EPIC 4 CPUC Project Workshop

Grid Technology Innovation

March 27, 2024

EPIC 4 Workshop Agenda

8:30 am	Introduction & Safety Moment
8:40 am	Opening Remarks
8:50 am	SCE & EPIC Overview
9:00 am	Swift Electrification of Transit (SET)
9:20 am	Stability Improvement with DERs (SIDER)
9:40 am	*Break*
9:50 am	Flexible Alternating Current System (FACS)
10:10 am	Quantum Networking
10:30 am	ML Augmented Digital Simulation (MAD-S)
10:50 am	*Break*
11:00 am	PG&E: Transmission & Distribution Co-Simulation Modeling
11:20 am	PG&E: Computer Vision Asset Registry and Maintenance
11:40 am	Closing Remarks

VIRTUAL MEETING EMERGENCY PROTOCOL

Follow these steps when a virtual or hybrid meeting attendee is incapacitated.

BEFORE THE MEETING STARTS - **ASSIGN ROLES**

- Who will call ESOC? **(626-815-5611)**
- Who will contact the leader?
- Who will stay on the call with the employee?
- Identify the location of employees who may be in transit or out in the field.

Mack Knobbe

Ryan Miller

Jordan Smith

1 A medical emergency occurs, or seems to be occurring.

2  If you know the employee's location, call 911.

3  Call Edison Security Operations Center (ESOC) at **626-815-5611.**

4  If 911 has not been called, ESOC will contact 911 to dispatch emergency services to employee's home address.

5  Contact the employee's leader.

6  Remain on the line with the employee until emergency services arrives.

If employee is a supplemental worker, ESOC will contact the vendor to provide known information; if unavailable, 911 will be contacted.

SOUTHERN CALIFORNIA EDISON® Energy for What's Ahead®

Edison Safety

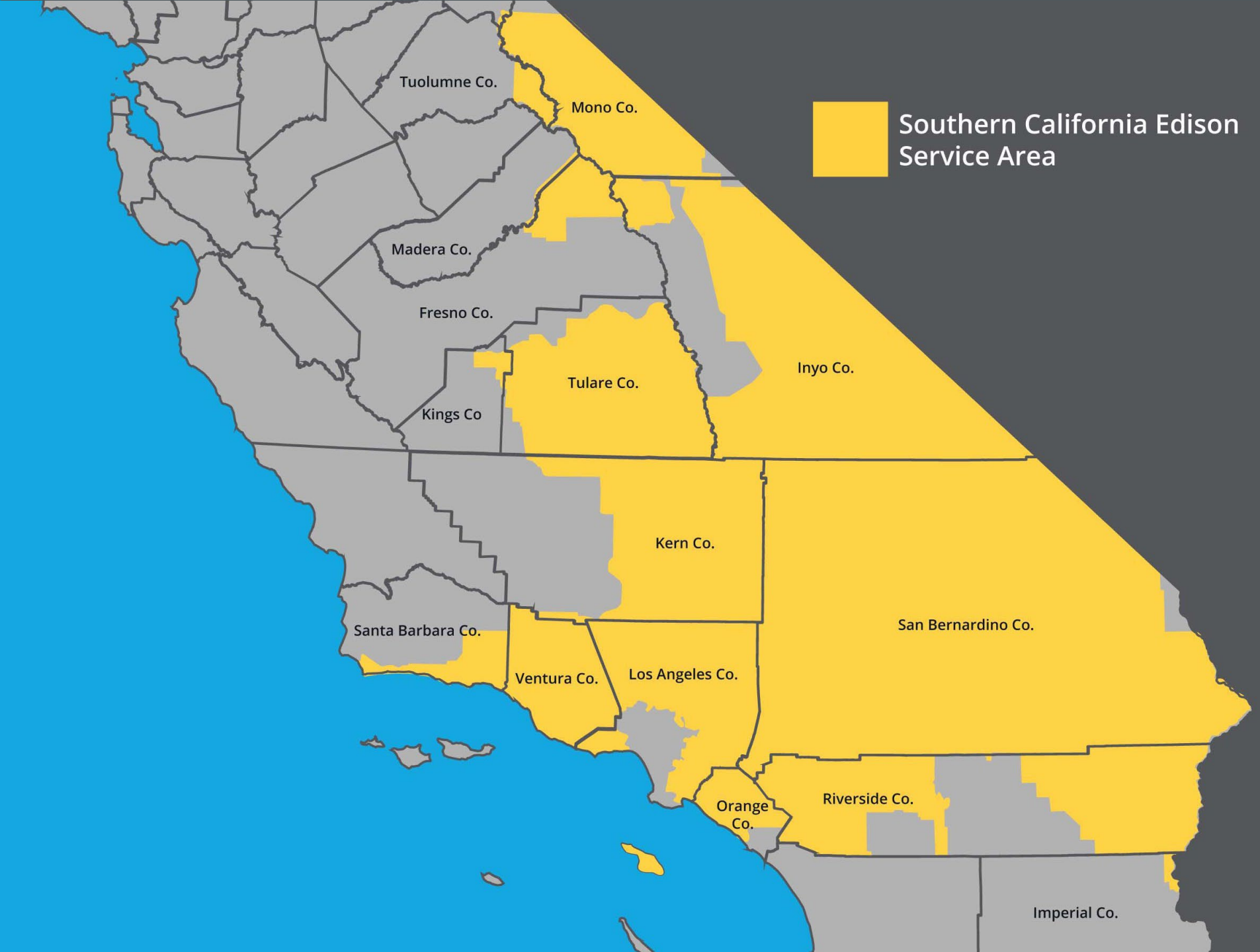
Safety Moment

The Importance of Proper Rest

- Not getting enough rest outside of work can lead to fatigue and hazards within the workplace for you and your colleagues.
- Being well rested is not only good for your mental health, but also helps to avoid potential injuries due to lack of sleep.
- Proper rest also includes taking regular breaks during the workday, so you are able to recharge.

Opening Remarks

Brian Stonerock
Director of Business Planning and Technology



- Electricity provided to more than 15 million people - one of the largest utilities in the US
- 50,000 square miles service territory
- 130+ years of service
- 23,000 MW Peak

EPIC Overview

Mission Statement: "EPIC invests in innovation to ensure equitable access to safe, affordable, reliable, and environmentally sustainable energy for electricity ratepayers."[1]

What is EPIC?	Mandatory Guiding Principles
Electric Program Investment Charge (EPIC) is a California ratepayer-funded public purpose program that enables the Utilities (SCE, SDG&E, and PG&E) and the California Energy Commission (CEC) to invest in and pursue new/novel emerging energy solutions to meet California's energy and climate goals and drive innovation in the industry. IOUs are limited to Technology Demonstration & Deployment projects.	EPIC's mandatory guiding principle is to provide ratepayer benefits. Ratepayer benefits are defined as: • **Improving Safety** • **Increasing Reliability** • **Increasing Affordability** • **Improving Environmental Sustainability** • **Improving Equity**

Notes
[1] In adopting D.21-11-028, the Commission approved a mission statement for EPIC and the Program's Guiding Principle.

