DOCKETED	
Docket Number:	19-ERDD-01
Project Title:	Research Idea Exchange
TN #:	240647
Document Title:	Berkeley Lab's ETA Program Development Office Comments - Staff Workshop on Valuation of Electricity Sector Resilience
Description:	N/A
Filer:	System
Organization:	Berkeley Lab's ETA Program Development Office
Submitter Role:	Public Agency
Submission Date:	11/19/2021 2:57:07 PM
Docketed Date:	11/19/2021

Comment Received From: Berkeley Lab's ETA Program Development Office
Submitted On: 11/19/2021
Docket Number: 19-ERDD-01

Staff Workshop on Valuation of Electricity Sector Resilience

Please see attached document.

Additional submitted attachment is included below.

BERKELEY LAB
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November 19, 2021

Laurie ten Hope
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

Re: Lawrence Berkeley National Laboratory Comments on forthcoming solicitation regarding research on valuation of investments in electricity sector resilience

Laurie ten Hope,

On Friday, November 5th, Commission staff hosted a workshop regarding research on valuation of investments in electricity sector resilience, which focused on seven specific discussion questions. Berkeley Lab is pleased to present our comments in response to the aforementioned discussion questions.

Peter Larsen, Nichole Hanus, and Kayiu Sun - researchers in the Energy Technologies Area at Berkeley Lab - participated in the workshop that took place on November 5th and provided a variety of comments. Berkeley lab will summarize those comments here as well as provide additional comments.

1. **What research approaches are needed to measure societal impacts and benefits of energy resilience, with a particular focus on Disadvantaged Vulnerable Communities (DVCs)?**

As part of value and resilience work, Berkeley Lab proposes to update the existing ICE Calculator, a tool to estimate the cost of power outages, by conducting a series of values of loss load studies to improve estimates. One measure of the value of resilience is the economic impact of a power disruption *avoided* due to a proposed investment in resilience. First, value of lost load surveys of utility customers, to assess resilience posture and impacts of power interruptions, need to be designed and administered to a representative sample of customers living across California. The surveys need to collect information about (1) economic costs of shorter duration power interruptions (< 24 hours), including whether advanced notice was given; (2) ability to maintain electricity service during the interruption (e.g., backup generator and available fuel) and shift production of goods and services to other times or places; (3) income levels; and (4) other useful information. Next, the results from these surveys should be used to calibrate a regional economic model to estimate the impacts of longer duration, more widespread power interruptions. A new disadvantaged community outage economic impact index could be developed using, among other things, the ratio of the costs of power interruptions to income levels as reported via the surveys.

Additionally, Berkeley Lab comments that while preventing blackouts altogether is infeasible, new technologies make it possible to provide limited emergency backup power to sustain critical

services. Society's willingness-to-pay to assure that some power remains available during widespread and long-duration power outages should be a key input to determine how much, if any, investment in resilient electric systems is socially justified. Understanding the economic costs of power interruptions is important, but public decision-making also requires an understanding of how much people will support critical social services and their vulnerable neighbors more resilient to widespread and long-duration power outages (Baik et al., 2020). Policy analyses that sum individuals' willingness-to-pay to meet private demands may underestimate the value that society places on resilient electric services during widespread and long-duration power outages if individuals express preferences for directly or indirectly supporting their communities. Thus, the value of supporting their communities more resilient above and beyond individuals' power interruption costs need to be further explored.

Berkeley Lab also suggests that an integrated systematic approach is needed to consider risk exposure, population dynamics, mitigation strategies, and damage assessment. Outcomes should be actionable and inform policies (e.g., utilities, codes and standards, government actions/programs).

2. **What type of skills, competencies, and expertise should the research team demonstrate, particularly for research that prioritizes DVCs?**

Berkeley Lab comments that multidisciplinary skills are needed including building science, HVAC, data analytics, modeling and simulation, sensing and metering, human behavior science, community engagement, policy, codes and standards.

Berkeley Lab suggests that research teams be able to demonstrate how existing environmental justice and equity screening models can be improved to better capture vulnerabilities associated with climate impacts and energy infrastructure. Depending on the project, these teams should be diverse enough to incorporate experts who can develop these screening models, as well as experts who can work locally with DVCs in stakeholder outreach and project implementation.

Furthermore, one question Berkeley Lab would like to consider is who pays for these resilience investments and the equitable distribution of them? Once we can understand the problem and define some metrics we can start to think about solutions. Having someone with a good understanding of business models would be useful to think about who's going to pay for this. Do we spread this across the rate base? What would be some issues doing that?

