

Increasing Resilience of Vulnerable Communities by Actively Managing Local Distributed Energy Resources in Buildings and Vehicles

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- Sonoma Clean Power Authority
- County of Mendocino
- County of Sonoma
- Regional Climate Protection Authority
- University of North Carolina – Chapel Hill

Technology Description: This proposed distributed energy resource (DER) management strategy applies advanced data analytics and automation techniques to better manage technology resources to improve grid resilience and equity for communities-at-risk of weather-caused power outages.

This strategy will coordinate data across a repository of sub-hourly electric meter data, demographic information, risk assessments, and techno-economic attributes. It will identify local communities of Sonoma Clean Power (SCP) customers in Mendocino and Sonoma Counties that are at heightened risk of power outage due to Public Safety Power Shutoff (PSPS) events, weather-based power outages, or other emergencies and have high social vulnerability, low community resilience, or any other disadvantages as indicated by designations such as Opportunity Zones. The strategy then evaluates the potential resilience values of the existing and planned portfolio of distributed energy and resilience resources in these communities, and engages in a community-driven planning process to determine how these resources should be managed to maximize community benefits before, during, and after PSPS events and other outages and emergencies. Finally, the community-designed resilience measures are implemented by utilizing and expanding existing digital integration channels from SCP's demand-response and energy efficiency programs, which enable real-time data processing and control of portfolios of DERs in the community as a resilience-optimized "virtual power plant".

The management strategy's portfolio approach allows participation from different customer types such as dedicated public-access resilience centers and electric vehicle (EV) charging infrastructure, commercial buildings typically utilized for other purposes, multi-family housing units, and single-family homes. Modular design empowers SCP customers with EVs, EV charging stations, rooftop solar systems, battery storage, smart thermostats, or other smart appliances to automatically prepare for, react to, and recover from PSPS events, weather-based power outages, and other emergencies.

The combinations of compatible technologies and eligible demonstration sites described above enable use-cases such as the following which will be contemplated in the community planning process: (a) Charging battery storage and electric vehicles more rapidly and more fully in advance of a PSPS or forecast weather event so that transportation energy services and vehicle-to-load applications are available during the outage; (b) Pre-loading the thermal mass in buildings using smart thermostats and water heaters prior to an event so that buildings remain comfortable and safe for longer periods; (c) Isolating grid-tied rooftop solar systems with storage in order to power their host buildings during an outage, charge vehicles, and keep critical needs such as communications and medical devices online; (d) Positioning mobile devices, such as vehicles or portable batteries, at target locations in response to events.

There are several reasons why this proposed management strategy is unique. Sonoma and Mendocino counties are subject to a disproportionately high risk of natural disasters and related emergencies that can burden and traumatize residents. Sonoma and Mendocino counties have a higher Federal Emergency Management Agency (FEMA) risk index, 99% and 97% respectively, than other counties in the United States – primarily due to risks from wildfires. California has implemented measures to mitigate the risks of wildfires to residents, including California Public Utilities Commission (CPUC) fire risk designations, Self-Generation Incentive Program (SGIP) resilience track, and PSPS events.

PSPS events are weather-driven and yet highly planned and structured outages, which requires resilience strategies in a way that grid outages caused directly by natural disasters do not. A large number of the customers that are de-energized are not themselves at risk of the event that is causing the de-energizing condition, and the events themselves have a common structure and advanced notice period. Over 135,000 Sonoma Clean Power customers have experienced more than 360,000 outages as a result of PSPS since they began in 2019. 86% of outages caused due to PSPS events have affected residential customers. 17% of the residential outages affected low-income customers, and 5% of the residential outages affected medical baseline customers who rely on electronic medical devices for their survival. 18% of SCP customers receive income-qualified bill assistance (over 42,000 homes), and 4% are enrolled as a medical baseline, meaning they have a medical device which relies on electricity (over 9,000 homes).

Implementing this management strategy through SCP's Community Choice Aggregation (CCA) business model is a unique way for local communities to exercise control over the resilience characteristics of their energy source. CCAs often enable a relatively high penetration of DER and can manage customer-sited DER through demand response and actively managed energy efficiency, electric transportation, and battery storage programs. However, CCAs do not operate lines and wires, so they share the customers' perspective on grid outages.