EPIC 4 Community Outreach Plan

SCE's EPIC 4 Investment Plan aims to incorporate CPUC Environmental Social Justice (ESJ) Action Plan, Distributed Energy Resources (DER) Action Plan, and federal Justice 40 elements to its research design and execution.

Highlights of SCE's plan to work with our communities include:

- Create an overarching **EPIC Community Advisory Board made up of grassroots stakeholders** who will advise SCE on siting and community benefits opportunities and provide input on project design
- Implement processes to **integrate equity and access features** into individual projects
- Seek to **site field use case projects in disadvantaged communities** that will most benefit from the project and work to incorporate measurable community benefits into success measures
- Seek to **incorporate local education, job training, internships and/or procurement opportunities** into the project that benefit the adjacent or greater community
- Host project initiation workshops to **create awareness and opportunities to work with the community**

Swift Electrification of Transit (SET)

Strategic Initiative: Energy Management Situational Capabilities

Research Topics: Energy Buffering, Islanding and Reconfigurability

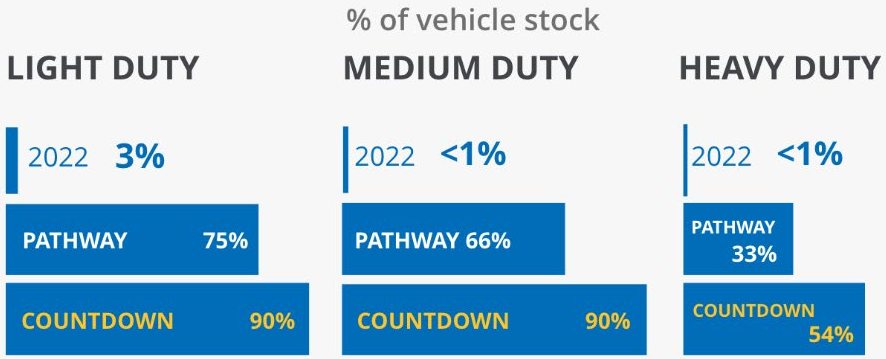
Ryan Miller
Engineering Manager, Grid Edge Systems Integration

Swift Electrification of Transit (SET)

Project Overview

Context

Achieving California's carbon neutrality goals is driving the need to electrify 90% of medium-duty and 54% of heavy-duty vehicles. This will require a 10x increase in the rate of infrastructure deployment.



Estimated Budget: $10M

Problem

- Customers electrifying fleets often wait several years for the necessary grid upgrades. This results in:
  - Delays in fleet electrification
  - Costly infrastructure upgrades
- Electrification customers are also vulnerable to outages, which can prevent charging and impact business operations

Project Objectives

- Expedite charging infrastructure deployments by maximizing throughput of existing circuits
- Minimize land needed for site upgrades by optimizing utility service equipment requirements
- Provide EV charging resiliency via microgrid & V2G functions

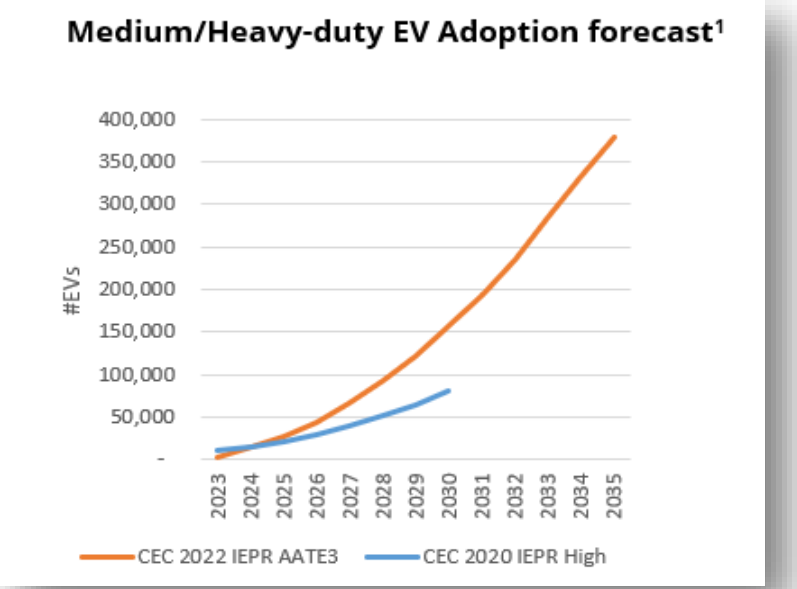
Potential Outcomes

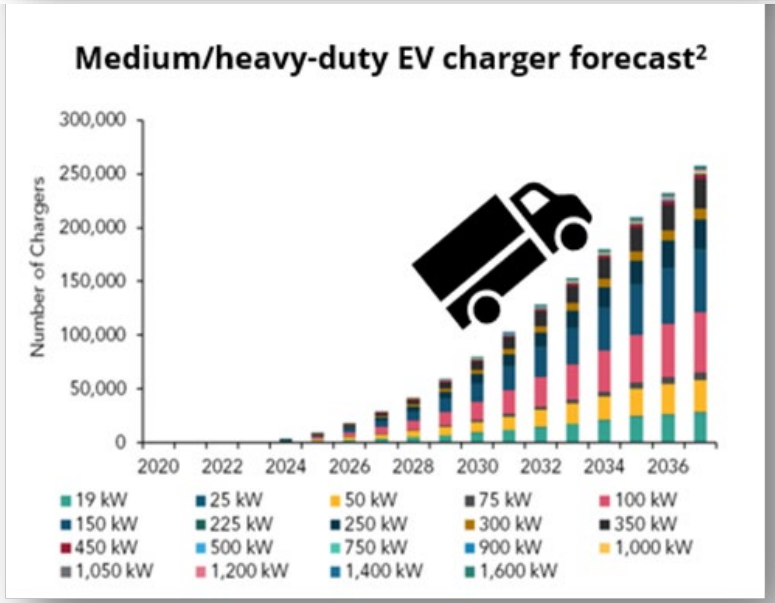
- Faster grid connection of EV charging infrastructure
- Reduced cost and improved access to EV charging infrastructure
- Improved reliability of customer EV charging and business operations
- Capacity and emissions benefits to local grid and community

Swift Electrification of Transit (SET)

Problem

- The transportation sector is expected to rapidly accelerate the pace of electrification over the next decade.
- Utilities are challenged in interconnecting loads (>1+ MW) quickly to meet customer needs.
- Customers with electrified transportation are especially vulnerable to outages that may prevent charging and impact business operations.
- Promising technologies that may help address these customer concerns are nascent and require further field demonstrations to enable deployment at scale in the near-term.





