

# Joint Utilities EPIC Public Workshop

August 29, 2022



# Safety



## Earthquake

- Drop
- Cover
- Hold



## Fire

- Exits, escape routes, evacuation plan
- Use a compliant fire extinguisher



## Medical Emergency

- First aid/CPR
- 911/share location
- AED



## Ergonomics

- 30/30
- Observe proper ergonomics



## Security

- Active shooter—get out, hide out, take out
- Use badge—don't tailgate



## Transportation

- On the road, off the phone

# Workshop Purpose

- For SCE, SDG&E, and PG&E, as EPIC Administrators, to present their candidate strategic objectives, initiatives, and topics that may be in their EPIC 4 investment plans, and to engage in open discussion with, and receive feedback from, workshop participants on
  - Technology innovation and demonstration priorities
  - Important topics that may not be included



# EPIC Workshop Agenda

Session	Start	Mins	Details	Lead
Opening	8:30	5	Safety Moment	PG&E
	8:35	5	Introduction to EPIC	PG&E
Strategic Objective: Create a More Nimble Grid to Maintain Reliability as California Transitions to 100 Percent Clean Energy	8:40	45	T&D Foundation Technologies Initiative	SCE
			T&D Situational Capabilities Initiative	SDG&E
			Grid Reliability Initiative	PG&E
			Clean, Dispatchable Resources Initiative	PG&E
	9:25	25	Grid Modernization Initiative	Utilities
9:25	25	Open Discussion	Utilities	
Break	9:50	5		
Strategic Objective: Increase the Value Proposition of Distributed Energy Resources to Customers and the Grid	9:55	45	Distributed Energy Resource Integration and Load Flexibility Initiative	PG&E
			Transportation Electrification Initiative	SDG&E
			Transportation Electrification Initiative	SDG&E
			Distributed Energy Resource Integration Initiative	SCE
	10:40	25	Energy Management Foundational Technologies Initiative	SCE
10:40	25	Energy Management Situational Capabilities Initiative	Utilities	
10:40	25	Open Discussion	Utilities	
Break	11:05	5		
Strategic Objective: Inform California's Transition to a Zero-Carbon Energy System that is Climate-Resilient and Meets Environmental Goals	11:10	45	Climate and Environment Initiative	PG&E
			Vulnerability, Threats, and Hazard Reduction Initiative	SCE
	11:55	25	Digital Transformation Initiative	Utilities
11:55	25	Open Discussion	Utilities	
Closing	12:20	10	Final Participant Questions and Comments	Utilities

The Strategic Objectives, Initiatives, and Topics in this presentation are preliminary and subject to change.



# Introduction to EPIC



# What is the EPIC?

- The Electric Program Investment Charge (EPIC) is a California state public purpose program that enables the Utilities (SCE, SDG&E, and PG&E) and the California Energy Commission (CEC) to invest in & pursue new/novel emerging energy solutions to meet California's energy goals and drive innovation in the industry
- EPIC promotes building the energy network of tomorrow through innovation focused on
  - Increased safety
  - Improved affordability
  - Greater reliability
  - Environmental sustainability
  - Equity



# CPUC-Designated EPIC Work Categories

Applied Research and Development	Technology Demonstration & Deployment	Market Facilitation
Investment in <b>applied energy science and technology</b> that provides public benefit but for which there is no current deployment of private capital.	Investments in technology demonstrations at real-world scales and in real-world conditions to showcase emerging innovations and increase technology commercialization.	Investments in market research, regulatory permitting and streamlining, and workforce development activities to address non-price barriers to clean technology adoption.
CEC	CEC	CEC
	SCE SDG&E PG&E	



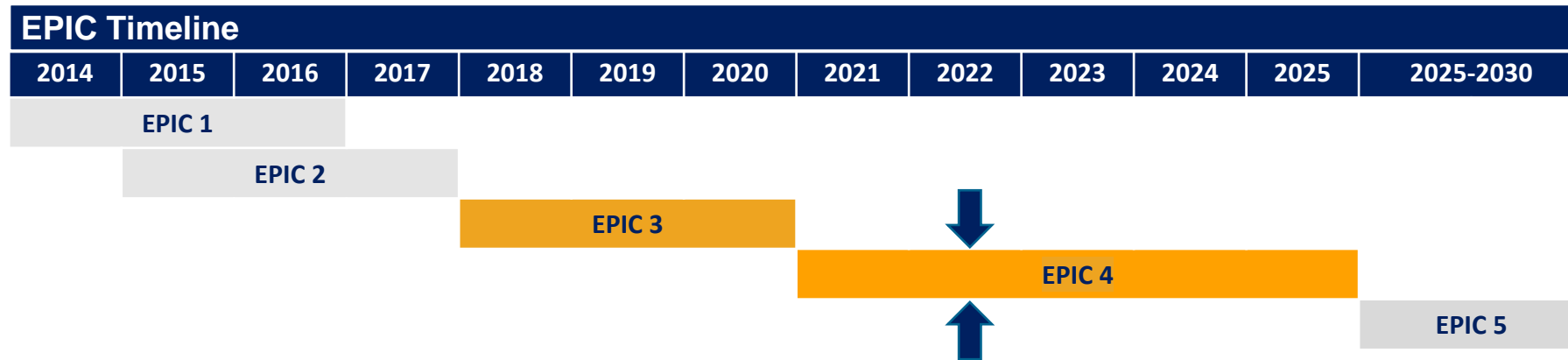
# Other Constraints on IOU EPIC Technology Development & Demonstration

- EPIC provides the IOUs with flexibility to demonstrate a wide range of emerging technologies, but
- CPUC-designated constraints state that IOU EPIC projects cannot be the following:
  - Only Energy Efficiency
  - Only Demand Response
  - Only Power Generation
  - Only Gas
  - Paper studies (i.e., without lab or field demonstration)
  - Broad deployments of commercially available/already proven technologies
  - Unnecessarily duplicative of other technology demonstrations





