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| **Project Title:** | Distributed Energy Resources (DER) Roadmap |
| **TN #:** | 233198 |
| **Document Title:** | DER Research Roadmap Workshop Slidedeck |
| **Description:** | Navigant's Slidedeck |
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| **Submitter Role:** | Commission Staff |
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| **Docketed Date:** | 5/28/2020 |
Distributed Energy Resources Research Roadmap Summary Workshop

5/29/2020, 10am –12pm
WebEx Hosted Meeting
# Workshop Agenda

<table>
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<tr>
<th>Session</th>
<th>Time</th>
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<tr>
<td>Workshop Purpose and Agenda</td>
<td>10:00 - 10:10</td>
</tr>
<tr>
<td>Team Introductions</td>
<td>10:10 - 10:15</td>
</tr>
<tr>
<td>Project Purpose</td>
<td>10:15 - 10:30</td>
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<tr>
<td>Project Approach</td>
<td>10:30 - 10:45</td>
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<tr>
<td>Load-Modifying Technology Research Needs</td>
<td>10:45 - 11:10</td>
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<tr>
<td>DER Communications and Controls Research Needs</td>
<td>11:10 - 11:30</td>
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<tr>
<td>DER Planning and Strategy Research Needs</td>
<td>11:30 - 11:50</td>
</tr>
<tr>
<td>Conclusion</td>
<td>11:50 - 12:00</td>
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**Join The Meeting Remotely:**

**Via Computer:** Please go to [https://energy.webex.com/ec](https://energy.webex.com/ec)
Meeting number: **924 024 437**
Meeting Password: cec@1516

**Via Telephone:** (no visual presentation):
Call **1-866-469-3239**
(toll free in the U.S. and Canada)
Meeting number: **924 024 437**
Today’s Purpose: Primary Questions

1. Do the research priorities identified in the Draft Final DER Research Roadmap Report accurately reflect the needs of California?

2. What improvements do you suggest to the Draft Final DER Research Roadmap Report?

3. Do you have any suggestions on performance targets for these research opportunities?
Roadmap Strategy Overview

Energy System Goals

- Sustainability: The operational stability of the power system and the rate at which it contributes to the growth of the nation’s energy infrastructure.
- Affordability: The ability of the system to provide power at a cost that is affordable.
- Resiliency: The ability of the system to respond to and adapt to changing conditions and withstand and recover rapidly from disruptions, including extreme weather events.
- Security: The ability of the system to maintain stable demand for security and respond to potential threats.
- Flexibility: The ability of the system to adjust to changing conditions and meet changing demands.

What do these technologies need to do?

Market Barriers

- Cost: The component, production, or operational costs of the resource are above what is required for adoption.
- Valuation: The resource is not adequately valued and benefits are not provided to the power system.
- Uncertainty: Limited information on the immediate or future performance of the resource restricts potential uses.
- Coordination: Complexity of the interactions between various participants and the ownership and utilization of the resource limits adoption.

What are the current limitations?

Research Solutions

What research can resolve the issues?
Energy System Goals

**Sustainability**
The operation of the power system in a manner that contributes to the reduction of pollutants, considering environmental, social and economic factors.

**Affordability**
The ability of the system to provide electric service at a cost that does not exceed customers’ willingness and ability to pay for those services.

**Reliability**
Uninterrupted delivery of electricity with acceptable power quality in the face of routine uncertainty in operation conditions.

**Resiliency**
The ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions, including deliberate attacks, accidents, or natural disasters.

**Flexibility**
Ability of the grid to respond to future uncertainties that stress the system in the short term and may require adaptation in the long run.

**Security**
The ability to resist external disruptions to the energy supply infrastructure caused by intentional physical or cyber attacks or by limitation of access to critical materials.

Source: Grid Modernization Laboratory Consortium (DoE) Metrics Analysis
Market Barriers

**Cost**
The component, production or operational costs of the resource are above what is required for adoption.

**Uncertainty**
Limited information on the immediate or future performance of the resource restricts potential uses.

**Valuation**
The resource is not adequately compensated for benefits it is providing to the power system.

**Coordination**
Complexity of the interactions between various participants in the ownership and utilization of the resource limits adoption.

**Capability**
The performance characteristics of the technology are not sufficient to replace existing solutions.
# Roadmap Methodology

## Step 1: Identify Research Needs
- CEC-Desired Research
- TAC-Identified Needs
- Public Workshops Needs

## Step 2: Initial Screen
- Go/No-Go Criteria:
  - Appropriate for this roadmap?
  - Commercial status?
  - Existing activity?
  - Covered elsewhere?

