EPIC Workshop

June 30, 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:
  - provide portfolio updates on their EPIC investments
  - seek feedback from participants on potential focus areas for upcoming EPIC 4 investments

EPIC Workshop Agenda

Theme	Start	Mins	Topic
Opening	8:30	5	Opening Remarks and Safety
	8:35	5	Introduction to EPIC and Today's Themes
Create a More Flexible Grid to Maintain Reliability as California Transitions to 100% Clean Energy	8:40	15	Accomplishments, Their Significance & Path Forward
	8:55	35	EPIC 4 Thematic Panel and Discussion
	9:30	5	Theme General Q&A
Increase the Value Proposition of Distributed Energy Resources to Customers and the Grid	9:35	15	Accomplishments, Their Significance & Path Forward
	9:50	35	EPIC 4 Thematic Panel and Discussion
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Close	12:20	10	Concluding Comments, Notes, Actions, Next Steps

Opening Remarks

Dan Gilani
Sr. Manager, Emerging Technology Strategy & Programs
PG&E

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

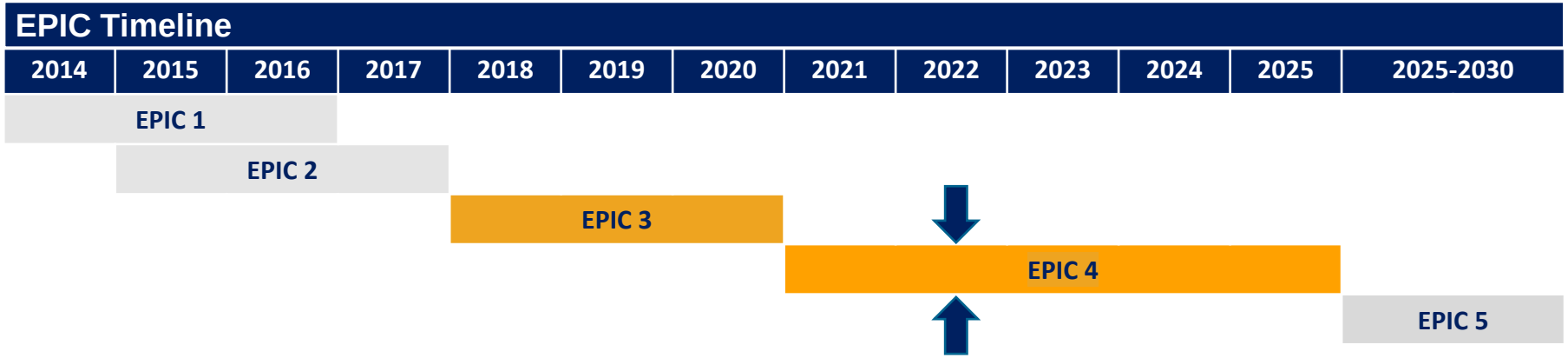
Applied Research and Development	Technology Demonstration & Deployment	Market Facilitation
Investment in **applied energy science and technology** that provides public benefit but for which there is no current deployment of private capital.	Investments in technology demonstrations at real-world scales 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
- Seeking feedback on the candidate topics provided in the four thematic panels
- Additional workshop later this summer to further coordinate

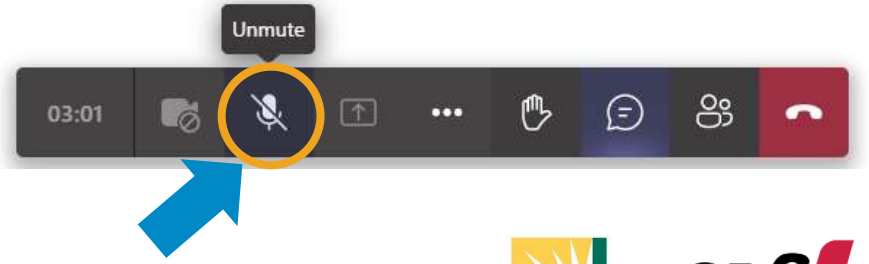
EPIC 4 Funding Allocations

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

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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Theme: Create a More Flexible Grid to Maintain Reliability as California Transitions to 100 Percent Clean Energy