# EPIC Timeline and EPIC 4 Investment Plans



- EPIC 3 cycle projects are continuing to completion
- Proceeding R.19-10-005 is ongoing (EPIC 4 & EPIC 5)
  - Phase 2B Decision in November 2021 authorized the IOUs to continue as EPIC Administrators through EPIC 4
- IOU EPIC 4 Investment Plans to be filed October 1, 2022
- EPIC 4 plans to be filed at the strategic initiative level with associated topics
  - not at the individual project level as in EPIC 1-3
- In this second of two workshops, seeking additional feedback on the initiatives and topics within the three strategic objectives

# EPIC 4 Funding Allocations

Administrator	Funding for 5 Year EPIC 4 Cycle (~\$M)	Share of Total (~%)
CEC	\$662M	80%
SCE	\$68M	8%
SDG&E	\$14M	2%
PG&E	\$83M	10%



# Investment Plan Structure

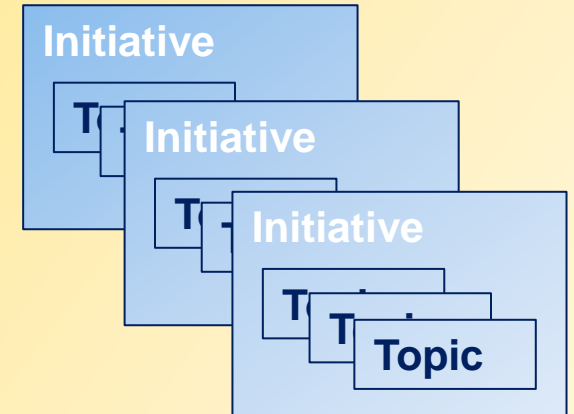
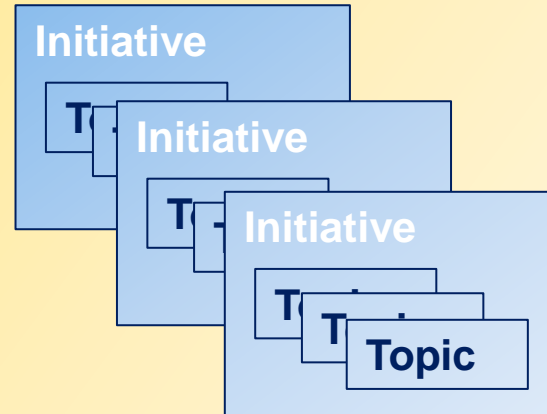
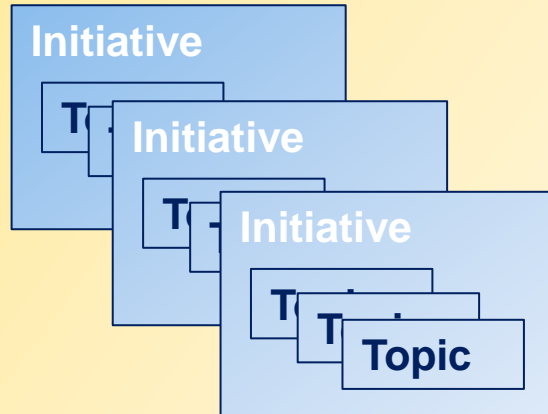
ALIGNED  
FOR ALL\*

**Strategic Objective:** Create a More Nimble Grid to Maintain Reliability as California Transitions to 100 Percent Clean Energy

**Strategic Objective:** Increase the Value Proposition of Distributed Energy Resources to Customers and the Grid

**Strategic Objective:** Inform California's Transition to an Equitable, Zero-Carbon Energy System that is Climate-Resilient and Meets Environmental Goals

UNIQUE TO  
EACH IOU



NOTE: IOU budgets allocated at the Initiative level



# EPIC 4 Implementation Process

Sequence of Activity	Date
IOUs file EPIC-4 applications with CPUC	October 1, 2022
CPUC review of applications	CPUC Process
CPUC modifications requested	
Final versions of applications approved	
Funding release by CPUC	
IOUs begin implementation of projects	T + 3 Months
Project plans written and internal teams formed	T + 6 Months
External partners and contract resources arranged	T + 9 Months
Demonstrations performed and final reports are prepared	T + 24 to 36 Months

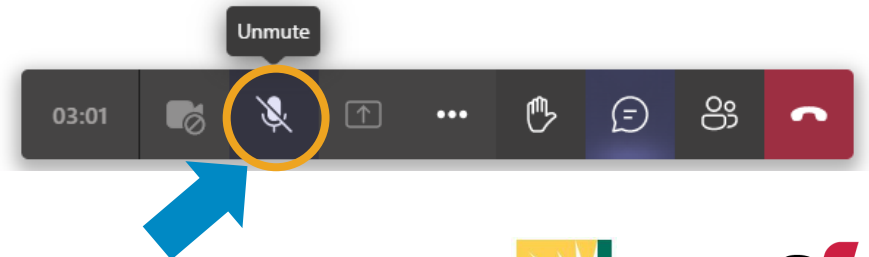


# To Participate

- Type your question in the Chat, or
- Raise your hand



- At an appropriate time, an Organizer or Moderator will
  - read your question from the Chat, or
  - if your hand is raised, request that you ask your question. When prompted please unmute and participate.
- Please mute yourself after you have completed your question or statement.



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# Introduction to the Strategic Objective

- Substantial grid changes needed for 100% clean energy
- More flexible
  - Distributed solar, wind, storage, flexible load
- Smarter
  - Predictive, optimized, communicating, aware, secure
- More resilient
  - Fault tolerant, microgrids

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# SCE Initiative: T&D Foundational Technologies

T&D Foundational Technologies research topic areas are expected to evaluate and demonstrate the **precommercial equipment and applications** that will be the basis of a **flexible grid**.

Research topic areas of focus:

- Adaptive Protection Systems
- Ultra Low-Latency Communications
- Ubiquitous Situational Awareness



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# Adaptive Protection Systems Topic

## **SCE**

### **Innovation Need**

- The protection system needs to adapt to the changes taking place on the distribution system, including the high penetration of Distributed Energy Resources (DERs) and adoption of advanced Distribution Automation (DA) functions.

### **Topic Description**

- A real-time online activity that modifies the preferred protective response to a change in system conditions, business rules, or forecasted reconfiguration in a timely manner by means of externally generated signals or control actions.