1. Source: 2020 IEPR and 2022 IEPR (CEC) which incorporated recently-approved CARB policies and future anticipated policies
2. Source: 2022 State Strategy for the State Implementation Plan (CARB)

Swift Electrification of Transit (SET)

Project Objectives

1. Implement energy buffering and islanding & reconfigurability concepts to:
   - **Expedite deployment** of charging infrastructure by leveraging energy storage, dynamic charge management and grid constraints management to maximize throughput of existing circuits.
   - **Minimize land acquisition** needed for site upgrades through optimizing sizing of service point(s) based on real-world loads, dynamic grid constraints and energy storage capabilities.
   - **Ensure resiliency** of EV charging infrastructure in outage scenarios through implementation of microgrid controller integrated with dynamic charge management—including V2G capabilities.
   - Partner with local educational institution(s) to develop **workforce of the future** considering energy storage and transportation electrification.
2. Advance technical knowledge and support implementation of novel vendor products:
   - Non-Lithium Energy Storage with low-cost, high-energy density and inherently safe
   - Microgrid Integration with high power charging infrastructure
   - Charge Management System with integrated V2G controls

Swift Electrification of Transit (SET)

Potential Outcomes

Industry Advancement

Inform future medium and heavy-duty charging infrastructure planning and deployments by:

- Developing best practices for non-lithium energy storage technologies
- Advancing microgrid best practices for high power charging loads to maximize reliability
- Advancing charge management system best practices to maintain resiliency while increasing throughput
- Developing load profiles of actual large scale transit fleet depots to aid in infrastructure planning
- Advancing grid constraint management best practices for large charging infrastructure loads

Customer Benefits

- Faster charging interconnections
- Improve access to charging infrastructure by reducing infrastructure footprint and associated costs
- Maintain and improve fleet charging reliability and resiliency while reducing operating cost

Community Engagement, DVC, Justice40 Benefits

- Workforce development with local educational institution in Energy Storage & Transport Electrification
- Improve resiliency by minimizing outage impacts to customers
- Support decarbonizing the grid by maximizing renewables integration

Stability Improvement with DERs (SIDER)

Strategic Initiative: Energy Management Foundational Technologies

Research Topics: Inertia Substitution, Customer Load Flexibility

Farzad Khalilpour
Engineering Manager, Grid Edge Analytics & Control

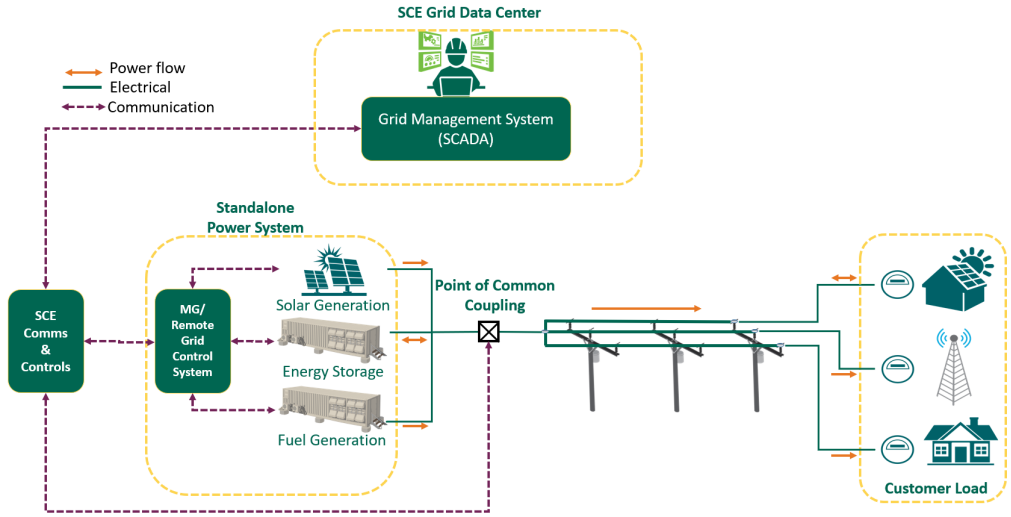
Stability Improvement with DERs (SIDER)

Project Overview

Context

As renewable energy penetration increases and traditional generation plants retire, SCE's grid faces new requirements and challenges. This project will showcase new grid stabilizing technologies to aggregate DERs and EVs to optimize their utilization and enhance load flexibility.

