CCST EXPERT BRIEFING SERIES:
Toward a Disaster Resilient California

Building a Resilient **ELECTRICAL GRID**

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Briefing held **AUGUST 2021**

One Pager

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About the
CCST Disaster Resilience Initiative:

Ongoing, complex, and intersecting disasters—including climate change, extreme heat, power outages, and the COVID-19 pandemic—are radically disrupting the ways in which Californians live and work. CCST is committed to delivering science and technology advice to improve our resilience to disasters, reduce harm, and improve the lives of all Californians.

SUMMARY

- Large-scale threats to the electrical grid from extreme events, such as wildfires or malicious attacks, are becoming increasingly common. Disruptions to the grid caused by these events can lead to catastrophic loss of life and economic damage.
- Increasing the resilience of the grid to these events can be achieved through a variety of pathways, including predicting extreme events and adapting operational policies, deployment of new technologies, and hardening of critical infrastructure.

Complex Disasters Threaten **CALIFORNIA'S ELECTRICAL GRID**

Today's electrical grid faces unprecedented challenges from extreme events. In California, natural disasters, such as wildfires, are growing in frequency and magnitude and routinely damage critical infrastructure.

As the effects of climate change intensify, the grid must respond to new disruptions, whether they be sea-level rise threatening coastal power plants or extreme heat putting additional stress on the system.

Malicious attacks have emerged as a relatively new threat to vulnerable grid infrastructure. Cyber attacks can disrupt large portions of electricity distribution, including to critical infrastructure such as hospitals or communications systems, threatening public health and national security

Disasters such as these can overlap and compound to create unprecedented and difficult to predict challenges for grid operators who must make real-time decisions in response to emerging threats.

Defining and Measuring **RESILIENCE**

Grid resilience, in contrast to reliability, concerns low probability, but high consequence events.

Broadly, resilience is the "ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions... [including] deliberate attacks, accidents, or naturally occurring threats or incidents."[1]

Developing a way to measure the resilience of the grid requires the consideration of:

SYSTEM
Resilience is assessed for a specific defined system, with its own unique assets and capabilities.

THREATS
Resilience is defined in relation to a specific threat. A system that is highly resilient to wildfires might not have the same level of resilience to earthquakes.

CONSEQUENCES
Resilience metrics must consider not only the impacts of an event on the system but the consequences of a grid disruption to social welfare.

[1] Presidential Policy Directive/PPD-21.

SELECT EXPERTS

The following experts can advise on ways to measure and improve grid resilience:

Moderator:

Assemblymember
CHRIS HOLDEN
California's 41st Assembly District

Panelists:

CHARLES HANLEY
Senior Manager
Grid Modernization and Energy Storage Program Area
Sandia National Laboratories
cjhanle@sandia.gov

ALYONA TEYBER
Staff Engineer
Grid Integration, Systems and Mobility Department
SLAC National Accelerator Laboratory
aivanova@slac.stanford.edu

JEAN-PAUL WATSON, PhD
Senior Research Scientist
Lawrence Livermore National Laboratory
watson61@llnl.gov

CCST Contact:

SARAH BRADY, PhD
Deputy Director
CCST
sarah.brady@ccst.us

Building
RESILIENT COMMUNITIES

When designing grid interventions for developing community resilience, planners must work with community stakeholders to properly assess the specific needs of a community during a grid disruption.

One useful metric for evaluating resilience in communities is **social burden,** which measures how hard people are working to achieve their basic needs. Metrics like social burden can help resilience planners identify assets and facilities that are maintaining social welfare in the wake of a disaster event.

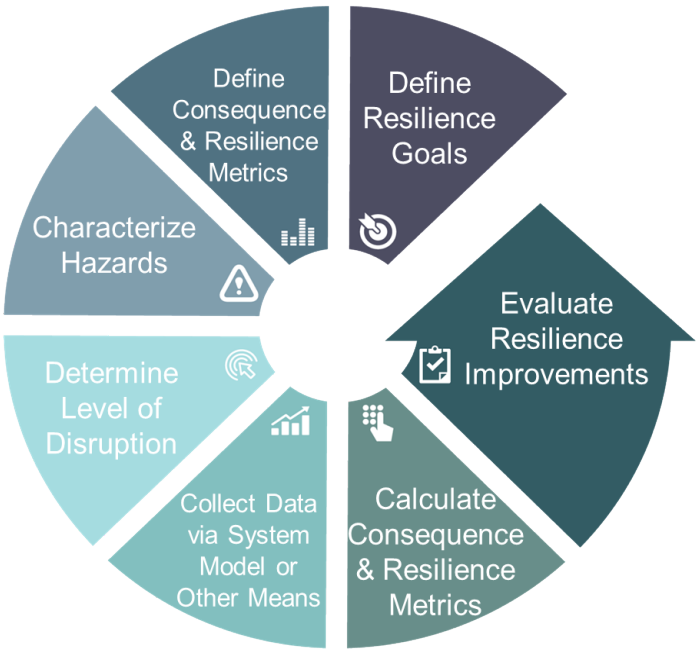

Figure: Resilience Analysis Process (OSTI.gov).

Predicting
EXTREME EVENTS

Utilizing data from a variety of sources, researches can develop models to predict how hazards may interact with or damage the grid. The output from these models can help grid operators make more informed decisions about infrastructure vulnerabilities, where to prioritize investments in the grid, and how to manage distributed energy resources, in real time.

Deploying
EMERGING TECHNOLOGY

In the wake of a disruption to the grid, finding other ways to deliver power to critical infrastructure is vital. By utilizing distributed energy resources such as battery storage, solar generation, or fuel cells—in combination with energy systems like microgrids—power can be maintained at important buildings, such as hospitals, despite a larger grid outage.

Hardening
GRID INFRASTRUCTURE

Investing in improvements to physical infrastructure can make it less susceptible to hazards. Examples of such improvements include replacing aging utility poles, burying transmission lines, or building floodwalls. Hardening infrastructure requires large investments of capital, so grid operators must make decisions about how to allot resources. Models that assess system hazards can be an important tool in assisting operators in understanding which improvements are most needed, and when.

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