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# Ultra Low-Latency Communications Topic **SCE**

## Innovation Need

- The increase in DER penetration has driven the need to better provide situational awareness and control of DER.

## Topic Description

- Determine available next-generation technologies that meet the requirements for ultra-reliable, low latency communications, investigate and compare the capabilities and constraints of these technologies, demonstrate the capabilities through lab testing, and perform field demonstrations for “real-world” applicability.

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# Ubiquitous Situational Awareness Topic **SCE**

## Innovation Need

- Weather, climate, and the increase in EV and DERs impact the grid. Because of these constant changes, we must innovate and enhance situational awareness to provide operators, engineers and other stakeholders visibility into the grid in real time.

## Topic Description

- Develop and demonstrate our ability to view the health and state of our grid in real time to promptly respond to abnormal events such as natural disasters and system imbalances

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# SCE Initiative: T&D Situational Capabilities

To meet the increased load growth projected by the electrification of uses that had previously been based upon fossil fuels, we will need to have **greater utilization of existing facilities**. This initiative would also examine the potential utilization of **power electronics** and **DC systems** to meet these needs.

Research topic areas of focus:

- High-Capacity Throughput & Protection
- Seamless Grid Flexibility

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# High-Capacity Throughput & Protection Topic **SCE**

## Innovation Need

- Infrastructure enhancements are needed as more distributed energy resources (DER) connect to the grid. Monitoring needs will increase as the utilization of the transmission and distribution system increases. Utilities will need to look to non-traditional methods of controlling the flow of energy.

## Topic Description

- As California transitions to 100% clean energy, the expectation is that the utilization of transmission and distribution assets, new and existing, will need to increase. The greater utilization of the assets will increase the need to manage the climate change impacts.

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# Seamless Grid Flexibility Topic

## **SCE**

### **Innovation Need**

- With increased levels of DERs like solar PV, battery storage and electric vehicles, electricity supply and demand will become increasingly variable and more difficult to predict.

### **Topic Description**

- Next generation software and hardware systems can help utilities achieve greater levels of control and optimization of grid assets to facilitate fast response and real time flexibility that predict and react to grid needs and events.

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# SDG&E Initiative: Grid Reliability

## Mobile Microgrid Demonstration Topic Innovation Need

- Innovative resiliency options which utilize clean energy sources and other related operating infrastructure from prior EPIC work to meet critical load during emergency and planned outage events

## Topic Description

- Providing resiliency to critical facilities during outage situations (planned and unplanned) while reducing the cost impact of outage events
- Builds on mobile battery demonstrations in EPIC-3 and experience with mobile generators
- Maps to multiple initiative areas

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# PG&E Initiative: Clean, Dispatchable Resources

- All things microgrid, needed to unlock DER potential
- Individual customer-focused resiliency
- Long duration energy storage needed to get to 100% clean energy



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# Microgrid Enablement Topic

## **PG&E**

### Innovation Need

- While PG&E has begun to develop foundational microgrid capabilities through its EPIC 3 program, many technical issues remain unresolved, including
  - protection schemes for various microgrid topologies
  - incorporation of EVs and temporary mobile batteries
  - alternate generating sources (such as fuel cells),
  - islanding and synchronization
  - flexibility of microgrid location (from substation to end of feeder)
  - general design repeatability

### Topic Description

- Define a set of microgrid architectures that accommodate the bulk of the current and emerging microgrid needs, model these architectures, conduct lab testing, and ultimately construct and demonstrate microgrids operationally, to advance capabilities in the areas described above

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# Individual Customer Resiliency Topic

## **PG&E**

### Innovation Need

- While PSPS and EPSS reduce wildfire risk, they also result in outages for customers, and sometimes numerous repeat outages for small groups of customers
- While PG&E has focused several customer programs on providing commercially available reliability solutions that reduce customer impacts of PSPS and EPSS, there is a need to demonstrate innovative, scalable, clean technologies and address deployment barriers

### Topic Description

- Conduct technology demonstrations for a range of clean mobile and stationary DERs to provide greater resiliency at lower costs for individual residential and non-residential customers impacted by PSPS and EPSS events
- Develop & demonstrate ancillary deployment tools including controls, meter connection and automatic transfer switches in order to enable resiliency and other benefits

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# Long Duration Energy Storage Topic

## **PG&E**

### Innovation Need

- Long Duration Energy Storage (LDES) technologies will be required to meet the needs of a 100% zero-carbon electricity system
- Apart from conventional pumped hydroelectric storage (“pumped hydro”), which has limited potential for expansion, neither the technologies nor the business models of other LDES solutions have been proven as grid-scale resources

### Topic Description

- Front-of-the-Meter (FTM) grid installation and demonstration of various LDES solutions that enable the storage of renewable energy for eight hours or longer
- Focus on demonstrating promising LDES solutions that have been matured through the CEC’s EPIC program and elsewhere
- Use cases will include firming of intermittent renewable generation, reliability during PSPS or EPSS events, and market participation for energy arbitrage

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# PG&E Initiative: Grid Modernization

- To achieve the Strategic Objective, many new technologies will be needed as part of grid modernization:
  - Sensing And Communication
  - Grid Scenario Planning
  - Advanced Drone Applications
  - Advanced Predictive Maintenance And Failure Cause Analysis
  - Work Management
  - System Protection

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# Sensing and Communication Topic

## **PG&E**

### Innovation Need

- In recent years, PG&E has demonstrated and deployed new sensors in the field, such as radio frequency-based sensors to improve preventative maintenance capabilities. There is a need and opportunity to continue exploring a wide range of additional sensor types to help reliably, safely, efficiently operate the grid of the future. As PG&E explores and adopts a wider range of sensors, it will also need to develop overarching infrastructure that does not currently exist for managing a significant volume of new data and establish clear processes and operational capabilities for acting on the insights that are derived.