Accomplishments, Their Significance, and the Path Forward

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

Distributed Cyber Threat Analysis Collaboration

SCE collaborated with industry stakeholders to identify gaps and improve threat intelligence for focused utility needs, allowing improved response to cybersecurity events

Objectives	Approach	Benefits
• Identified gaps in available data and sharing processes that hinder utility sector threat intelligence sharing • Demonstrated the ability to standardize and automate utility cyber-threat feeds across security operations centers, utilities, and government agencies • Shortened the time needed to analyze and respond to cybersecurity events by automating data ingestion	• Automated aggregation, risk assignment, and filtered existing data sources and enriched with individual utility focus • Responded to 2021 White House 100-day initiative to improve cybersecurity across the electric sector* by analyzing and recommending gap closure measures for deeper grid risk state knowledge and sensor requirements • Created a vendor neutral baseline of security practices and technologies needed to allow faster and lower risk sharing with utility partners	• Demonstrated the ability to, and benefit of, combining and filtering multiple threat intelligence feeds that are utility centric and company relevant • Identified and defined gaps in operational data and sharing processes that will allow utilities to garner relevant, time sensitive data in alignment with national focus on grid sensor data • Assuming broad adoption, DCTAC could lead to the reduction of compromises of SCE cybersecurity controls (currently estimated at 25 events/year**) through early warning by industry community and reduce the 16% of events that lead to significant cyber event outcomes**

*Fact Sheet: Biden Administration and Private Sector Leaders Announce Ambitious Initiatives to Bolster the Nation's Cybersecurity

**See SCE's 2022 RAMP Filing

Advanced Distribution System Infrastructure

Objectives

Develop safety training programs to support distribution system infrastructure advances.

Configure existing off-the-shelf software to improve the instructional training experience for two workgroups.

- Module 1: Distribution System Operators in Training: Integrate data from various virtual systems to provide one view for operator trainees (SCADA, wireless fault indicators, smart meters, synchrophasors).
- Module 2: Journeymen Lineworkers: Use augmented/virtual reality to improve the training experience applied to implementation of equi-potential zones for underground distribution

Module 1: Eliminating Fault Location Ambiguities

Module 2: Equi-Potential Zone Training in Virtual Reality

Status

- Work in both modules has concluded
- Final reports for both modules posted on www.sdge.com/epic

Applications of AMI Data to System Operations

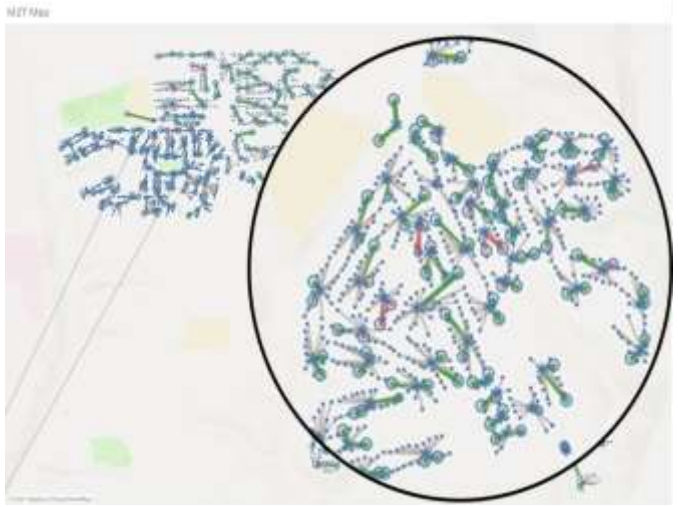
Objective

Evaluate two critical capabilities – 1) the AMI system as a voltage sensor network and 2) as a phase identification and meter-to-transformer mapping tool – for leveraging SDG&E's AMI system with its 1.4 million endpoints to provide actionable secondary voltage data and analysis to SDG&E.