## Step 3: Sort Opportunities
- High Potential
- Watch List
- No Further Review

## Step 4: Priority Screen
- Priority Screen Criteria:
  - Technical Impact
  - Market Scalability
  - Fit with policy goals
  - Need for EPIC
  - Benefit to EPIC Ratepayers

## Step 5: Sort Opportunities
- High Priority
- Watch List

## Step 6: Schedule Activities
- Roadmap Recommendation
## Research Need Definitions

<table>
<thead>
<tr>
<th>Research Description</th>
<th>What research would be performed?</th>
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<tbody>
<tr>
<td>Barriers Resolved</td>
<td>Which barrier or barriers will this research alleviate?</td>
</tr>
<tr>
<td>Policy Goals Addressed</td>
<td>Which of California’s policy goals would be addressed by this research?</td>
</tr>
<tr>
<td>EPIC Investment Area</td>
<td>Which of the CEC EPIC Program Areas would be the funding source?</td>
</tr>
<tr>
<td>Metrics Impacted</td>
<td>How much is the research expected to improve DER technical metrics?</td>
</tr>
<tr>
<td>Benefit to EPIC Ratepayers</td>
<td>How would EPIC ratepayers benefit from this research?</td>
</tr>
</tbody>
</table>
Research Need Areas

- Energy Storage
- Energy Flexible Load Assets
- Electric Vehicle Integration
- Distribution Grid Communications
- Distribution Grid Management
- DER in Grid Planning
- DER for Reliability and Resiliency
- Load-Modifying Technologies
- DER Communications and Controls
- DER Planning and Strategy
## Energy Storage

### Distributed Thermal Energy Storage Aggregation
Control aggregate behind-the-meter thermal loads in response to wholesale grid signals including communications and controls

### Battery Performance Testing Protocols
Establish testing checklist for repeated practical issues like communications gaps, incorrect state of charge measurement, efficiency expectations and conflicting customer and grid instructions

### Storage Safety Standards
Develop standards for battery cells, enclosures, ventilation and fire control strategies to ensure code meets safety standards while not being overly restrictive

### Evaluate Alternative Storage Technologies
Evaluate non-lithium ion storage technologies with a particular focus on multi-day energy shifting applications

### Next Generation Lithium-ion Storage
Continue to develop lithium-ion batteries with a focus on improved controls for extended battery life as well as the opportunity for local geothermal-backed lithium extraction

### Energy Storage Recycling
Study most efficient re-use or recycling of different battery cell chemistries as well as information needed to inform potential regulation around recycling efficiency

### Green Electrolytic Hydrogen for Long-Duration Storage
Implement distributed multi-day green electrolytic hydrogen solution to reduce wind and solar generation curtailment

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<td>Evaluate Alternate Storage Technologies</td>
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<tr>
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<td>Next Generation Lithium-ion Storage</td>
<td>Distributed Thermal Energy Storage Aggregation</td>
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<tr>
<td>Low</td>
<td>Storage Safety Standards</td>
<td>Energy Storage Recycling</td>
<td>Battery Performance Testing Protocols for Grid Applications</td>
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Energy Flexible Load Assets (1 of 2)

Assess Costs of Demand Response Automation
Develop a generalized cost characterization tool for cost / benefit decisions around deploying demand response technology in new buildings

Enable Load Flexibility Alongside Fuel Shifting
Provide market facilitation for smart controls in space and water heating as loads are decarbonized

Coordinate Water Heater Design and Controls
Inform heat pump water heater system design with likely grid request signals; adjust design to operate efficiently to meet grid requests

Evaluate the Effect of Demand Response on Market Decisions
Compare the effectiveness of market-integrated versus utility rate-based DR programs to provide estimates of responsiveness of different types of load management programs

Develop NEC-Approved HEMS to Reduce Panel Upgrade Costs
Develop home energy management system to control increased loads from PEVs and electrification in order to avoid panel upgrade costs

Improve Building-to-Grid Coordination
Use DoE open source VOLTTRON platform to coordinate building loads, EVSE and storage to response to wholesale grid signals

Enhance Commercial Building Monitoring and Controls
Explore opportunities for high granularity data on building operation and environmental controls preference of occupants to better characterize load flexibility opportunity

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<td>Assess Costs of Demand Response Automation in New Buildings</td>
<td>Assess Device-Level Lifespan Effects of Load Flexibility</td>
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<td></td>
<td>Derive Capacity Value of Variable Distributed Energy Resources</td>
<td>Coordinate Residential Loads with Commercial Home Automation Hubs</td>
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<td>Medium</td>
<td>Enable Load Flexibility Alongside Fuel Shifting</td>
<td>Study Load-Modifying Participation Models</td>
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<td>Coordinate Water Heater Design and Controls</td>
<td>Evaluate the Effect of Demand Response on Market Decisions</td>
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<td>Medium</td>
<td>Evaluate Distributed Resources Performance in New Construction</td>
<td>Improve Building-to-Grid Coordination</td>
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</table>
# Energy Flexible Load Assets (2 of 2)

## Coordinate Residential Loads with Commercial Home Automation Hubs
Explore opportunities to use home automation hubs to control loads based on inferred customer preferences

## Study Load-Modifying Participation Models
Assess market and non-market integrated participation models for their ability to enable value stacking and multiple services