### Topic Description

- Demonstrate a wide variety of additional field sensors related to a range of initiatives for wildfire prevention, asset protection and grid operations
- Demonstrate a combination of central and edge computing, infrastructure to support far greater data volumes, a flexible, pervasive, multi-use communication system, and advanced cybersecurity protection

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# Grid Scenario Planning Topic

## **PG&E**

### Innovation Need

- Several macro-trends are pressuring the traditional grid architecture
  - Changing environmental conditions
  - Proliferation of new technologies
  - Evolution in how end users consume electricity
  - Decarbonization goals
- There is a need for a holistic grid planning tool to inform decision-making out to the 40-year time horizon

### Topic Description

- Create and demonstrate a whole system (T, D, S, Supply, Load) simulator that analyzes a wide range of scenarios and potential future stressors to the grid, produces a proposed grid model, and distills grid design principles

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# Advanced Drone Applications Topic

## **PG&E**

### Innovation Need

- There are safety risks inherent in employing manned vehicles for grid surveillance and other field-related work, and manual monitoring creates opportunities for human error
- PG&E has taken initial steps to incorporate some drone use cases into its operations, but the continued incorporation of drones through wider and more advanced use cases has significant potential to improve the safety, effectiveness, and efficiency of system operations

### Topic Description

- Continue to advance PG&E's drone applications by building upon the initial demonstration of automated and Beyond Visual Line-of-Sight (BVLOS) capabilities in EPIC 3
- Expand to additional use cases, explore a wider range of onboard sensors, and create better integration between vendor systems and PG&E's work management systems/processes
- Progress from limited scale demonstrations of individual drones operating in isolation, to smart networks of multiple drones, and explore the more holistic integration of manned and unmanned inspection processes

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# Advanced Predictive Maintenance and Failure Cause Analysis Topic **PG&E**

## Innovation Need

- In recent years, PG&E has built up its core data science capability and established the central Foundry platform, which have contributed to initial successes in predictive maintenance
- There is an opportunity and need to continue developing analytical tools for the Distribution system, where PG&E has been most focused to date, as well as for Transmission and Substation where there are perhaps even richer datasets and significant opportunity
- Purely analytical tools have the potential to yield high risk-spend efficiency as compared to other solutions that require the broad deployment of sensors and other hardware

## Topic Description

- Improve understanding of failure modes for T, D & S assets, and develop tools to predict deterioration, imminent failures, remaining useful life, high risk conditions, and the need for maintenance across these asset types



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# Work Management Topic

## ***PG&E***

### Innovation Need

- Many PG&E processes, and particularly complex processes that involve multiple stakeholder groups, are inefficient and have limited or antiquated underlying technology solutions

### Topic Description

- Demonstrate a range of technologies to improve various PG&E work processes, such as:
  - Analytical models to optimize resource allocation and staging of various types of work
  - Augmented reality for shared situational awareness between employees in the field and PG&E offices
  - Novel physical tools for faster repair or replacement of overhead assets

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# System Protection Topic

## PG&E

### Innovation Need

- PG&E's electric system is changing rapidly, including from the significant increases in BTM and FTM DERs and renewable energy-based microgrids
- The characteristics of these DERs and microgrids challenge our system protection equipment, standards, and strategies. Many unanswered questions remain in how to maintain and improve system protection as the grid changes

### Topic Description

- Demonstrate technologies needed for improved system protection in several potential areas, including:
  - Improved protection methods for faults generated in inverter-formed microgrids
  - New methods for collecting precise three-phase multi-parameter telemetry data
  - Novel protection schemes that leverage advanced telemetry data and machine learning
  - Adoption of transmission-level system protection algorithms to distribution system relays
  - Alternatives to fuses that currently contain powerful greenhouse gases

# Open Discussion on Strategic Objective

Strategic Objective:

*Create a More Nimble Grid to Maintain Reliability as California Transitions to 100 Percent Clean Energy*

<p><b>T&amp;D Foundation Technologies Initiative</b></p> <ul style="list-style-type: none"> <li>• Adaptive Protection</li> <li>• Ubiquitous Situational Awareness</li> <li>• Ultra Low-latency Communications</li> </ul> <p><b>T&amp;D Situational Capabilities Initiative</b></p> <ul style="list-style-type: none"> <li>• High Capacity Throughput</li> <li>• Seamless Grid Flexibility</li> </ul>	<p><b>SCE</b></p>
<p><b>Grid Reliability Initiative</b></p> <ul style="list-style-type: none"> <li>• Mobile Microgrid Demonstration</li> </ul>	<p><b>SDG&amp;E</b></p>
<p><b>Clean, Dispatchable Resources Initiative</b></p> <ul style="list-style-type: none"> <li>• Microgrid Enablement</li> <li>• Individual Customer Resiliency</li> <li>• Long Duration Energy Storage</li> </ul> <p><b>Grid Modernization Initiative</b></p> <ul style="list-style-type: none"> <li>• Sensing And Communication</li> <li>• Grid Scenario Planning</li> <li>• Advanced Drone Applications</li> <li>• Advanced Predictive Maintenance And Failure Cause Analysis</li> <li>• Work Management</li> <li>• System Protection</li> </ul>	<p><b>PG&amp;E</b></p>



# 5 Minute Break



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# Introduction to the Strategic Objective

- DERs are a big part of the transition to 100% clean energy and a decarbonized economy
  - FTM and BTM DERs, EVs, energy storage, energy efficiency, and load flexibility
- Manifold benefits: flexible load, peak demand reductions, reducing or deferring grid upgrades, reliability, resiliency, new value streams
- DER integration and operation complexity limit value
- Many new technologies are needed to optimize so maximum value to the DER owners and the grid can be achieved

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# PG&E Initiative: Distributed Energy Resource Integration and Load Flexibility

- To get to a high-DER future and maximize value of DERs
  - interconnection must become faster, more flexible, and easier
  - accurate visibility into, and control over, powerflows is key

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# Interconnection Enablement Topic

## **PG&E**

### Innovation Need

- Speeding connection of renewables & avoiding costly grid upgrades
- In the face of accelerating load growth from building and transportation electrification, PG&E has limited available distribution service capacity, long lead times for building new capacity, and limited capital available for capacity investments
- As a result, PG&E is often either unable to interconnect customer loads or generation or must set static constraints on their operation for them to be interconnected
- This problem is forecast to worsen, and there is an urgent need to explore a wider range of solutions for eliminating barriers to timely, smarter, more flexible interconnection