Status

- A major project focus was to use the AMI system as a voltage sensor network, to translate secondary voltages that can then be used in operation or planning tools.
- Another major focus was on available AMI data to identify phasing information of each distribution segment, load, and customer.

- Clustering algorithms iteratively applied to time series data
- Algorithm tuning
- Verified results with known source (field verification)



Use Case	Accuracy Range
Phase Identification	83% - 98%
Meter-to-Transformer	*65% - 89%*

System Harmonics for Power Quality Investigations

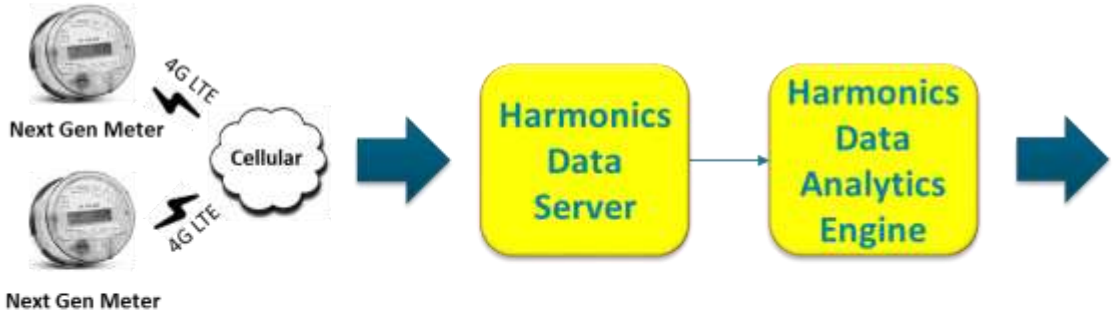
Harmonics issues on the grid negatively impact customer equipment operation and can also damage utility assets

Objective

- Demonstrate the use of next generation smart meters to detect, investigate and mitigate harmonic issues on the distribution system
- Higher incidence of harmonics issues is anticipated with increased DER penetration

Status

- Next gen smart meters installed on representative circuits
- Data connectivity established, pipeline and dashboards created
- Data analysis continuing through summer 2022



Next gen meters continuously monitor and transmit harmonics data

Harmonics data stored within PG&E server. Automated algorithms detect high harmonics level exceeding acceptable limits and flag meter locations for engineering review and analysis.

Harmonics data are used for investigating and resolving harmonics issues and tracking system harmonics

EPIC 4 Thematic Panel and Discussion

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

Moderator and Panel Members

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

Moderator	Brian J. Deaver Sr., P.E. Senior Technical Executive Electric Power Research Institute (EPRI)
Panelists	Josh Mauzey Grid Edge Innovation Senior Manager SCE
	Frank Goodman Principal Technology Development Advisor SDG&E
	Damian Inglin Emerging Technology Strategy & Programs PG&E

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

Ultra-Low Latency Communications

Southern California Edison

SDGE

PG&E

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

Inertia Substitution

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

Adaptive Communication and Control Infrastructure for Advanced Distribution Systems