Estimated Budget: $9M



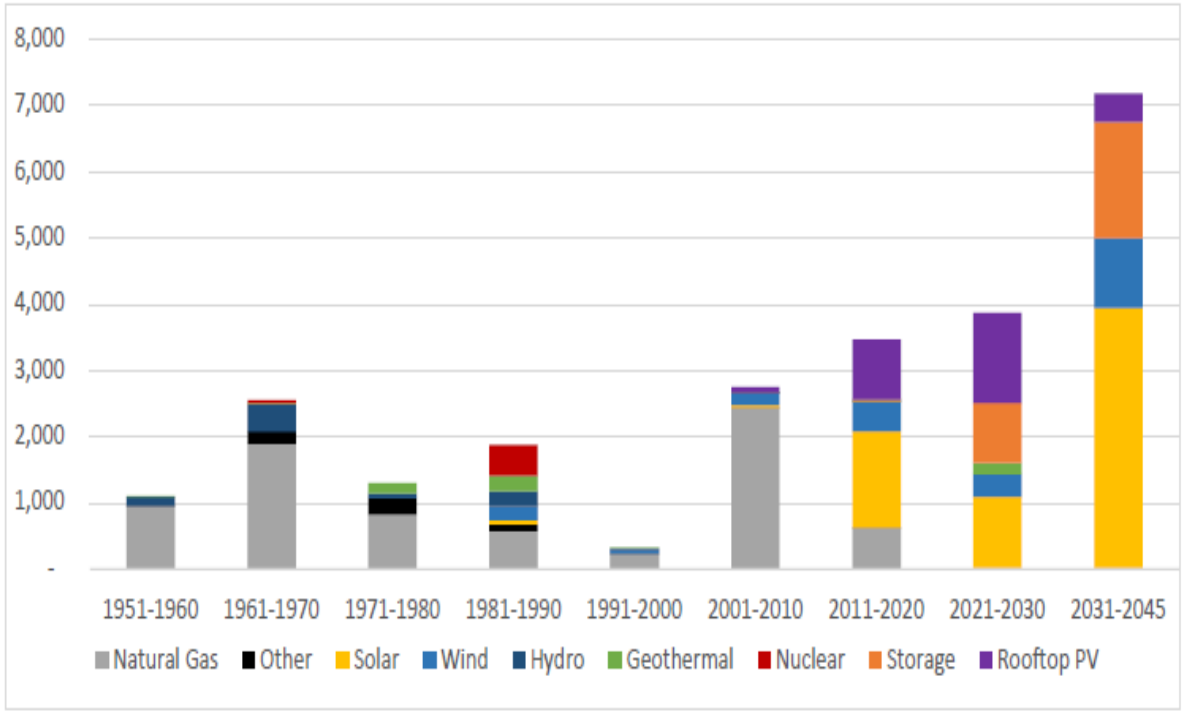
Problem	Project Objectives	Potential Outcomes
• As traditional generation retires, SCE needs to substitute inertia resources for grid stability. • DERs (including EVs) could be a source of grid stability, provided communications and control challenges are overcome.	• Identify the grid's current and future inertia needs. • Demonstrate advanced grid stabilizing technologies. • Demonstrate new communication platform to provide DER visibility, monitoring, control and optimization of DER resources.	• Increase flexible load capabilities through communications, monitoring and control of DERs (including EVs). • Improve grid stability by optimizing the use of flexible loads and other grid stabilizing technologies.

Stability Improvement with DERs (SIDER)

Problem:

- As traditional generation plants retire, and their inherent inertial characteristics are replaced by inverter-based generation, SCE's transmission and distribution system dynamics will need new tools and techniques to maintain grid stability.
- High DER penetration provides new, clean energy resource potential, but requires a reliable and rugged platform for communication with aggregators to enable:
  - Exchanging daily and close to real-time data between all types of the DERs and variable renewable energy resources as well as market information
  - Providing DER monitoring and control capabilities
  - Ability to engage DERs based on the grid's load flexibility needs
- Though multiple EV manufacturers and EV Service Providers are developing communication schemes, there is not a standard platform and method to enable communications with a Grid Management System.

Figure 11: Average Annual CAISO Additions (MW)



Source - Energy Velocity[xliii]

Stability Improvement with DERs (SIDER)

Project Objectives:

1. **Identify the grid's current and future stability needs**, and test and simulate grid stabilizing technologies to meet the grid's new dynamics and needs.
2. **Improve DER Registration, Monitoring and Control capabilities** by implementing a reliable and rugged communication platform with aggregators to receive data from DERs such as EV charging controllable load, EV V2G, energy storage, and variable renewable energy resources, as well as communicate grid-related controls with SCE's DER management system to support load flexibility.
3. **Increase flexible load and EV energy storage capabilities** through integration of a compatible multi-vendor communication platform with SCE's DER Management System (DERMS) to provide system-related intelligence and determine a grid support profile.
4. **Partner with local educational institution**(s) to pilot technologies, analyze coordinated data, and to improve the V2G capabilities and test the customer environment and advance grid flexibility technologies.

Stability Improvement with DERs (SIDER)

Potential Outcomes:

Industry Advancement

- Demonstrate advanced grid stabilizing technologies to support inertia substitution.
- Demonstrate vendor communications platforms with SCE DERMS to monitor, control and optimize DER resources.
- Demonstrate coordinated community/area support with DERs, V2G and load flexibility.

Customer Benefits

- Maintain community reliability and resilience with existing or planned community resources.
- Increase the potential use of DERs including customer EVs to provide grid flexibility services.
- Enable further electrification, including EV ownership and value, consistent with VGI principles.

Community Engagement, DVC, Justice40 Benefits

- Partnership with local community and educational institution to deploy DER intelligence and management systems.
- Foster EV V2G use case valuation.
- Engage STEM programs with system data aggregation and analysis.

BREAK

Flexible Alternating Current System (FACS)

Strategic Initiative: T&D Situational Capabilities

Research Topics: High-Capacity Throughput and Protection, Seamless Grid Flexibility

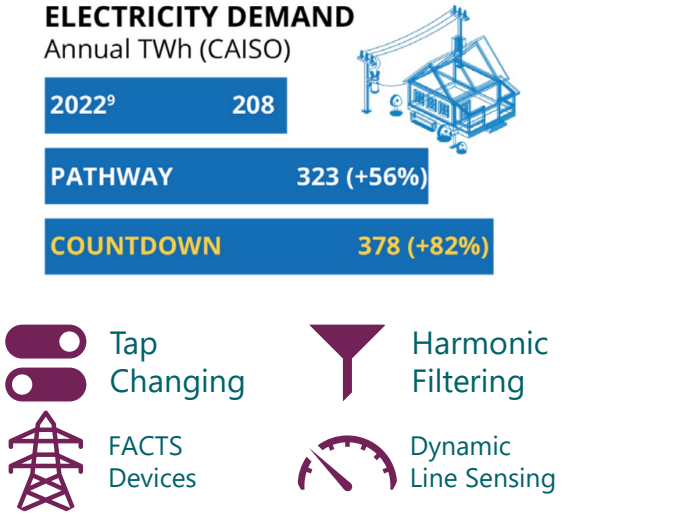
Andrew Ioan
Engineering Manager, Substation Systems & Applications

Flexible Alternating Current System (FACS)

Project Overview

New transmission and distribution grid projects need to be built at 4x and 10x their historical rates, respectively. The FACS project aims to demonstrate sensing and hardware control technologies that increase capacity and uphold power quality. By doing so, we can cost-effectively integrate intermittent renewable resources and meet additional load requirements without resorting to expensive upgrades.

Estimated Budget: $7M



Recent 2045 demand forecasts will require flexible asset utilization to get the most out of existing infrastructure

Problem

- High variable renewable energy (VRE) concentrations can cause voltage issues, reverse power flow, and power quality issues.
- Traditional solutions may be costly and inflexible to rapid changes in power flow.
- Solutions that monitor or regulate voltage, reactive power, and power flow for VRE variability could improve the grid's utilization and resilience.