### Topic Description

- Demonstrate a range of new solutions for enabling the interconnection of residential and commercial customers' loads and DERs
- Potential solutions include establishment of dispatchable FTM storage as a short or long-term alternative to distribution upgrades, as well as automated and dynamic load management capabilities as an alternative to static constraints to allow for interconnection



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# Advanced Distribution Powerflow Management

## Topic

### PG&E

#### Innovation Need

- Maximize value of customer DERs, and compensate them for their energy export
- As more FTM and BTM DERs are connected to the grid, powerflow is becoming increasingly complex, and there is an increasing need to have accurate visibility into powerflow, be able to communicate with and control DERs, and maximize the value of DERs to the utility and customers by enabling them to support the grid and participate in the market

#### Topic Description

- Demonstrate a range of capabilities, including:
  - Cost-effective methods for providing a detailed and accurate grid connectivity model, to support higher-fidelity modeling of complex power flows
  - Expansion of foundational DERMS work in EPIC 3, to progress from DER communication to DER control
  - Development and demonstration of uses cases for DER export (including grid support and market participation), along with corresponding communication & control schemes and customer compensation models

Strategic  
Objective:

*Increase the  
Value  
Proposition of  
Distributed  
Energy  
Resources to  
Customers  
and the Grid*

# PG&E Initiative: Transportation Electrification

- EVs are key to California's clean energy goals
- Technology is evolving rapidly; many obstacles to optimal EV experience and coordination
- EV Battery Re-Use for Stationary Energy Storage

Strategic  
Objective:

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Value  
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# EV Technology Development and Standardization Topic

## PG&E

### Innovation Need

- EVs, from fleets of heavy trucks to millions of light vehicles need reliable, compatible, affordable, coordinated charging solutions. Continued innovation is needed to address myriad issues that prevent optimal experience for the EV operator as well as the great potential value of EVs for the grid

### Topic Description

- PG&E will build upon its own prior work and research by the CEC to address a range of issues, including:
  - Facilitating interoperability between all combinations of vehicles and chargers
  - Enabling alternative charging methods, such as wireless charging
  - Improving system modeling capabilities to support a range of use cases from customer targeting for EV programs to real-time load awareness for grid management

Strategic  
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# EV Battery Re-Use for Stationary Energy Storage Topic

## PG&E

### Innovation Need

- Cost-effective, scalable leveraging of rapidly growing 2<sup>nd</sup> life batteries for storage

### Topic Description

- Maximize value of customer EV batteries, accelerate storage cost-effectively

Strategic  
Objective:

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# SDG&E Initiative: Transportation Electrification

## Repowering a Diesel-Powered Rail Line with Electrification Topic

### Innovation Need

- Decarbonizing public transportation to lower local emissions and improve air quality while maintaining community resiliency for public transportation

### Topic Description

- Repowering of diesel-powered commuter trains with batteries and locomotive charging during normal station stops from the grid
- Improving air quality for multiple DAC communities
- Would require significant work on feasibility, permitting, construction, demonstration, and reporting
- Could consume all SDG&E EPIC-4 funds

Strategic  
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# SDG&E Initiative: Distributed Energy Resource Integration

- **DER integration plays an essential role in the State's transition to carbon neutrality**
  - More insight into what's on the distribution system and communicating with those assets
  - Optimizing areas with high solar penetration
  - Power quality management
  - System protection
  - Inverter enhancements
  - Achieving successful interoperability of the various controllable components

Strategic  
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# Optimizing Real Time Net Energy Metering (NEM) Hosting Capacity Topic **SDG&E**

## Innovation Need

- Creating solutions for feeders with high levels of penetration of solar DER that have voltage limitations on additional DER penetration

## Topic Description

- Precommercial demonstration of a closed loop, real-time control system to enhance the ability of distribution feeders to accept higher levels of bi-directional power injection and flow

Strategic  
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# Demonstrating Solutions for Inverter Integration Issues Topic **SDG&E**

## Innovation Need

- Assure that inverter performance and function operations do not trigger harmful impact on distribution system operations

## Topic Description

- Resolve integration issues for multi-function inverters in distribution system advancement with growing DER integration
  - Assure that inverters perform as specified
  - Avoid erroneous crosstalk with other devices
  - Assure compatibility with communication and control systems
  - Support development and maintenance of industry standards



Strategic  
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# Communication and Control for Advanced Distribution Systems Topic **SDG&E**

## Innovation Need

- Advancing power system infrastructure is a continuously ongoing process of integrating emerging technologies into the infrastructure

## Topic Description

- Precommercial demonstration of communication, visualization, and control concepts for advanced distribution system infrastructure
- Consider not only the ongoing assimilation of DER into the infrastructure, but also the interoperability of the DER with other emerging technologies in monitoring, power quality management, resilience, and protection
- Builds on legacy work in past EPIC cycles and on recent advances in industry practices
- Maps to multiple initiative areas

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# SCE Initiative: Energy Management Foundational Technologies

As the more traditional, fossil fuel based generation is replaced by renewable energy resources, the services provided to the grid by those resources will need to be replaced as well. The first is the delivery of energy—the basic function of these resources. Next is the capacity services, which includes basic capacity service, load shaping and shifting capacity, and ramping reserve capacity. Additional services include constraint management, cold load pickup, frequency control and response, black start, resilience to disturbances, and finally voltage support. The capability of distributed energy resources (DER) to deliver these services needs to be demonstrated.

The key foundational research topic area for increasing the value proposition for DER is to examine **how to manage the grid and energy delivered**. The research Topic Area to be investigated is:

- Localized & Edge Control
- Inertia Substitution

The Strategic Objectives, Initiatives, and Topics in this presentation are preliminary and subject to change.



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# Localized & Edge Control Topic

## **SCE**

### **Innovation Need**

- Edge monitoring, control, and situational awareness innovations are needed to ensure that distributed and resilient energy sources are fully utilized. Edge processing will minimize the large amount of data transferring to traditional grid control centers and reduce the communication network traffic.

### **Topic Description**

- Demonstrate the ability of advanced software and communication protocols operating at the grid edge to manage and process large amount of data coming from multiple distribution automation devices and energy systems including solar PV, battery storage, EV charging stations, and microgrid systems working in synchrony to provide stable, reliable energy to communities and variable loads.