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

Remote Grid and Microgrid Enablement

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

Individual Customer Resiliency

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

Long-Duration and Alternative Advanced Energy Storage Systems

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

Mobile Microgrids

Closing Discussion for Theme

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

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

Accomplishments, Their Significance, and the Path Forward

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

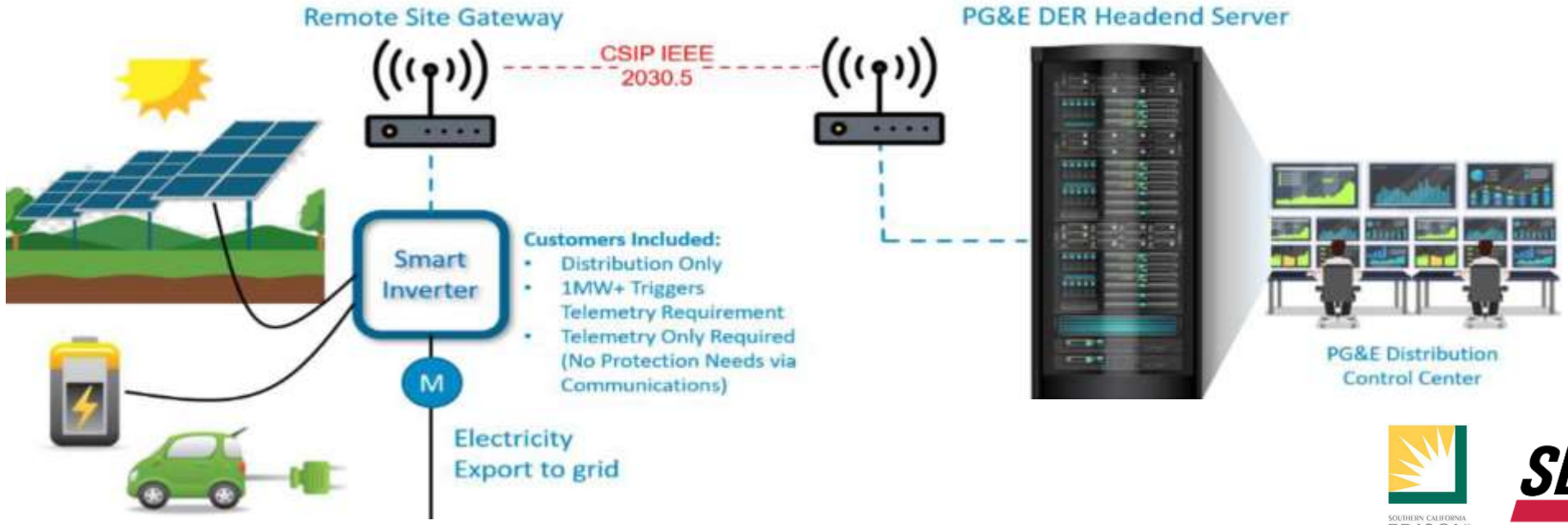
Advanced DERMS & ADMS

Objective

- Develop a DERMS head-end system and associated low-cost interface solution for DER telemetry & control
- Demonstrate this system for single customer DERs and pilot with multiple BTM DERs
- Provide a low-cost telemetry solution for new/existing DERs with the 1MW+ telemetry requirement

Status

- Demos complete at two sites
- Working with aggregators to apply learnings to more complex systems
- Project is in “stabilization” phase prior to transfer to Operations in Q3 2022
- Project will achieve objective to provide low-cost telemetry solution for new/existing DERs



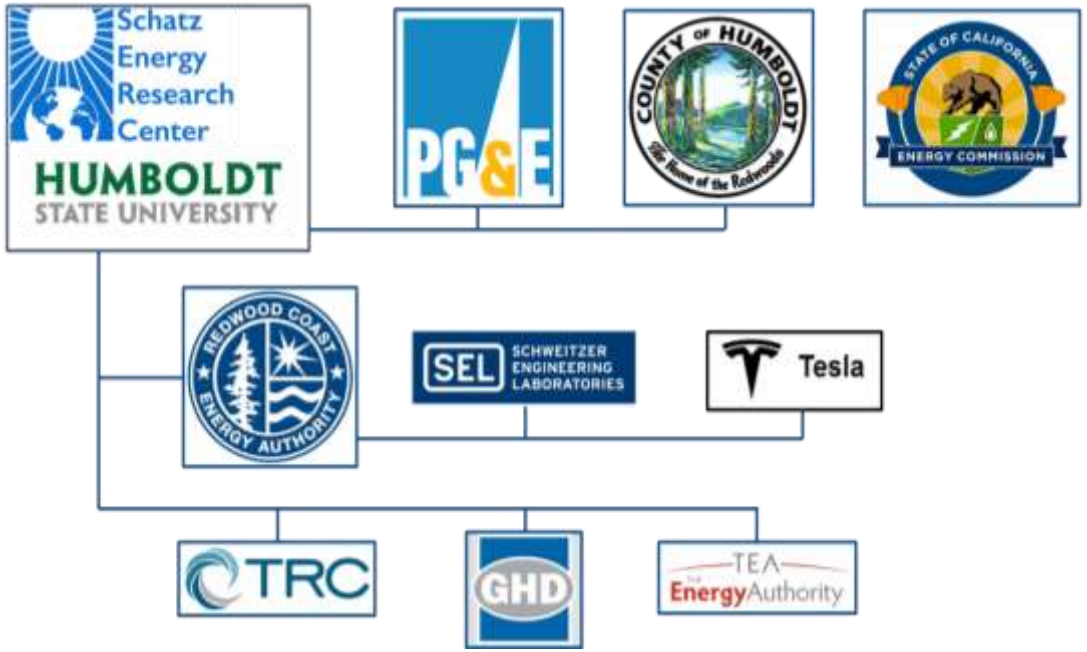
Multi-Use Microgrids and Microgrid Coordination of BTM DERs