Project Objectives

- Evaluate/demonstrate potential for solid state devices to provide grid services (power quality, increased asset health and capacity).
- Evaluate/demonstrate accuracy, usability, and O&M of dynamic line rating solutions on a congested line
- Develop asset strategy for this class of technologies.

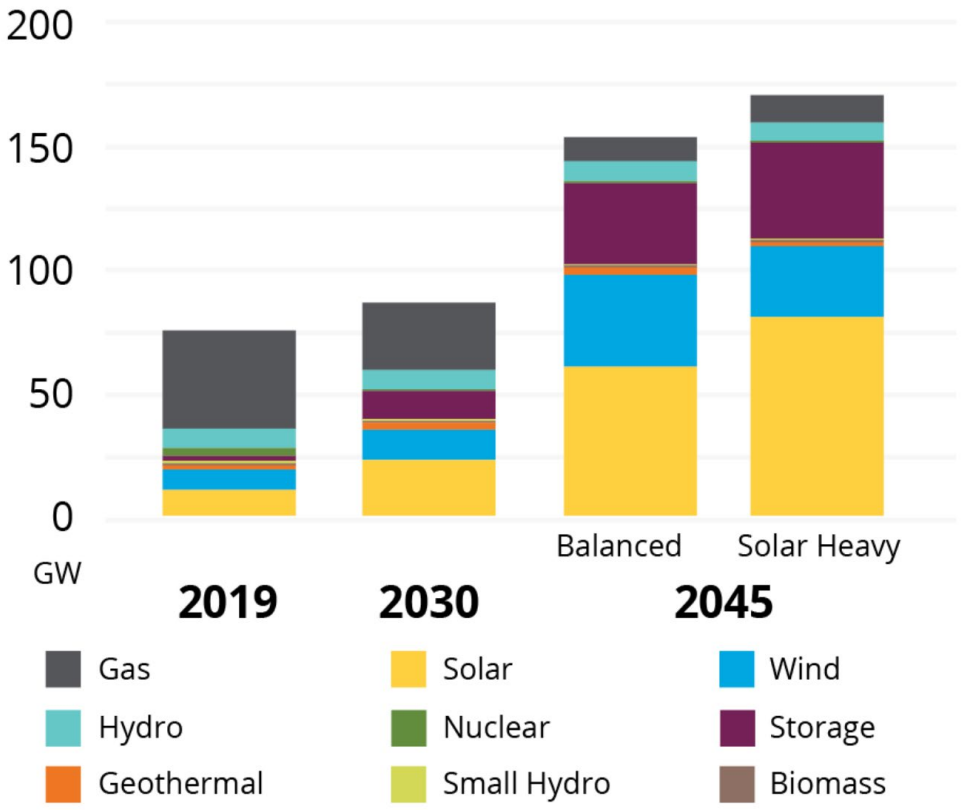
Potential Outcomes

- Increase line utilization & reduce congestion of existing transmission & distribution assets
- Support grid flexibility in response to high-VRE penetration and demand
- Enhance grid reliability and resiliency
- Potentially defer targeted transmission & distribution capacity upgrades

Flexible Alternating Current System (FACS)

Problem

- Building and transportation electrification, high penetration of rooftop solar, and demand response programs are needed to support the clean energy transition
- VREs and electrified loads will pose challenges to the grid in higher concentrations. Issues will include:
  - Power quality issues such as dynamic voltage fluctuations and flicker
  - Accelerated aging of infrastructure due to added heat/utilization
- Traditional solutions to mitigate congestion or power quality issues on our network, such as upgrading transformers, circuits, and substations can be more costly and are not as adaptable to rapidly changing grid conditions.
- To address these problems:
  - Solid State solutions that regulate voltage, reactive power, and serve as a buffer for brief dips and surges in power flows could help to manage the impact of uncontrollable VRE intermittency on the grid.
  - Dynamic Line rating technologies can calculate the maximum line capacity in real-time according to environmental conditions for improved flexibility and utilization on congested circuits.



Pathway 2045, Forecasted Generation Mixes, Figure 6

Flexible Alternating Current System (FACS)

Project Objectives

1. Identify opportunities to increase grid utilization through improved sensing or power quality regulating technologies in a targeted manner on the distribution or transmission networks.
2. Demonstrate the capability how power quality regulating technologies in targeted deployments can:
   - **Strengthen weak or congested areas of the grid** impacted by high demand
   - **Defer costly distribution capacity upgrades** that would traditionally be used to address those issues
   - **Improve local power quality** for customers with sensitive loads to improve grid reliability
   - **Extend grid asset lifespan** by reducing the overheating of grid assets impacted by poor power quality
3. Demonstrate how dynamic line rating technologies can:
   - **Increase transmission network capacity** to support load and renewable energy resource growth
   - **Defer costly transmission capacity upgrades** by increasing existing line utilization
4. Develop asset deployment strategies for these technology classes

POWER Magazine. (2021, June 24). LineVision's V3 Transmission Line Monitoring System to Be Installed in California for the First Time. Retrieved from https://www.powermag.com/press-releases/linevisions-v3-transmission-line-monitoring-system-to-be-installed-in-california-for-the-first-time/

Dynamic Line Rating technology can sense and adjust line capacity based environmental conditions and real-time demand

AMSC. (2021, April 1). *A D-VAR VVO distribution-class STATCOM installed in a 15-kV class feeder. Courtesy: AMSC. POWER*. Retrieved from https://www.powermag.com/using-distribution-class-statcoms-to-resolve-distributed-generation-plant-voltage-issues/

Distribution Statcoms can mitigate Dynamic Voltage Issues used at the Substations or on the distribution network itself

Flexible Alternating Current System (FACS)

Potential Outcomes

Industry Advancement

- Demonstrate that solid-state devices such as distribution level statcoms, energy storage systems, solid-state converters/links, or dynamic line rating can:
  - Offer a more **cost-effective** approach to increasing grid utilization on the transmission network with dynamic line ratings or maintaining power quality on the distribution network with solid state devices.
  - **Require less land** than traditional capacity upgrades
  - Provide a **targeted solution**, depending on the size of the impacted area
  - Utilize a **standardized process** within SCE to identify when its most cost-effective to deploy solid state technologies on the distribution network and defer capacity upgrades

Customer Benefits

- Increase amount of VREs customers can connect to the grid (without triggering an upgrade)
- Reduce greenhouse gas emissions
- Improve resiliency by minimizing power quality impacts to customers

Community Engagement, DVC, Justice40 Benefits

- Provide above customer benefits within disadvantaged communities
- Workforce development with local educational institution in areas of power systems engineering