## Evaluate DER Performance in New Construction
Review the effectiveness of previously installed DERs to ensure they are meeting the expected efficiency; provide corrective suggestions for other installations if not

## Assess Device-Level Lifespan Impact of Load Flexibility
Perform lab tests of the impact of responding to grid requests for load changes on customer appliance lifespan

## Derive Capacity Value of Variable DER
Study the practical capability of different types of loads to provide demand flexibility at different times across all seasons

### Time Horizon

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Vehicle Grid Integration

Vehicle-to-Building for Resiliency
Test ability of electric vehicle batteries to power community resiliency centers during unplanned outages and Public Safety Power Shutoffs

Model EV Charging and Price Responsiveness
Investigate the ability of direct managed charging and differential price signals to meet explicit load flexibility requirements at the individual distribution circuit level

Assess EV Charging Technology Efficiencies
Research the impact on charging efficiency of charging at different SoC, current and transformer capacity levels to optimize V2G requests with respect to losses

EV Charging Device Performance Standards
Provide comprehensive performance metrics on EVSE capabilities, deployment status, consumer acceptance, cost and other categories

Assess Second Life EV Batteries
Resolve questions on second life EV batteries such as degradation rate, optimal cell matching, customer concerns, and target market price

VGI Data Program
Collect results of VGI projects and programs including time series charging profiles for use by grid planners and policy makers

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<td>Assess Second Life Electric Vehicle Batteries</td>
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<td>Medium</td>
<td>Assess Electric Vehicle Charging Technology Efficiencies</td>
<td>Model Electric Vehicle Charging and Price Responsiveness</td>
<td>VGI Data Program</td>
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# DER Communications and Controls

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<th>Priority</th>
<th>Task</th>
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<tbody>
<tr>
<td>Short</td>
<td>High</td>
<td>Secure Communications for DER</td>
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<tr>
<td>Medium</td>
<td>Low</td>
<td>Low-Cost Telemetry for Aggregated DER</td>
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<tr>
<td>Long</td>
<td>Low</td>
<td>Hosting Capacity Expansion Planning and Operational Controls</td>
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</table>

## Low-Cost Telemetry for Aggregated DER
Assess different costs and requirements for DER participation in wholesale markets.

## Secure Communications for DER
Coordinate distribution grid operators and DER providers to resolve identified cybersecurity issues preventing open communications.

## Standardization of Device Protocols
Demonstrate proposed standards for DER data accessibility to limit need to support multiple protocols.

## Sensors for Circuit De-Energization
Evaluate adapters to allow existing utility assets with limited communications to coordinate with the distribution operator to provide alerts for de-energization.

## Local DER Transaction Platform
Demonstrate platform for local distributed energy transactions allowing local energy sources and sinks to schedule and conduct transactions.

## Real-Time Estimation of PV Power
Develop hardware and estimation-based methods of calculating BTM generation.

## Hosting Capacity Expansion Planning
Study how flexible DER can be used to increase the hosting capacity of a circuit for less flexible DER.

## Estimating Distributed Inertia Requirements
Evaluate inertia requirements for subsets of the electrical grid that might be sectionalized during Public Safety Power Shutoffs or other adverse conditions.
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DER Planning and Strategy (1 of 2)

**Behind-the-Meter DER Load Flexibility**
Study the ability of behind-the-meter DER to provide local load flexibility at given cost profiles as well as the timeframe such resources can be visible to the planning process.

**DER Controls to Minimize Integration Costs**
Demonstrate how DER controls can be used to avoid expensive service upgrades.

**Sociotechnical Demand Response Impact**
Evaluate how social and technological factors combine to influence demand response capacity.

**DER Integration in Low-Income Communities**
Expand on SB350 Barriers Study to assess differences in DER adoption and usage in low-income communities.

**Dynamic Photovoltaic Modeling**
Study how variable DER profiles can be used in planning rather than fixed profiles.

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**Time Horizon**

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**Valuing Resiliency for Microgrids**

Develop consensus benefit figures to be used in determining the effectiveness of a microgrid or other technology that improves resiliency.

**Residential Outage Backup**

Prototype small battery backup systems that would seamlessly operate garage doors, emergency lighting and life safety devices in the event of wildfire or safety shutoff.

**DC Microgrid with Electric Vehicles**

Design and implement a DC microgrid to integrate natural DC technologies like electric vehicles and photovoltaic generation to avoid conversion losses.

**Risk Mitigation Metrics**

Establish a framework for including severe events in standard distribution planning processes.

**Outage Grid Support Fuels**

Research low emissions fuels that achieve the availability and energy density requirements currently met by back up diesel generation.

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Next Steps

Public Comment
Written comments can be submitted to the Docket Unit until 5:00 p.m. on June 12, 2020

Project Conclusion
The project team will work with Energy Commission staff to address any additional comments and enter the Final Research Roadmap into the public docket

Project Impact
The final Research Roadmap will be used to inform future Energy Commission research planning around DER integration

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