Objective

- Configure the Arcata-Eureka airport's local microgrid controller to integrate the microgrid into PG&E's distribution network and enable Distribution Control Center (DCC) visibility and control of the microgrid.
- Develop scalable and replicable approaches to planning, designing, deploying and operating multi-customer microgrids.

Status

- Microgrid complete and awaiting final MOA & PTO
- Lab testing of additional equipment underway
- Ribbon cutting ceremony 6/22
- Project completion Q3 2022
- Results will provide an immediate blueprint for future multi-customer microgrids



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Multi-Purpose Meter (EVSE Submetering Enablement)

Objective

- Enable simplified EVSE installations and access to submetered billing at specific low rates by developing a compact integration of PG&E's Next Generation Meter (NGM) with Commercial and Residential EVSEs

Status

- All manufactured prototypes received
- Lab testing complete
- Upcoming installation at PG&E sites
- Project to complete in Q3 2022

Modular Next Generation Meter Core

External/Retrofit version of the NGM Submeter (shown with EVSE)

Commercial EVSE w/ NGM Submeter Integrated

Integrated Grid Planning (IGP)/ Electric Access System Enhancement (EASE)

SCE tested methods to control generation, storage, and load resources on the distribution system on a large scale that's economical and improves reliability

Objectives

- Demonstrated a scalable, interoperable, and cost-effective means of integrating and optimizing a high penetration of DER
- Demonstrated ability for residential/commercial customer DER resources to bid into a simulated energy market via their DER aggregator
- Demonstrated dynamic hosting capacity capability
- Demonstrated adaptive protection capability

Approach

- Several subprojects were assembled to achieve the objectives of IGP, which included: EASE, Adaptive Protection, Integrated Grid Analytics, Integration of Big Data
- Each subproject contributed to the final field demonstration, which was conducted under EASE
- Partnered with closely related projects under ARPA-E, CEC determined capabilities of load flexibility support for renewable integration and validated/strengthened IEEE 2030.5 standard

Benefits

- Federal, California, and partner funds resulted in a total of $2.3 spent for each $1 of EPIC funding; combined value of the EPIC dollars and other funding was approximately $48 million
- DERMS used controllable DER to dynamically manage demand/ generation hosting capacity
- Incentivized customers to provide grid services and bid into the energy market – improving customer ROI on DER ($462/year for EASE DSO market participants)
- Distribution upgrades deferred, saving approximately $400 million by 2040 on capacity upgrades
- Enabled SCE to shift toward clean generation, helping SCE reach its goal of carbon neutrality by 2045
- Replaced spinning reserve with flexible loads and controllable DER

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EPIC 4 Thematic Panel and Discussion

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

Moderator and Panel Members

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

Moderator	Haresh Kamath Director of Distributed Energy Resources and Energy Storage Electric Power Research Institute (EPRI)
Panelists	Josh Mauzey Grid Edge Innovation Senior Manager SCE
	Frank Goodman Principal Technology Development Advisor SDG&E
	Damian Inglin Emerging Technology Strategy & Programs PG&E

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

Advanced Powerflow Management

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

V2G Technology Development and Interoperability

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

Interconnection Enablement

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

Islanding & Reconfigurability

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

Optimizing Real-Time NEM Hosting Capability

Closing Discussion for Theme

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

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Theme: Inform California's Transition to a Zero-Carbon Energy System