Quantum Networking

Strategic Initiative: T&D Foundational Technologies

Research Topic: Ultra Low-Latency Communications

Anthony Johnson
Consulting Engineer, T&D Innovation

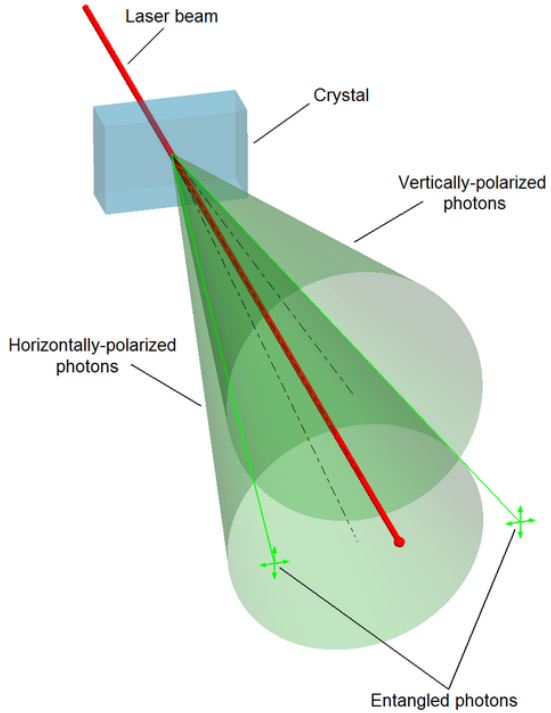
Quantum Networking

Project Overview

Context

Cybersecurity threats against electric grid infrastructure continue to evolve, and the stakes continue to mount as society becomes increasingly reliant on electricity. This project leverages systems[1] developed to support the DOE's Quantum Internet blueprint vision – steps to build a secure quantum-based internet.

Estimated Budget: $4M



J-Wiki at English Wikipedia, GFDL <http://www.gnu.org/copyleft/fdl.html>, via Wikimedia Commons

Problem

- Robust cybersecurity of the electric grid is of paramount importance to avoid disruptions and to maintain the integrity of grid operations.
- Cyber-threats continue to evolve, requiring utilities to continue advancing their ability to address these threats.

Project Objectives

- Develop and field deploy quantum solutions utilizing entanglement, which is a quantum physics property that creates secure particle pairs to protect against:
  - Cybersecurity threats to the grid
  - GPS local disruptions and desynchronization

Potential Outcomes

- Understanding of quantum networking solution for potential SCE system application.
- Improved ability to mitigate evolving cyber-security threats to SCE grid, thereby preserving the integrity of grid operations.

[1] Systems include high-rate, high-fidelity entanglement systems, state-of-the-art synchronization systems, single photon detectors,

Quantum Networking

Problem

- The modern electric power system incorporates increasing numbers of distributed resources that require more communications to maintain grid reliability, resilience, and safety.
- Advanced grid management tools require secure communications and data to enable the envisioned future grid capabilities.
- As cyber-hacking tools continue to advance, quantum computers of tomorrow could more easily penetrate today's cyber-defenses.
- Robust cybersecurity is needed for widespread sensors, analytics, and controls to integrate with utility grid management systems—which will be essential to provide the security needed to maintain the integrity of grid operations across California and the nation.

Quantum Networking

Project Objectives

1. Demonstrate a quantum-enhanced network's ability to protect against cybersecurity threats to the grid.
   - Quantum enhanced security will augment and protect critical grid infrastructure from cyber threats including "store now, decipher later" attacks[2].
   - Quantum-enhanced network solutions utilize quantum entanglement for robust defense against cyber threats targeting critical grid infrastructure, as well as GPS local disruption and synchronization challenges
2. Demonstrate the ability to protect against GPS disruptions by augmenting synchronization using our optical clock system developed for our quantum entanglement distribution network.
3. Complete the first field technology demonstration of these technologies in an augmented Grid architecture deployed at production-level grid network stations.

[2] Describes attacks with unknown vectors and solutions

Quantum Networking

Potential Outcomes

Industry Advancement

- Benchmarking of technical and economic feasibility of quantum communications hardware and software.
- Advance industry cybersecurity tools for grid encryption and synchronization systems.

Customer Benefits

- Enhanced safety, reliability, and resiliency through more cyber-secure grid operations.

Community Engagement, DVC, Justice40 Benefits

- Develop educational materials for junior and student engineers and scientists.
- Explore hiring an intern dedicated to the project.

ML-Augmented Digital Simulation (MAD-S)

Strategic Initiative: Digital Transformation

Research Topics: Data Driven Operations, End-to-End Advanced Simulations and Analytics

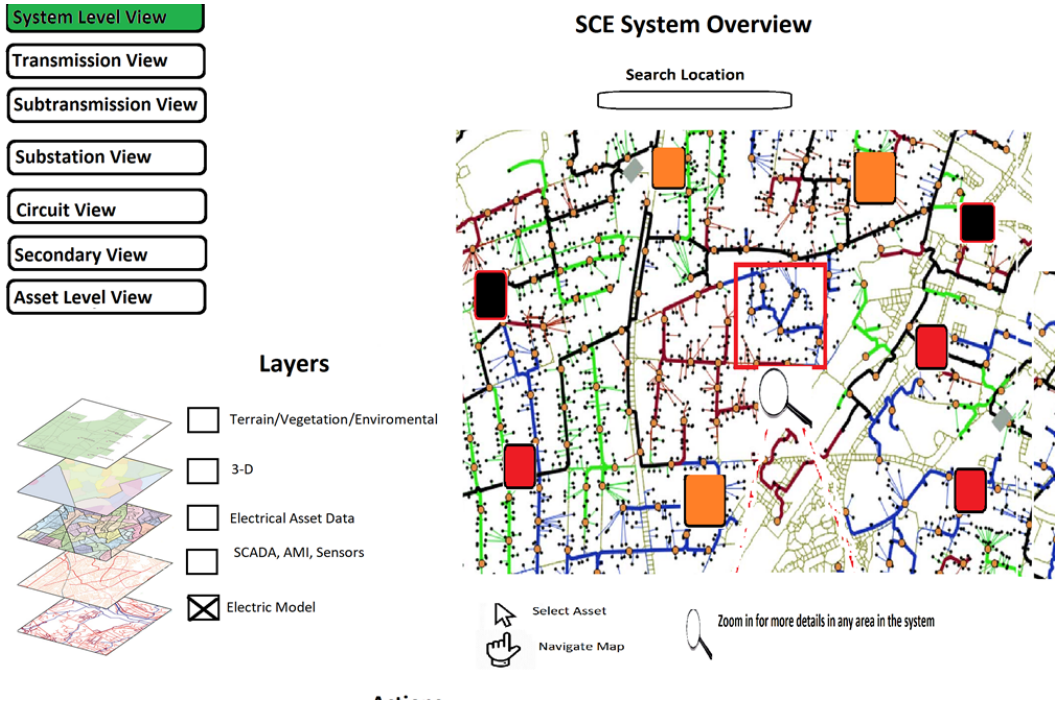
Abder Elandaloussi, PE, MSEE, MBA
Engineering Manager, Advanced Grid Solutions

