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Distributed Energy Resources Research Roadmap Summary Workshop

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

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Workshop Agenda

Workshop Purpose and Agenda	**10:00 - 10:10**
Team Introductions	**10:10 - 10:15**
Project Purpose	**10:15 - 10:30**
Project Approach	**10:30 - 10:45**
Load-Modifying Technology Research Needs	**10:45 - 11:10**
DER Communications and Controls Research Needs	**11:10 - 11:30**
DER Planning and Strategy Research Needs	**11:30 - 11:50**
Conclusion	**11:50 - 12:00**

Join The Meeting Remotely:

***Via Computer*:** Please go to
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**

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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?

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Roadmap Strategy Overview

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

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.

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

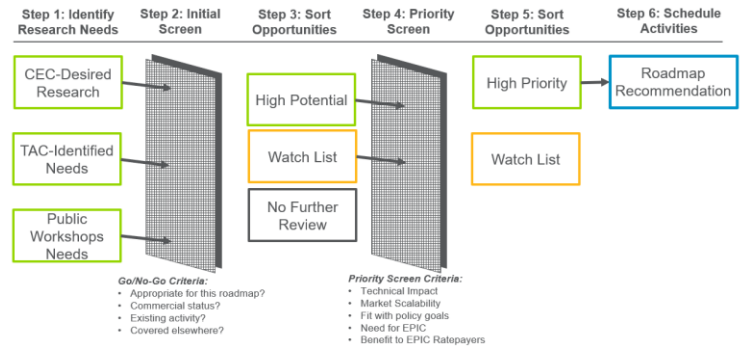
Valuation
The resource is not adequately compensated for benefits it is providing to the power system.

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.

What are the current limitations?

Research Solutions



What research can resolve the issues?

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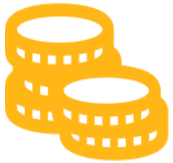

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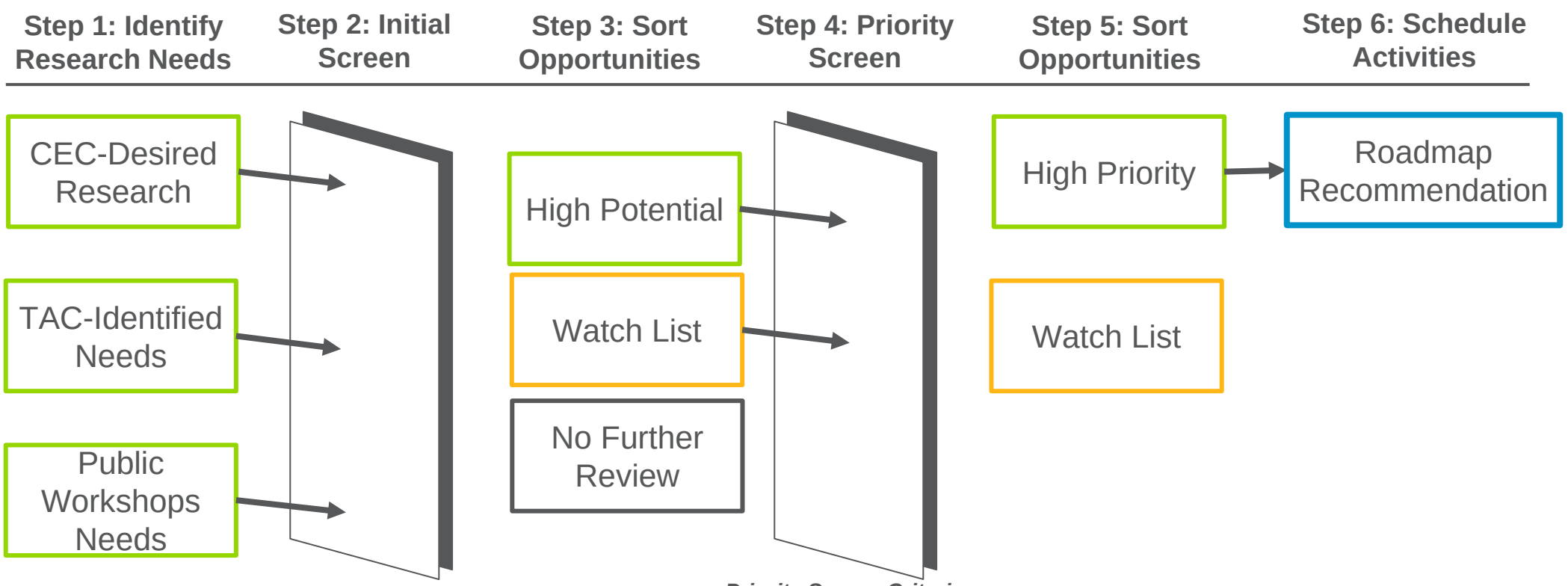
Roadmap Methodology



