution under 24 hour outage, 80% load conditions

	UC1 (10 kW /45 kWh)	UC2 (22 kW /136 kWh)	UC3a (13kW /59 kWh)	UC3b (105 kW /523 kWh)	UC4 (10 kW /66 kWh)
Min	0.10	0.10	0.10	0.10	0.10
25th Percentile	1.00	0.50	0.48	0.48	0.60
Median	1.00	0.75	0.73	0.74	0.85
25th Percentile	1.00	0.94	0.94	0.93	1.00
Max	1.00	1.00	1.00	1.00	1.00
% times SOC > 25%	99.2%	89.8%	88.8%	89.4%	94.9%

Table 4: Battery state of charge distribution under 48 hour outage, 80% load conditions

	UC1 (10 kW /67 kWh)	UC2 (23 kW /190 kWh)	UC3a (14kW /156 kWh)	UC3b (115 kW /1334 kWh)	UC4 (10 kW /143 kWh)
Min	0.10	0.10	0.10	0.10	0.10
25th Percentile	0.58	0.54	0.55	0.55	0.92
Median	0.81	0.78	0.77	0.78	1.00
25th Percentile	0.95	0.93	0.92	0.93	1.00
Max	1.00	1.00	1.00	1.00	1.00
% times SOC > 25%	95.6%	94.6%	95.3%	95.5%	99.1%

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