Accomplishments, Their Significance, and the Path Forward

Inform California's Transition to a Zero-Carbon Energy System

Operational Vegetation Management Through Novel Onsite Equipment

Objective

- Demonstrate technologies capable of creating significant improvements to wood management value chain, (i.e. material improvements economic, environmental, and/or safety-related) and lower VM costs, such as torrefaction or wood bailing

Status

- Reviewing RFP responses from the 11 responding organizations

Smart City/Control & Protection of Microgrids Projects

These SCE projects will evaluate and demonstrate how we can integrate operation of DERs and the distribution system to enhance resiliency and reliability for our customers

Objectives	Approach	Benefits
• Demonstrate control and protection schemes for safe and reliable operation of nested microgrids under a variety of ownership models; develop standard operations to support grid integrity in high-DER environments	• Develop common, standards-based control and communication platform to be used across multiple/future microgrid projects for scalability. which in turn supports reliability, affordability, and safety	• Microgrids can remove the need for diesel generators, each of which emits 544 pounds of CO_2 per hour*
• Demonstrate the electric utility role in a Smart City initiative, including coordination with urban planning, streamlined interconnection, efficient utilization of energy resources, and resiliency for critical city operations	• Establish and utilize lab simulation and testing capabilities to ensure designs and implementation strategies are safe and robust before field commissioning	• Microgrids improve reliability and resiliency by decreasing the number of outages through temporary islanding; this could reduce the need for outages during Public Safety Power Shutoff events (105M total Customer Minutes of Interruption in 2021)
• Identify technical requirements, challenges, and standard solutions to enable safe microgrid operation, supporting the Commission's Microgrid rulemaking	• Leverage EPIC framework/funding, Smart City concept, and local government interest in resiliency solutions to gain real-world experience implementing and operating a cyber secure microgrid that touches both utility and customer assets and information systems	• Smart City will be deployed in an underserved community that is heavily affected by pollution, with a CalEnviroScreen 4.0 score in the 80th percentile, with adjacent neighborhoods as high as the 96th percentile

*Per South Coast Air Quality Management District, 500 kW generator

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Multi-Purpose Mobile Battery Energy Storage Systems (MBESS)

Objectives

- Pre-commercial demonstration for proof of concept
- Determine value proposition for alternative use cases
- Identify preferred sequencing for rotational use at various sites
- Encourage the emergence of an MBESS supplier industry
- Not an evaluation of specific vendor products

Status

- Several use cases demonstrated with two MBESS units at various sites in two work modules
- Final reports for both modules posted on www.sdge.com/epic
- Third module with additional use cases in progress
  - Will include trial of IEEE 2030.5 interoperability standard

MBESS at community resource center

MBESS at Cameron Corners Microgrid

EPIC 4 Thematic Panel and Discussion

Inform California's Transition to a Zero-Carbon Energy System

Moderator and Panel Members

Inform California's Transition to a Zero-Carbon Energy System

Moderator	Evan Birenbaum Senior Program Manager Electric Power Research Institute (EPRI)
Panelists	Josh Mauzey Grid Edge Innovation Senior Manager SCE
	Frank Goodman Principal Technology Development Advisor SDG&E
	Damian Inglin Emerging Technology Strategy & Programs PG&E

Inform California's Transition to a Zero-Carbon Energy System

Long-Term Grid Planning

Inform California's Transition to a Zero-Carbon Energy System

End-to-End Advanced Simulations and Analytics

Inform California's Transition to a Zero-Carbon Energy System

Woody Biomass Densification & Conversion

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Inform California's Transition to a Zero-Carbon Energy System

Light Rail Electrification

Closing Discussion for Theme

Inform California's Transition to a Zero-Carbon Energy System

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Theme: Advance Toward a Climate-Resilient Electric System