This proposed management strategy is innovative because it uses a portfolio approach to coordinate a wide variety of existing resources for resilience to discrete events. The strategy seeks to integrate electric vehicles, building thermal mass, and load-shifting as energy storage resources coupled with behind-the-meter and distribution-scale, and transmission-scale solar photovoltaic and battery storage systems. It also contemplates simple inverter, electrical panel, and charging station configuration and upgrades to existing photovoltaic and electric vehicle systems to enable off-grid islanding during grid outages and load shifting before and after outages, and evaluates the potential of portable solar-powered EV chargers and batteries. In addition, it allows identification of priority areas for future deployment of distributed energy technologies in resilience centers and vulnerable homes on sections of the grid at higher risk from these events.

Level of Performance: A successful implementation of this management strategy will supplement a high proportion of disconnected load during PSPS events and reduce downtime for customers with high energy burdens (high percentage of income spent on energy costs). The project should result in increased consumer awareness of the benefits of DER, knowledge of incentives available toward adoption of DER, increased consumer confidence in the availability and reliability of DER, and an increased adoption rate of DER in vulnerable communities. The project also aims to evaluate the best use-case for DERs when not deployed for emergency situations to promote equitable access to community resources.

State-of-the-Art: Resilience is being valued in different ways which implicate utilities, customers, and wider groups differently. Some locations have adopted metrics such as value of lost load, avoided economic losses or damages, and valuation methods that incorporate health outcomes. Equitable approaches based on energy burden are missing from grid resilience discussion and research. There is a need to understand who is affected by outages, by how much, and how those distributions affect marginalized communities in order to determine what

actions can be taken to reduce inequities in extreme weather events and build community-scale resilience.

To date, most DER and resilience education campaigns have not focused on outreach to underrepresented and lower income communities, and behind-the-meter resources are rarely coordinated with emergency response. Around 11% of registered plug-in vehicles in Sonoma and Mendocino counties are connected to compatible smart chargers. Previous approaches have not effectively addressed consumer reluctance to fully electrify homes and vehicles due to concerns about PSPS events and ability of current electricity grid to handle increased loads from electrification. Vehicle to building use cases are not incorporated into adoption and charging infrastructure decisions due to current technical limitations. Most approaches do not investigate how different technology needs affect the resilience value and availability of electricity. Transmission and distribution utilities do not have an obligation to provide resilience services to customers affected by unreliability of the grid. Effective management and deployment of DERs to provide an energy reserve of at least several hours' duration can fill this service gap for customers. The cost of resilience is most often borne by the property owner in need of the resilience service, and there are no widely accepted formal approaches for community investment in cooperatively owned and operated DER to provide resilience services.

Feasibility: As the local public power provider, SCP aims to emphasize energy equity as a primary consideration in resilience-driven DER management by assembling a team consisting of the county governments in its service territory, a local authority with transportation-specific expertise, and an academic research institution with knowledge of the state of the art in this field. Together, this team has the unique ability to bring together local stakeholders for the community planning process phase, model the impacts of potential management strategies, integrate program design into existing emergency response measures, demonstrate the resulting management strategy across a portfolio of existing assets, monitor the strategy at a high level of granularity, and rigorously evaluate its design and efficacy throughout the project.

SCP's current programs interface with over 180 MW of grid-tied solar PV across 20,000 installations, 26 MW of stationary battery storage across 2,200 installations, 600 smart thermostats, 40 smart water heaters, 1,500 electric vehicle chargers, and 900 households which are willing to manually shed load as part of demand response events. Existing technology integrations for these assets enable this portfolio of DERs to be available for active resilience management and more complex actions as described in this proposal based on original equipment manufacturer (OEM) settings.

Risks & Impacts: Proactively demonstrating the use of innovative technology and approaches can increase community resilience during PSPS events. Intelligently deploying and managing DER technologies throughout affected communities can reduce impacts on vulnerable customers during emergency situations by enabling core public services, such as emergency services, to remain online. This management strategy could mitigate the financial and other socioeconomic costs of the PSPS policy and serve as a framework for developing response strategies to other related risks.

This proposed management strategy supports SCP's purpose as a public agency as formed by local government partners, which includes the provision of electric power, the development of local DER, and the promotion of resilience. Most SCP-contracted energy supply cannot be transmitted or distributed to customers when the grid is down, and SCP does not

operate transmission or distribution infrastructure itself, so SCP has an interest in giving customers access to clean DER when grid-based energy is not available. Much of this demand will otherwise be served by fossil fuel combustion generators, or not met at all.

The proposed management strategy will support Sonoma County's goal to achieve carbon neutrality by 2030 by increasing the value of DER for the community. Also supported will be Mendocino County Board of Supervisor's Resolution No. 21-117 declaring its intent to reduce and eliminate the carbon footprint of buildings and operations of the County of Mendocino.