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# Inertia Substitution Topic

## **SCE**

### **Innovation Need**

- Retiring traditional generating plants will lead to a decline in the inertia of the grid. This issue needs to be accurately aligned to ensure that the retirement of the traditional generating plants will not lessen the critical grid benefits to the customer.

### **Topic Description**

- Understand, enable, and improve grid performances by adopting inertia substitution technologies to achieve reliability and resilience for the future grid.

Strategic  
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# SCE Initiative: Energy Management Situational Capabilities

Growing and enhancing utility energy management capabilities by leveraging distributed energy resources (DER) requires further advancement in the **areas of energy storage and grid controls**. The ability to store energy for longer periods and to anticipate when that will be necessary will both be important. Control systems and strategies enabling formation of microgrids and greater variation in power supply and demand across the grid will increase utilization of DERs.

The key situational capabilities designed to solve specific grid challenges through DERs will be investigated around the following Research Topic Areas:

- Energy Buffering
- Islanding & Reconfigurability
- Bidirectional Power Flow
- Customer Load Flexibility

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# Energy Buffering Topic

## **SCE**

### **Innovation Need**

- The intermittency of solar and wind generation requires energy storage to act as a buffer to ensure that loads can be supported by the grid even when the solar and wind generation is not high enough to meet customer demand.

### **Topic Description**

- Demonstrate a variety of Long Duration Energy Storage systems, including but not limited to flow, compressed air, liquid air, pumped hydro, gravity, and thermal energy storage, and their capability to provide greater than 10 hours of energy needed to provide valuable energy buffering support during periods of low renewable energy.

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# Islanding & Reconfigurability Topic

## **SCE**

### **Innovation Need**

- The islanding functionality of advanced microgrids provides improved resiliency and reliability of the grid by giving distribution service operators and their customers the option to continue operating through power outages, whether planned or unplanned.

### **Topic Description**

- Demonstrate a new paradigm for nested microgrids leveraging multiple islanding points and reconfiguration of electrical network that provides scalability to allow for management of a high number of grid supportive DERs with high PV penetration for both resiliency and reliability.

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# Bidirectional Power Flow Topic

## **SCE**

### **Innovation Need**

- Bidirectional flow information is required for areas with high levels of DER penetration where reverse power flow will occur during certain times of the day and year.

### **Topic Description**

- Understand the impact of high penetration level of DER on the monitoring, protection and control systems that have been designed for traditional, radial operation.



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# Customer Load Flexibility Topic

## **SCE**

### **Innovation Need**

- The intermittency of solar and wind generation requires energy storage to act as a buffer to ensure that loads can be supported by the grid even when the solar and wind generation is not high enough to meet the demand.

### **Topic Description**

- Demonstrate methods to establish the parameters of applied customer flexibility and advance techniques to serve the future customer with higher efficiency, safety, lower cost, and lower emissions.

# Open Discussion on Strategic Objective

Strategic Objective:

*Increase the Value Proposition of Distributed Energy Resources to Customers and the Grid*

<p><b>Distributed Energy Resource Integration and Load Flexibility Initiative</b></p> <ul style="list-style-type: none"> <li>• Interconnection Enablement</li> <li>• Advanced Distribution Powerflow Management</li> </ul> <p><b>Transportation Electrification Initiative</b></p> <ul style="list-style-type: none"> <li>• EV Technology Development and Standardization</li> <li>• EV Battery Re-Use for Stationary Energy Storage</li> </ul>	<p><b>PG&amp;E</b></p>
<p><b>Transportation Electrification Initiative</b></p> <ul style="list-style-type: none"> <li>• Repowering a Diesel-Powered Rail Line with Electrification Topic</li> </ul> <p><b>Distributed Energy Resource Integration Initiative</b></p> <ul style="list-style-type: none"> <li>• Optimizing Real Time Net Energy Metering (NEM) Hosting Capacity</li> <li>• Demonstrating Solutions for Inverter Integration Issues</li> <li>• Communication and Control for Advanced Distribution Systems</li> </ul>	<p><b>SDG&amp;E</b></p>
<p><b>Energy Management Foundational Technologies Initiative</b></p> <ul style="list-style-type: none"> <li>• Localized &amp; Edge Control</li> <li>• Inertia Substitution</li> <li>• Customer Load Flexibility</li> </ul> <p><b>Energy Management Situational Capabilities Initiative</b></p> <ul style="list-style-type: none"> <li>• Bidirectional Power Flow</li> <li>• Energy Buffering</li> <li>• Islanding &amp; Reconfigurability</li> </ul>	<p><b>SCE</b></p>



# 5 Minute Break



# EPIC Workshop Agenda

Session	Start	Mins	Details	Lead
Opening	8:30	5	Safety Moment	PG&E
	8:35	5	Introduction to EPIC	PG&E
Strategic Objective: Create a More Nimble Grid to Maintain Reliability as California Transitions to 100 Percent Clean Energy	8:40	45	T&D Foundation Technologies Initiative	SCE
			T&D Situational Capabilities Initiative	SDG&E
			Grid Reliability Initiative	PG&E
			Clean, Dispatchable Resources Initiative	PG&E
	9:25	25	Grid Modernization Initiative	Utilities
9:25	25	Open Discussion	Utilities	
Break	9:50	5		
Strategic Objective: Increase the Value Proposition of Distributed Energy Resources to Customers and the Grid	9:55	45	Distributed Energy Resource Integration and Load Flexibility Initiative	PG&E
			Transportation Electrification Initiative	PG&E
			Transportation Electrification Initiative	SDG&E
			Distributed Energy Resource Integration Initiative	SDG&E
	10:40	25	Energy Management Foundational Technologies Initiative	SCE
10:40	25	Energy Management Situational Capabilities Initiative	SCE	
10:40	25	Open Discussion	Utilities	
Break	11:05	5		
Strategic Objective: Inform California's Transition to a Zero-Carbon Energy System that is Climate-Resilient and Meets Environmental Goals	11:10	45	Climate and Environment Initiative	PG&E
			Vulnerability, Threats, and Hazard Reduction Initiative	SCE
	11:55	25	Digital Transformation Initiative	SCE
	11:55	25	Open Discussion	Utilities
Closing	12:20	10	Final Participant Questions and Comments	Utilities