ML-Augmented Digital Simulation (MAD-S)

Project Overview

Context

The future electric grid will face greater load and generation variability than ever before. The impact on the grid and our customers must be constantly tracked and seamlessly integrated into processes such as planning to optimize decision making. This is a big data + engineering effort that requires innovation & collaboration



Estimated Budget: $9M

Problem

- Existing power flow engines generally assume static grid configuration, capacity, asset ratings, and performance.
- This can result in sub-optimal load flow analyses that lead to sub-optimal decision making.

Project Objectives

- Improve power flow engine results by augmenting results with a digital twin platform to analyze grid data and integrate predictive analytics to improve LF engine assumptions.
- Demo a situational, context-based power flow engine use case with:
  - Data and model Ingestion/Clean-Up/integration layer
  - ML powered power flow engine
  - Visualization of predictive analytics results

Potential Outcomes

- Integration of operational and non-operational datasets to reflect real-world operating conditions.
- ML Augmented planning decisions that improve reliability and resiliency and result in more efficient capital investment decisions—including DER opportunities.

ML-Augmented Digital Simulation (MAD-S)

Problem

- Integrating datasets of different time scales and attributes to improve decision making requires substantial data engineering effort.
- Existing power flow engines assume static parameters and grid, which leads to results that may not reflect actual system conditions (asset health, performance, climate conditions, etc.).
- Modeling inaccuracy, exacerbated by constant changes in the grid and to factors out of utility's control, can impact results and subsequently decision making.
- There is uncertainty in the grid and environment in which the grid operates that is difficult to visualize.

ML-Augmented Digital Simulation (MAD-S)

Project Objectives

1. Demonstrate a digital twin platform to import and analyze grid data and integrate predictive analytics with the existing power flow engines to augment the engine's power flow results for accuracy.
2. Demonstrate a use case on the digital twin platform relating to a situational, context-based power flow engine. To achieve this objective, the project components will include demonstration of:
   - Data and model management and integration (operational, non-operational , societal, geographical, climate)
   - ML powered power flow engine
   - Visualization of predictive analytics results
3. Explore technology integrations during ideation (Design Thinking):
   - ML techniques
   - Digital twin data integration technologies
   - Datasets for ML use cases
   - Open platform architecture for scalability and modularity
   - Safe and secure democratization of access to digital twin data for community to build ML models

ML-Augmented Digital Simulation (MAD-S)

Potential Outcomes

Industry Advancement

- Successful solutions to the project objectives should enable fast, efficient collection, clean-up and stitching of operational and non-operational datasets. These stitched datasets will include data beyond traditional electric data and connectivity models to reflect real world conditions under which the grid operates.
- The stitched datasets will be analyzed, and machine learning models will be built and combined with traditional power flow calculations to obtain power flow results that consider external conditions.
- Power flow simulations will become dynamic and allow for the integration of climate, customer behavior, and other variables beyond SCE control.
- Load flow results will be displayed and compared between traditional load flows and ML augmented load flows for future benchmarking and model improvement.
- The results will be visualized in a user interface that provides seamless, intuitive, and responsive visualization of simulation/analysis of results.

Customer Benefits

- Enhanced reliability and resiliency via more accurate, data informed, context-based load flow analysis

Community Engagement, DVC, Justice40 Benefits

- Demonstrate solution by modeling a distribution system that serves disadvantaged communities.
- Platform to promote equity by providing safe, secure access to data and information

SCE Projects Wrap-Up

We greatly appreciate your valuable questions and comments. For any additional feedback on the proposed projects presented today before scoping is finalized and they are launched, please fill out the form below:

SCE Public Workshop Follow-Up Form

BREAK

EPIC 4

Public Workshop

March 27, 2024

This program is funded by California utility customers under the auspices of the California Public Utilities Commission.

Agenda

Desired Outcomes

1. Attendees are aware of and understand projects that PG&E is considering to launch as the first wave of the EPIC 4 Portfolio.
2. Attendees have the opportunity to provide feedback on proposed projects before scoping is finalized and they are launched.

Context of Today's Presentations

- On November 30, 2023, California Public Utility Commission (CPUC) approved PG&E's EPIC 4 Investment Plan. The Plan details 23 Research Topic Areas, in which PG&E can pursue technology demonstrations.
- On January 16, 2024, PG&E subject matter experts presented 20 project proposals that were selected from 85 internal idea submissions, that went through an internal screening, refining and scoring process.
- Today, PG&E subject matter experts will present 2 additional project proposal. **Attendees have the opportunity to provide feedback on proposed projects before scoping is finalized and they are launched**
- Deck will be uploaded to **pge.com/epic**. For additional questions/comments for these projects, please email **Epic_Info@pge.com**.
- Candidates for future waves of PG&E EPIC 4 projects will also be presented in public workshops, prior to launch.
- This program is funded by California utility customers under the auspices of the California Public Utilities Commission.

Transmission & Distribution Co-Simulation Modeling

This project would focus on modeling and studying one snapshot in time (scenario) for both the transmission and distribution system simultaneously.

TOPIC	DESCRIPTION
Concern / Gap Addressed	This project would focus on modeling and studying one snapshot in time (scenario) for both the transmission and distribution system simultaneously. This is currently not possible with current tools - current software model and study transmission and distribution separately. This is because the mathematically methodologies for solving each type of load flow is different. Also, in the past when power flow was not bi-directional we could reduce computational complexity and solve these systems separately an in isolation.
Objective	This project will implement a new application which will make utility T&D co-simulation possible to provide enhanced support for the existing transmission planning processes. An optimization application will later be built on top of the co-simulator so users can run T&D wholistic planning optimizations by defining goals and optimize the use of current T&D capacity and future T&D build out.
Project Description / Scope of EPIC Demonstration	The focus of this project would be: • To unify T&D load assumptions. For example, we are told by the California Energy Commission that the load forecast for the state is going to be a certain forecasted amount each year. But they are not rolled up/down through our systems the same way for T&D. • To connect/model both these systems in the co-simulation • T&D Co-Simulation in PG&E local area(s) (no to min change to current tools) • Optimize T&D planning project scopes with to achieve least cost, longer project deferral
Estimated Cost	$2M
How PG&E can scale to full deployment (Path to Production)	The project will be developed and demonstrated on a real-world use case in D&T capacity planning. The project will also be built on leveraging and connecting the existing planning software used by Transmission Planning and Distribution Planning. If the project is complete and successful, there will be minimum technical hurdle for Transmission Planning and Distribution Planning to use the tool. Additionally, as the project will be developed to help solve real use problem, T and D Planning groups could utilize the tool to further solve more similar issues on the grid which are of great urgent need for providing more effective and affordable interconnecting capacity for load customers.