Go/No-Go Criteria:

- Appropriate for this roadmap?
- Commercial status?
- Existing activity?
- Covered elsewhere?

Priority Screen Criteria:

- Technical Impact
- Market Scalability
- Fit with policy goals
- Need for EPIC
- Benefit to EPIC Ratepayers

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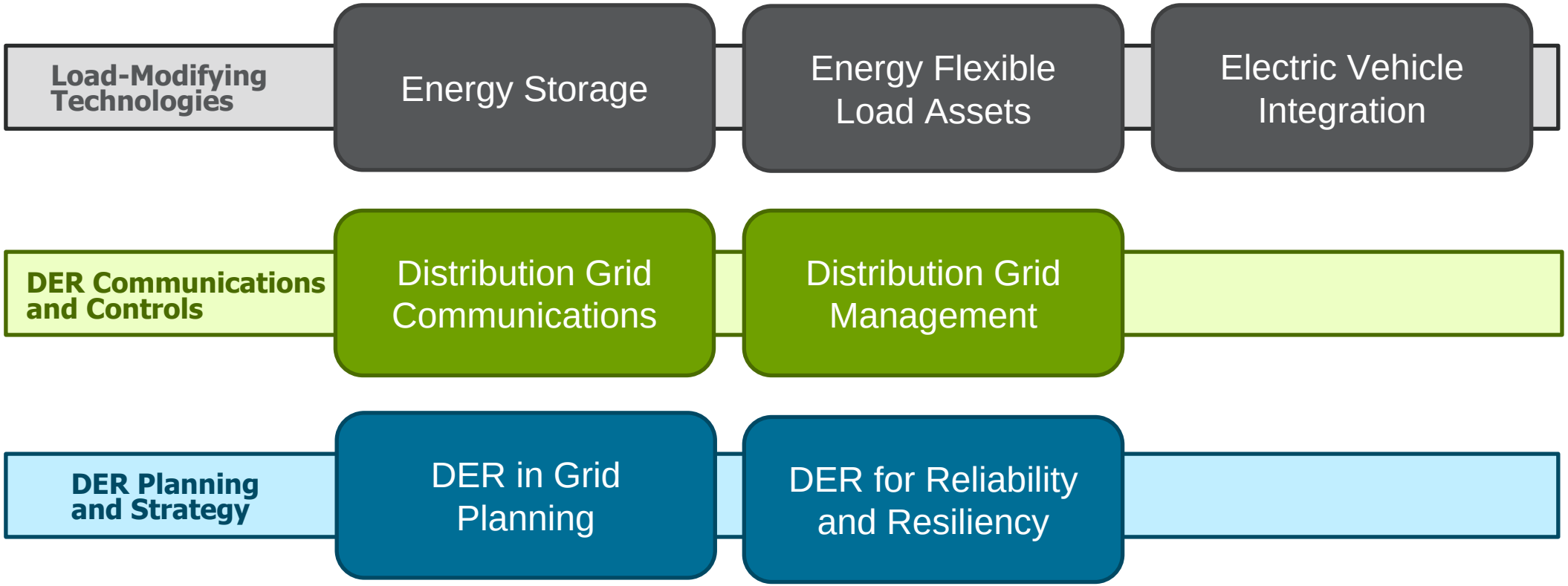
Research Need Definitions