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# Introduction to the Strategic Objective

- Resilient and adaptable in the face of increasing climate change-related risks
- Environmentally sustainability

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# PG&E Initiative: Climate and Environment

- Carbon Capture and Re-Use
- Individual Customer Emissions Visibility
- Preventing Faults from Causing Ignitions
- Undergrounding Capabilities
- Improved Inspection Capabilities
- Pinpointing Fault Location
- Risk Modeling Improvements
- Crowdsourcing
- Disaster Protection

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# Carbon Capture and Re-Use Topic

## **PG&E**

### Innovation Need

- As part of our commitment to climate action in California, by 2040 PG&E will achieve a net zero energy system on the way to a climate- and nature-positive energy system by 2050
- Carbon emissions reduction will not be 100% by 2040; therefore, in order to achieve a net zero energy system, PG&E will need to also deploy cost-effective carbon capture, storage, and re-use technologies
- There needs to be substantial advancement for these technologies to be ready for wide-scale deployment to materially contribute to achievement of the PG&E's climate plan

### Topic Description

- Demonstrate a range of carbon capture, storage and re-use solutions. Candidates include solutions for woody biomass management, such as densification and conversion technologies, as well as solutions for the capture and sequestration of carbon generated at peaker plants

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# Individual Customer Emissions Visibility Topic

## **PG&E**

### Innovation Need

- PG&E's customers are increasingly interested in, and would benefit from, more timely and granular information about the emissions & environmental impact of their energy consumption
- Providing commercial, industrial, and agricultural customers with timelier & granular estimates of the GHG emissions footprint from their consumption will empower them—not only to provide the information to their shareholders—but also to take steps to reduce their environmental impact and save money

### Topic Description

- Provide customers with a detailed, individualized view of their electricity usage and emissions by time of day, using existing hourly SmartMeter data and 5-minute CAISO emission estimates
- Include the purchase of renewable energy credits (RECs) in the accounting of a customer's emissions, and demonstrate the technologies and systems required to provide rigorous tracking and reporting of RECs with respect to the time of day they are created



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# Preventing Faults from Causing Ignitions Topic

## PG&E

### Innovation Need

- PG&E has invested in methods for rapidly de-energizing faults before they can cause ignitions, such as through its EPSS initiative, and the demonstration of REFCL technology
- However, there are still opportunities to enhance overall capabilities to reduce false positive and negatives, address specific types of faults that pose challenges for current solutions, increase the speed of de-energization, and reduce overall solution deployment costs
- Beyond rapid de-energization capabilities, there are also opportunities for other innovations to prevent faults from causing ignitions

### Topic Description

- Demonstrate a range of new rapid de-energization capabilities, such as accelerometer or PMU-based capabilities, and real-time edge processing of LiDAR sensors to anticipate contact with external objects and de-energize before faults occur
- Demonstrate solutions beyond rapid de-energization, such as novel ways of managing fuels in ROWs or new conductor materials that do not pose the same risk of ignition if downed

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# Undergrounding Capabilities Topic

## **PG&E**

### Innovation Need

- PG&E has committed to undergrounding 10,000 miles of the overhead distribution system in high fire risk areas
- Conventional undergrounding methods and processes are slow and expensive. There is a broad opportunity to introduce innovating technologies and solutions to improve undergrounding capabilities as we ramp up undergrounding efforts in the coming years

### Topic Description

- Demonstrate a wide range of innovative capabilities in the following areas:
  - Subsurface Mapping
  - Novel Materials / Construction Methods
  - At Surface Alternatives
  - Monitoring Technology
  - Spoils Management
  - Permitting / Easement Facilitation

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# Improved Inspection Capabilities Topic

## **PG&E**

### Innovation Need

- PG&E collects extensive data for routine inspections through a variety of collection methods, but processes for reviewing the collected data are almost entirely manual. Manual inspections of assets are costly, and the quality of results can vary from inspector to inspector. Processes for updating asset information in systems of record are also manual and labor-intensive.
- There is also opportunity to employ new sensors to collect additional data types to help improve understanding of asset health & risks along ROWs. There is particularly opportunity around failure modes that begin to manifest within assets and are not externally apparent.

### Topic Description

- Demonstrate capabilities for leveraging existing inspection data and machine learning to automate inspection processes, as well as automate processes for updating asset records
- Demonstrate new sensors that can improve the early identification of various asset failure modes, such as internal issues with transformers or corrosion within steel structures

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# Pinpointing Fault Location Topic

## **PG&E**

### Innovation Need

- While PG&E has numerous methods for identifying when there are faults in its electric system, it can be difficult to determine the precise locations of the faults
- The time spent working to identify fault location creates longer exposure to safety risks, and longer outage times for customers

### Topic Description

- Demonstrate new methods for determining fault location, such as using precise timing signals available from co-located third party fiber optics cabling, next generation line sensors, synchrophasors, or analyzing fault and mid-circuit voltages using a combination of data from existing sources
- Beyond demonstrating methods to narrow down the geographic location of faults within the system, also explore methods for identifying the specific locations of deterioration and faults within assets themselves

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# Risk Modeling Improvements Topic

## **PG&E**

### Innovation Need

- While PG&E has made strides in developing risk models to support investment decisions, there is opportunity to make models used for annual WMP development more dynamic and granular
- There are also opportunities to improve the various underlying environmental forecasting capabilities that drive risk models used for investment and operational decision-making

### Topic Description

- Make existing risk models more dynamic, starting by exploring feasibility of quarterly model refresh rate and associated processes for revisiting/refreshing work plans
- Make risk models more granular, to support more detailed selection of the most appropriate mitigation measures in narrower geographic areas. Work here will provide steps toward a full “digital twin” of PG&E’s system
- Improve environmental forecasting capabilities, such as by increasing spatial resolution of wind forecasts, and integrating models for non-wildfire hazards such as volcanic events

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# Crowdsourcing Topic

## ***PG&E***

### Innovation Need

- PG&E has taken initial steps to crowdsource information through the pilot rollout of the “Report It” app, as required by the CPUC
- The Report It app is intended only for non-emergency situations, is limited to pictures and video, and all submissions are reviewed manually. There is opportunity significantly build upon existing crowdsourcing capabilities to more fully leverage the general public and other companies as PG&E’s extended eyes and ears.