Transmission & Distribution Co-Simulation Modeling

This project would focus on modeling and studying one snapshot in time (scenario) for both the transmission and distribution system simultaneously.

TOPIC	DESCRIPTION
New / Novel / Urgency	While there have been great advancements in T&D co-simulation technics, applying these breakthroughs in utility scale to help solve Transmission and Distribution planning problems in a holistic way and optimize utility T and D build out the meet the fast-growing demand is novel and of great urgency. Additionally, PG&E hasn't been equipped with the tools necessary to maximize utilization of its current T&D system. This project, if successful, will become a substantial part of such tools.
Urgency	PG&E is expecting a 70% load increase in the next 20 years while meeting aggressive decarbonizing goals. It is imperative to make the right investments at the right time, in the right place, and provide more efficient interconnection planning services to our customers. PG&E hasn't been equipped with the tools necessary to maximize utilization of its current T&D system. This project, if successful, will become a substantial part of such tools.
Benefits	• Affordability: At scale could provide method for PG&E to address both local grid and system peak loading issues when aggregated. Also, could redirect funds that go to paying for behind-the-meter storage to front-of-the-meter storage that has a more beneficial impact to more customers. • Reliability: Added reliability for customers in high fire threat districts, potential to manage loading at the transformer level to detect and potentially avoid transform failure.

Computer Vision – Asset Registry

Use image-based machine learning models to supplement/correct existing transmission & distribution (T&D) asset registry and to track asset degradation/change over time.

TOPIC	DESCRIPTION
Concern / Gap Addressed	PG&E's asset registry of electric transmission and distribution assets has inaccuracies and may not be complete. Additionally, current processes to evaluate the condition of assets are manual, inefficient, and costly. While aerial and mobile imagery and LiDAR is being collected on PG&E's electric system, the extensive dataset is not yet used for asset identification or threat detection. If a technology and process existed to use Artificial Intelligence (AI) and Machine Learning (ML) to efficiently analyze the data, this can enhance our understanding of our electric system and prioritize our inspection and replacement programs. This effort aligns with the PG&E Research and Development problem statements: “Advanced Monitoring, inspection, analytics of asset health and integrity” and “Eliminate ignitions”.
Objective	Track asset condition from one inspection to another. Use Computer Vision to supplement/correct existing T&D asset registry and to track asset degradation/change over time.
Project Description / Scope of EPIC Pilot	Insulator is used as an example use-case for illustration purposes only. The specific use case will be determined with PG&E stakeholders. 1. The project will identify a specific component type (i.e. insulator) on T&D, where that component is located on the structure, link the image to its field location (i.e. insulator1234 on NW corner of structureABCD), document and predict its condition. PG&E does not currently distinguish between insulators on a structure, which means we cannot track their degradation over time. The pilot will either link an existing insulator ID to its pole ID or design a new ID system of individual components to link it to its pole ID. 2. We will work with stakeholder/SMEs to pick appropriate component type and condition/damage (i.e. extract install date from plaque on pole, tree leaning on pole, transformer mismatch between field location and asset registry), how to label the condition (i.e. require immediate replacement, correct geographic location id), what model metrics need to be met to deliver value, build models: data labeling, algorithm selection, results delivery.
Estimated Cost	$8M

Computer Vision – Asset Registry

Use image-based machine learning models to supplement/correct existing T&D asset registry and to track asset degradation/change over time.

TOPIC	DESCRIPTION
How PG&E can scale to full deployment (Path to Production)	The updated data and prediction will be delivered to Asset Strategy quarterly via Foundry (GIS tool) for them to make inspect/repair/replace decisions. This automated model prediction and data delivery require data pipelining to know which year/component id/structure id each component is associated with, and to retrieve that information accurately and quickly. This delivers business value and does not require changing existing processes because it provides Asset Strategy with information it does not currently have. It integrates into existing processes by adding data to decision making around maintenance timelines. An outcome may be not requiring A tags be replaced within 6 months. Sponsors need to sign off if we create new component id structure to integrate into existing databases. If the pilot delivers business value, we will scale the technology to more component and damage types.
New / Novel	While PG&E has amassed a rich imagery, video, and LiDAR dataset on the electric system, the ability to leverage the data for informed decision making has not been available. The PG&E team has filed US Patent #11,604,448 granted in 2023 for our CV work in assisting inspections. The patent uses raw field images to aggregate AI predictions at the pole level. This proposal expands on the patent by going to the component-level; it also proposes to compare the asset to itself over time to detect degradation. Additionally, evaluations of third party vendors with AI and ML capable solutions for asset registry and health monitoring will be performed to consider for adoption and deployment at PG&E.
Urgency	Reducing failures and potential wildfire incidents by having a more complete understanding of our assets will help us to "Rebuild trust with our customers and our local communities by delivering affordable energy & excellent customer experiences every day." The sooner we can do this, the faster we can realize this outcome.
Benefits	**Safety:** enhances understanding of our assets, allowing decisions to be made on repairs and replacements. Can be more accurate than relying on subjective human inspections. Informs risk mitigation programs by avoiding run-to-failure scenarios. . This capability has the potential to improve TNS KPI 4, “Wildfire Risk Reduction” and KPI 7, “CPUC Reportable Fire Ignitions" if consequential electrical and physical anomalies can be accurately detected and prevented. **Waste:** reduces truck rolls and the need for costly inspectors to perform foot patrol. This can improve TNS KPI 35, “Waste Elimination” by automating the validation of field collected photo imagery data. **Customer:** improved reliability and resiliency for customers. This can improve TNS KPI 2, “Customer Satisfaction Score” by identifying issues and anomalies before a customer calls it in, or an event occurs.

Close & Questions

Deck will be uploaded to pge.com/epic.

For additional questions/comments for these projects, please email Epic_Info@pge.com.

Thank you!

Thank You

We’re always open to innovative ideas and would love to hear from you. Please go to sceideas.com to share your thoughts with us

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