Accomplishments, Their Significance, and the Path Forward

Advance Toward a Climate-Resilient Electric System

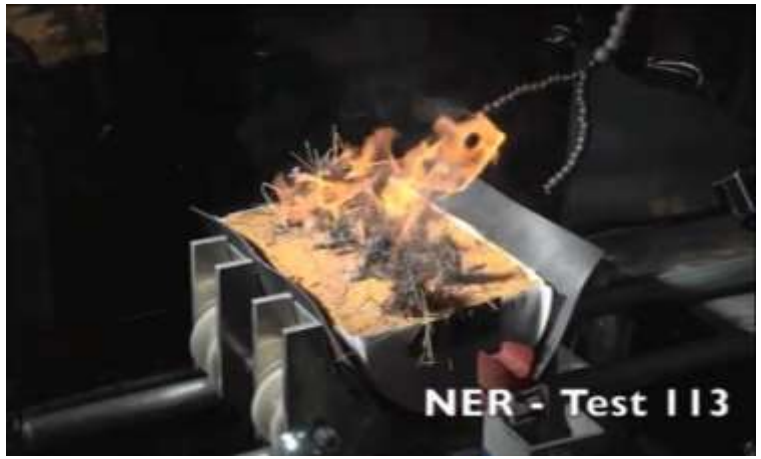
Proactive Wire Down Mitigation

Objective

- Demonstrate Rapid Earth Fault Current Limiter (REFCL) technology at a PG&E substation serving a high fire-risk area, to assess its effectiveness at automatic current reduction in wires down events, with the goal of drastically reducing the likelihood of wires down events causing wildfires.

Status

- Stage testing successfully completed—will replace VRs then turn over to operations in advisory mode.
- Project complete by ~3Q 2022
- Prioritizing future installations, in combination with undergrounding and hardening solutions.



Normal Ground Fault

With REFCL Technology

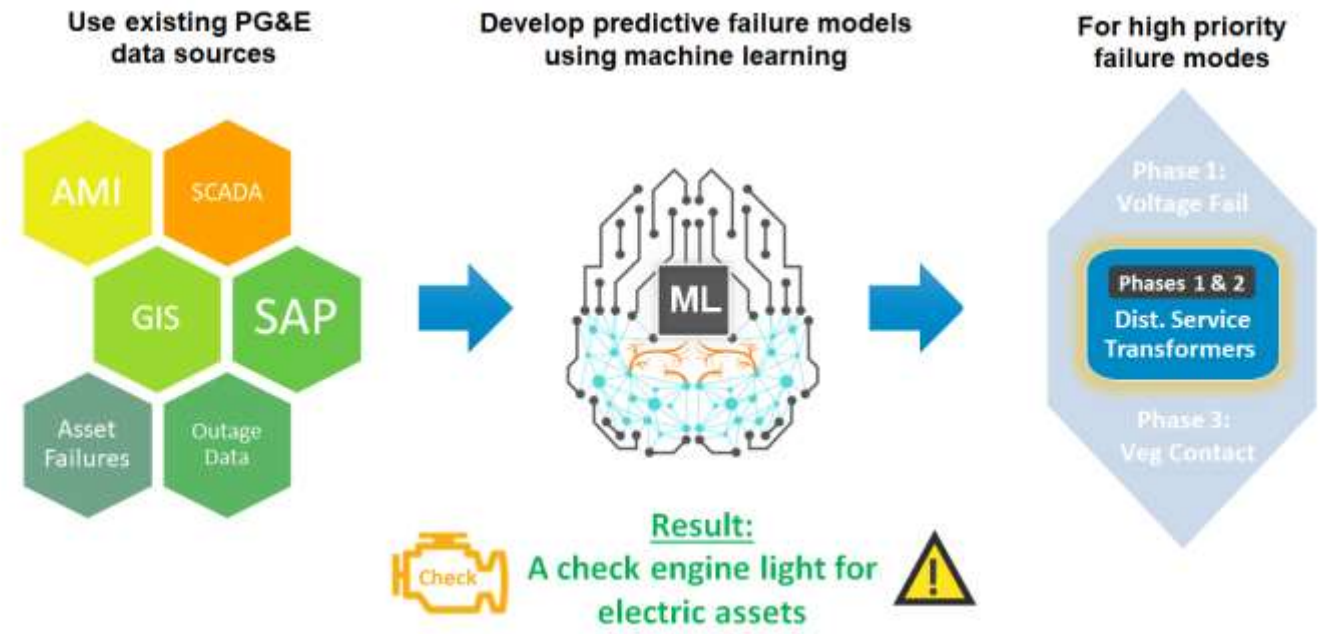
Data Analytics for Predictive Maintenance