### Topic Description

- Demonstrate enhanced crowdsourcing capabilities to intake a wider range of data beyond photos and video, broaden crowdsourcing to partnerships with companies that may be routinely collecting valuable data (ex, LiDAR data from fleets of self-driving cars), apply machine learning to automate the review of collected data, and explore opportunities to apply crowdsourcing to real-time emergency situations

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# Disaster Protection Topic

## **PG&E**

### Innovation Need

- While PG&E has invested significantly in wildfire response capabilities, there are opportunities to improve the speed of fire detection. AI-based camera detection is being explored, but still in its infancy, and satellite detection is limited in timing and locational precision.
- Beyond wildfires, California has high earthquake risk and there is significant opportunity to also continue improving emergency response capabilities in this area

### Topic Description

- Demonstrate a range of disaster protection capabilities, such as:
  - Methods for faster detection of ignitions and improved real-time situational awareness of fire spread. One potential solution to explore is the use of stratospheric balloons.
  - Enhancements to earthquake protection capabilities, including methods for integrating detection within protective devices to trigger automatic de-energization, and other enhancements around real-time data collection and impact modeling
  - Enhancements to rapid coordination and evaluation of impacts after earthquakes occur

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# SCE Initiative: Vulnerabilities, Threats, and Hazard Reduction

Climate change has brought about many threats to the electric system and the surrounding environment where it operates. Hazards such as overhead line contact with vegetation, flying debris in a storm, earthquakes, mud slides, floods, and fire, all impose great threats to our grid. To mitigate its impact, in concert with traditional grid hardening and safety programs, such as Public Safety Power Shutoffs (PSPS), we must investigate **novel methods** to maintain public safety and the safety of the workforce charged with building, operating, and maintaining the electric system.

The Research Topic Areas to be examined under this objective include:

- Safety & Work Methods Advancement
- Hardening & Remediation



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# Safety & Work Methods Advancement Topic **SCE**

## Innovation Need

- In response to address increased frequency of wildfires and the damage caused in surrounding communities, there is growing interest to identify, develop, and implement new methods to mitigate the risks of wildfires caused by electrical equipment by investing in safe and efficient ways to monitor and maintain electrical assets.

## Topic Description

- Develop and demonstrate technologies that can improve the safety of both utility personnel and the public.

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# Hardening & Remediation Topic

## **SCE**

### **Innovation Need**

- Increase the resilience of the grid in response to physical and cyber threats, such as weather-related events and external factors such as cars crashes into assets.

### **Topic Description**

- Develop and demonstrate technologies that can reduce the need for PSPS through alternative methods that harden the grid and reduce its exposure to wildfires and other weather-related events.

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# SCE Initiative: Digital Transformation

As we expand into a more data driven model to operate the grid, communicate with smart digital technologies, and maintain our assets, there will be increased reliance on data systems. This strategic initiative focuses on the **digitization of utilities data and processes.**

The areas of investigation to be examined under this objective include:

- Data Driven Operations
- End-to-end Advanced Simulations & Analytics

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# Data Driven Operations Topic

## **SCE**

### **Innovation Need**

- A resilient and responsive grid is enabled by the efficient implementation of Internet of Things (IoT) devices and grid data to make accurate and timely analysis of events impacting the grid.

### **Topic Description**

- Evaluate and demonstrate systems and technologies that support data collection, analyses efforts used to provide situational awareness and guide inspections and work orders associated with vegetation management, electrical faults, and system maintenance.

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# End-to-end Advanced Simulation & Analytics

## Topic SCE

### Innovation Need

- The growing penetration of distributed, intermittent generation on the grid, a changing climate, and cyber security threats create new challenges and complexity in both planning and in operations.

### Topic Description

- Software tools that can ingest, organize, and analyze complex forecasting and grid information can prove to be critical for planning and operating the transmission and distribution systems. Once scaled up, these tools can be deployed to support recurring grid and work planning processes and disaster preparedness/response plans and procedures.

# Open Discussion on Strategic Objective

Strategic Objective:

*Inform California's Transition to a Zero-Carbon Energy System that is Climate-Resilient and Meets Environmental Goals*

<p><b>Climate and Environment Initiative</b></p> <ul style="list-style-type: none"> <li>• Carbon Capture and Re-Use</li> <li>• Individual Customer Emissions Visibility</li> <li>• Preventing Faults from Causing Ignitions</li> <li>• Undergrounding Capabilities</li> <li>• Improved Inspection Capabilities</li> <li>• Pinpointing Fault Location</li> <li>• Risk Modeling Improvements</li> <li>• Crowdsourcing</li> <li>• Disaster Protection</li> </ul>	<p><b>PG&amp;E</b></p>
<p><b>Vulnerability, Threats, and Hazard Reduction</b></p> <ul style="list-style-type: none"> <li>• Hardening &amp; Remediation</li> <li>• Safety &amp; Work Methods Advancement</li> </ul> <p><b>Digital Transformation</b></p> <ul style="list-style-type: none"> <li>• End-to-end Advanced Simulation &amp; Analytics</li> <li>• Data Driven Operations</li> </ul>	<p><b>SCE</b></p>



# Workshop Close

Final Participant Questions and Comments



# Contact Information

- CPUC: [www.cpuc.ca.gov/energyrdd/](http://www.cpuc.ca.gov/energyrdd/)
- EPIC Administrators:
  - CEC: <https://www.energy.ca.gov/programs-and-topics/programs/electric-program-investment-charge-epic-program>
  - SCE: [www.sce.com/regulatory/epic](http://www.sce.com/regulatory/epic)
  - SDG&E: <https://www.sdge.com/epic>
  - PG&E: [www.pge.com/epic](http://www.pge.com/epic)
- Joint EPIC Database: [www.epicpartnership.org](http://www.epicpartnership.org)
- Comments on today's workshop: [EPIC\\_info@pge.com](mailto:EPIC_info@pge.com)





# Thank You