3. **This upcoming GFO prioritized DVCs among other ratepayers. (i) Should this research focus on specific geographic locations and areas? At what scale (neighborhood, zip code, county, region, etc.)? (ii) What types of weather-related events should this research focus on? (iii) What types of climate-related impacts and social vulnerability factors should be considered? (iv) Are there other considerations we should be aware of to help maximize benefits to DVCs?**

This research could build on existing state models such as CalEnviroScreen, to couple common metrics for identifying and characterizing DVCs (e.g. income levels, local air pollution), with metrics that may be tied to or exacerbated by climate-related impacts now and in the future. For example, smoke from wildfires worsening pollution concentrations in areas that currently have higher exposure to unhealthy concentrations. These vulnerability studies could be coupled with assessments for how state-wide and local adaptation measures improve local DVC resilience.

Berkeley Lab suggests setting up transparent and quantitative criteria for selecting DVCs. Multiscale may be needed: city block for actual actions recommendations, larger scales for policy analysis and directions**.** Research should focus on weather related events such as extreme temperature events, wildfires, droughts, and flooding as well as the climate-related impacts and social vulnerability factors associated with extreme indoor temperatures, human health/death, property damage, and business loss. More specifically, this research could focus on the extreme weather events that are California-specific and generate corresponding scenarios as inputs to the resilience valuation and assessment. These events could include wildfire, extreme heatwave, flooding and drought (w.r.t hydro-generation), etc. This research could also consider the available remedies for the DVCs to maximize the resilience benefits, e.g. access to the distributed energy resources that provide critical backup power during extreme events and public safety power shut-up (PSPS) events.

To help maximize benefits to DVCs, Berkeley Lab suggests considering climate justice, human behaviors and factors, access to resources, and education.

4. **Which existing frameworks or metrics for Valuation of Resilience should be considered for this research?**

Berkeley Lab is pioneering new techniques to estimate the value of resilience via the Power Outage Economics Tool (POET) project with Commonwealth Edison. The method (i.e., framework) being employed in the POET project is based on a recent publication (Baik et al. 2021) and earlier research (e.g., Larsen et al. 2019).

Additionally, USDOE BTO is funding a tri-lab project to develop a standardized methodology to value energy efficiency for energy resilience. Final report will be available in June 2022. Tianzhen Hong is the LBNL PI of the project.

5. **Please provide feedback on the following: (a) Which of the following should be included in the scope of the research? (ai) Past historical weather-related events prior to the project timeframe; (aii) Analyzing data from impacts of events during the project timeframe? And (aiii) A combination of the above? (b) What data should be collected? (d) What types of metrics should be established? (c) Beyond metrics, what characterizations of resilience should this research focus on?**

Berkeley Lab comments that, both historical and future extreme temperature events should be considered. Joint probability of extreme weather events and power outages should be

calculated and analyzed to provide a basis for economic impact analysis of such low probability large impact events. Additionally, the scope of the research should consider the duration and intensity of the extreme weather events and power outages, populations impacted, number of lives lost or hospitalized, property damage, and business lost.

In the context of the national infrastructure bill and federal funding, scoping this in a way that estimates the value of resilience broken down by different types of society ratepayers and taxpayers, might be useful. Some of these resilience strategies have benefits that may go beyond the utilities or the state of California. If Federal Government funds resilient infrastructure, we need to-know investments that would be covered by ratepayers versus those covered by taxpayers.

6. What aspects of resilience should this research focus on?

Resilience research can focus on extreme temperature events (especially heat waves) and wildfires in California that lead to power outages and large-scale impacts.

It's critical to combine grid resilience with extreme weather events. For example, when there's a heat wave coupled with a power shutdown, it's particularly dangerous to vulnerable populations who live in buildings with poor performance and have less resources for self-adjusting. In this case, cooling centers become critical infrastructure to mitigate the health hazard of the vulnerable population when shelter-in-place is not a safe option for them. Therefore, Berkeley Lab identifies the following research topic: identifying the optimal location of a cooling center within a disadvantaged community. This relates to (1) evaluating the heat vulnerability through vulnerability mapping within a disadvantaged community to identify which areas are the most vulnerable spots. That would be a key factor contributing to the determination of the optimal location of a cooling center. And (2) evaluating the indoor environment of the buildings to determine if the residents in the building need to be sheltered in place or if they really need to be evacuated to the Cooling Center or somewhere else. This is another important input regarding which areas are in higher needs of cooling centers.

7. What research is needed to guide efforts to identify and provide resilience for critical services in under-resourced communities?

This research could:

- Explore the potential mitigation actions that enhance the resilience performance of the DVCs during multiple stages of the extreme events, such as pre-, during, and post-events remedy actions. For instance, the data-driven wildfire mitigation study (Hong et al. 2021) could provide an accelerated decision-making solution for utility companies before and during wildfire events.
- Use modeling and analysis to study at the community scale what are low cost measures to improve thermal resilience performance of houses in the DVCs. For houses with AC, tune it up or replace it with high efficiency AC units; for houses without AC, consider installing high efficiency AC units.

- Explore mobile cooling shuttles/buses
- Produce an economic study of community microgrid with PV + Storage

Berkeley Lab appreciates the opportunity to provide these comments in support of development of the forthcoming solicitation regarding research on valuation of investments in electricity sector resilience.
Sincerely,

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