The proposed management strategy will also help inform local policy on building electrification and electric vehicle charging infrastructure. With the release of the 2022 update to the California State Building Code, local jurisdictions are considering reach codes that will go beyond what will be required when the new code goes into effect in January 2023. The community planning sessions made possible by the grant will ensure that the needs of underserved communities are understood and factored in to the policy making process. SCP's exploration of new technologies will provide important information on the feasibility of and barriers to wider deployment of these technologies and identify ways that local policy could facilitate deployment.

We foresee management logistics for integrating different technologies as a potential obstacle, especially when community engagement identifies a valuable use of a technology that may not yet be possible to automate. Adoption of the strategy among existing DER-owners may also be an obstacle: while many high-risk customers are wealthy enough to deploy technologies in isolation, this opportunity will enable local focus on community resilience. Instead of these technologies being installed with low resilience value (e.g., net-metered standalone solar PV) or underutilized (e.g., an industrial microgrid that could support the surrounding community's needs during an emergency, but has no plan to do so), these technologies and applications can be enhanced for resilience applications.

Funding will connect local planning efforts to each other within the two-county service territory on a vital issue. SCP, the local energy service provider, will be included in existing planning & deployment efforts and supported in monitoring and evaluating resilience capabilities among its members. With funding, the team will be able to demonstrate and test the capabilities of these technologies. A key focus will be supporting community planning sessions and focus groups, made possible by funding. Funding will encourage a focus on underserved communities by removing barriers to participation associated with the profit motive and other resource-limited perspectives.

Addendum (Project Team): The Principal Investigator is Sonoma Clean Power Authority (SCP). SCP is a public agency dedicated to supplying clean energy to electricity consumers in its service territory in Mendocino and Sonoma counties (excludes the cities of Healdsburg and Ukiah which have their own local municipal electricity supply). SCP generates electricity for 229,000 customer accounts, sets generation rates, bills generation charges, and manages energy use data including advanced meter data. SCP procures energy from a variety of clean sources such as hydropower, geothermal, solar, and wind, including procuring 50 MW of geothermal and 6MW of solar from within SCP's service territory. With a high penetration of DER enrolled in SCP's services, data and varying levels of control for the following technologies is available: behind-the-meter solar PV, behind-the-meter storage, utility-scale solar PV, utility-scale storage, electric vehicles, EV chargers, thermostats, heat pumps, and heat pump water heaters. SCP interfaces directly with PG&E before, during, and after PSPS events regarding number of customers affected and de/re-energization plans and timelines. SCP has adequate access to the equipment and facilities necessary to accomplish the strategy through its existing programs and technology integration service providers.

County of Mendocino: The County of Mendocino delivers services that meet public safety, health, social, cultural, education, transportation, economic and environmental needs of its community of approximately 90,000 residents. The General Services Agency will coordinate participation for the County of Mendocino, which will span across other County departments and divisions, including Emergency Services, as needed.

County of Sonoma: The County of Sonoma's 26 departments/agencies provide a full range of services to its community of roughly 500,000 residents. The new Climate Action and Resiliency Division within the County Administrator's Office will coordinate participation for the County of Sonoma, which will span across other County departments and divisions, including Emergency Services, as needed.

Regional Climate Protection Authority (RCPA): RCPA was formed in 2009 through locally sponsored State legislation to coordinate countywide climate protection efforts among Sonoma County's ten jurisdictions and multiple agencies. RCPA fosters collaboration, helps to set goals, pools resources, formalizes partnerships, and works across policy areas to address the local government role in reducing greenhouse gas emissions and building climate resiliency. RCPA aims to create local solutions to complement State, Federal, and private sector actions – all showing that a better future with lower emissions is possible.

University of North Carolina – Chapel Hill: The Sustainable and Resilient Energy Group studies energy systems at multiple scales, from regional and international power grids to community-owned micro-grids and household energy dynamics. The group's work examines the relationship between energy systems, low-carbon development, and human health through peer-reviewed research.

County of Sonoma and County of Mendocino are member counties of SCP. SCP and RCPA have worked together on a number of projects and programs related to the development of climate action strategies and plans; building and transportation electrification; and community education and engagement on climate related topics. SCP is currently hosting a graduate of the Sustainable and Resilient Energy Group from the University of North Carolina – Chapel Hill to study energy burdens and DER across its service territory.