Objective

- Leverage existing PG&E data sources, such as GIS, weather, SmartMeter™, SCADA and other data to develop and demonstrate analytical models that predict when maintenance will be needed for distribution assets.
- Main driver is to move from “run to failure” to predictive maintenance.

Status

- Three primary targets for in-depth analytics: fuses, transformers, and vegetation contact.
- Predicting incipient transformer failure has been highly successful.
- Transformer failure prediction has transitioned to operations.
- Vegetation contact workstream in progress, showing promise.
- Project to complete Q3 2022



Advanced Comprehensive Hazards Tool

SCE demonstrates the latest advancements in software-based solutions in assessing and improving seismic and climate resilience of an electricity system

Objectives	Approach	Benefits
• Investigate the potential of open source or commercially available risk assessment and geospatial analysis tools and adding functionality to develop an all-hazards risk assessment tool • Develop a capability to merge asset information, known failure probabilities, and hazards to determine high or low case scenarios to determine the overall hazard risk of an asset or area • Combine several features of hazard assessment into a single tool rather than disparate processes to assess risk • Develop capabilities to inform hazard mitigation in the long term but also provide early situational awareness in the case of an acute event, such as an earthquake or heavy storm to prioritize preparation effort	• Demonstrate advanced analytics that provide SCE the ability to identify electric asset specific vulnerabilities due to seismic, severe weather, and climate change events • Investigate the ability to improve upon and standardize internal tools used for natural hazard risk assessment • Demonstrate capabilities to inform hazard mitigation in the long-term as well as provide early situational awareness in the near-term • Model a diverse range of natural hazard events with adjustable parameters • Demonstrate models that can predict the probability of an event occurring and estimate its likely impact on specific assets and the overall network	• Tool will reduce repair costs by targeting SCE's most seismically vulnerable areas with hardened assets and specific response plans • Current estimated repair and recovery rate from a seismic event is 30 man-hours per repair, with multiple repairs necessary to fully restore a distribution circuit based on the intensity of the ground acceleration; tool could help SCE harden the grid where hazards are most present and reduce the number of repairs and completion time per repair

Applications of Unmanned Aircraft Systems

Objective

Evaluate new UAS sensors for assessment of infrastructure (i.e., equipment, lines, and structures) and determine which sensors best supply a necessary file format and metadata to deliver data for ingestion and processing within a future data platform.

Status

- Evaluated concepts for instrumentation and monitoring of power system equipment using enhanced imaging on UAS and sensor technology.
- Evaluated potential UAS applications to increase reliability, safety and cost efficiency in power system operations.

EPIC 4 Thematic Panel and Discussion

Advance Toward a Climate-Resilient Electric System

Moderator and Panel Members

Advance Toward a Climate-Resilient Electric System

Moderator	Doug Dorr Technical Executive, Power Delivery and Utilization Sector Electric Power Research Institute (EPRI)
Panelists	Josh Mauzey Grid Edge Innovation Senior Manager SCE
	Frank Goodman Principal Technology Development Advisor SDG&E
	Damian Inglin Emerging Technology Strategy & Programs PG&E

Advance Toward a Climate-Resilient Electric System

Preventing Distribution-Caused Ignitions

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Undergrounding Technology

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Sensors, Communication, and Analytics

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Advanced Unmanned Aircraft Systems

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Emergency Management

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Asset Data Analytics and Automation

Closing Discussion for Theme

Advance Toward a Climate-Resilient Electric System

Workshop Close

Concluding Comments, Notes, Actions, Next Steps

Contact Information

- CPUC: 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
  - SDG&E: https://www.sdge.com/epic
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- Comments on today's workshop: EPIC_info@pge.com

Thank You