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

Research Need Areas



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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

Time Horizon

Priority	Short	Medium	Long
High	Evaluate Alternate Storage Technologies Next Generation Lithium-ion Storage	Green Electrolytic Hydrogen for Long-Duration Storage	
High	Distributed Thermal Energy Storage Aggregation		
Medium	Storage Safety Standards		Energy Storage Recycling
Low	Battery Performance Testing Protocols for Grid Applications		

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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

Priority	Time Horizon: Short	Time Horizon: Medium	Time Horizon: Long
High		Assess Costs of Demand Response Automation in New Buildings	Assess Device-Level Lifespan Effects of Load Flexibility
		Develop National Electric Code-Approved Home Energy Management System to Reduce Panel Upgrade Costs	Enhance Commercial Buildings Monitoring and Control
		Derive Capacity Value of Variable Distributed Energy Resources	Coordinate Residential Loads with Commercial Home Automation Hubs
		Enable Load Flexibility Alongside Fuel Shifting	
		Study Load-Modifying Participation Models	
		Coordinate Water Heater Design and Controls	
		Evaluate the Effect of Demand Response on Market Decisions	
Medium		Evaluate Distributed Resources Performance in New Construction	Improve Building-to-Grid Coordination

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

Priority	Short	Medium	Long
High		Assess Costs of Demand Response Automation in New Buildings	Assess Device-Level Lifespan Effects of Load Flexibility
		Develop National Electric Code-Approved Home Energy Management System to Reduce Panel Upgrade Costs	Enhance Commercial Buildings Monitoring and Control
		Derive Capacity Value of Variable Distributed Energy Resources	Coordinate Residential Loads with Commercial Home Automation Hubs
		Enable Load Flexibility Alongside Fuel Shifting	
		Study Load-Modifying Participation Models	
		Coordinate Water Heater Design and Controls	
		Evaluate the Effect of Demand Response on Market Decisions	
Medium		Evaluate Distributed Resources Performance in New Construction	Improve Building-to-Grid Coordination

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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

Time Horizon

Priority	Short	Medium	Long
High	Vehicle-to-Building for Resiliency	Assess Second Life Electric Vehicle Batteries	
		Assess Electric Vehicle Charging Technology Efficiencies	
Medium	Model Electric Vehicle Charging and Price Responsiveness		VGI Data Program
Low		Electric Vehicle Charging Device Performance Standards	

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DER Communications and Controls

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

Priority \ Time Horizon	Short	Medium	Long
High	Secure Communications for DER	Low-Cost Telemetry for Aggregated DER	
Medium		Standardization of Device Protocols and Data Transparency and Availability	Local DER Transaction Platform
		Estimating Distributed Inertia Requirements	
		Sensors for Circuit De-energization	
Low		Hosting Capacity Expansion Planning and Operational Controls	
		Real-Time Estimation of PV Power	

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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 an 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

Priority	Time Horizon: Short	Time Horizon: Medium	Time Horizon: Long
High	Behind-the-Meter DER Load Flexibility	DER Controls to Minimize Integration Costs	
High	Outage Grid Support Fuels	Risk Mitigation Metrics	
High	Residential Wildfire Resilience - Outage Backup	Valuing Resiliency for Microgrids	
Medium		DER Integration in Low Income Communities	
Medium		Sociotechnical Demand Response Impact	
Low		Dynamic Photovoltaic Modeling	Direct Current Microgrid

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DER Planning and Strategy (2 of 2)

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

Priority	Short	Medium	Long
High	Behind-the-Meter DER Load Flexibility	DER Controls to Minimize Integration Costs	
High	Outage Grid Support Fuels	Risk Mitigation Metrics	
High	Residential Wildfire Resilience - Outage Backup	Valuing Resiliency for Microgrids	
Medium		DER Integration in Low Income Communities	
Medium		Sociotechnical Demand Response Impact	
Low		Dynamic Photovoltaic Modeling	Direct Current Microgrid

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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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