EPIC 4 Public Workshop
SDG&E Proposed Projects

April 24, 2024

Agenda

1. Opening Remarks and Safety Moment
2. What is EPIC?
3. EPIC-4 IOU Constraints
4. Purpose of this Workshop
5. Project Proposals
6. Next Steps

Opening Remarks

Director Fernando Valero

Advanced Clean Technology

Safety Moment – Cybersecurity

- Did you know Americans lost $10 Billion due to fraud in 2023?
- Cybersecurity is a major focal point for SDG&E® in 2024
- Social engineering is the easier way for criminals to get your money:
  - Texting, emailing, and calling are how criminals pretend to be from a legitimate company.
  - Please question and stop to verify any requests that mandate money right away

SDG&E® At-a-Glance

4,100
square miles

3.7M
customers;
1.5M electric meters,
905k gas meters

25
communities,
2 counties, 18 federally-recognized tribes

17,496
miles of Distribution;
2,003
miles of Transmission

59%
of our energy sources are renewable

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What is EPIC?

The Electric Program Investment Charge (EPIC) is a California statewide program that enables Utilities and CEC to invest in & pursue new/novel emerging energy solutions to meet California's energy goals & 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**

Background: EPIC Regulatory Update

- EPIC 4 Investment Application Plan Approved

Strategic Objective	Strategic Initiative	Funding ($M)	Research Topic
1. Create a More Nimble Grid to Maintain Reliability as California Transitions to 100 Percent Clean Energy	Grid Modernization	$7.3	1. Communication and Control Infrastructure for Power System Technology Advancement 2. Mobile Microgrid
2. Increase the Value Proposition of DERs to Customers on the Grid	DER Integration	$7.3	3. Optimizing Real-Time Net Energy Metering Hosting Capacity 4. Demonstrating Solutions for Inverter Integration Issues 5. Integrated DER Operational Flexibility

EPIC 4 - IOU Constraints

- Only can do “Pre-Commercial Demonstration”
- *New to EPIC 4 – 25% of the budget needs to be located within a DAC and 10% in low-income community*
- EPIC provides the IOUs with flexibility to demonstrate a wide range of emerging technologies.
- CPUC-designated constraints state that IOU EPIC projects cannot be the following:
  - <u>Only</u> Energy Efficiency or <u>Only</u> Demand Response
  - <u>Only</u> Power Generation
  - <u>Only</u> Gas
  - Paper studies (i.e., without lab or field demonstration)
  - Broad deployments of commercially available/already proven technologies
  - Unnecessarily duplicative of other technology demonstrations

Purpose of Today's Workshop

Introduce Potential Projects

Solicit Feedback

EPIC-4 Proposed Project Proposals - Overview

1. Grid Resilience and Sustainability through Integrated Vehicle-to-Grid (V2G) and Renewable Energy at Community Resource Centers (CRCs)
2. Phasor Measurement Units (PMUs) Based Power Network Analysis for Increased Situational Awareness
3. Power Quality and Fire Detection Camera Integration
4. Zonal Electrification With Integrated Distributed Energy Resources (IDER) Operational Flexibility
5. Renewable Mobile NanoGrid for Climate Resiliency

SDG&E EPIC-4
Project Proposals

Grid Resilience and Sustainability through integrated Vehicle-to-Grid (V2G) and Renewable Energy at Community Resource Centers (CRCs)

Nick Fiore

Clean Transportation Innovation Manager

Project Overview

- **Project Overview: Clean Transportation Innovation at Community Resource Center (CRC)**
- **Location**: CRC within SDG&E's service area (tentatively Pine Valley CRC)
- Budget: $0.9M
- **Key Components**:
  - **Battery Electric Vehicles (BEVs)**: Integration of EVs with Vehicle-to-Building (V2B) and Vehicle-to-Grid (V2G) technologies
  - **V2G Capable EV Chargers**: bidirectional energy flow
  - **Solar Installations**: Planned solar arrays (planned)
  - **Battery Energy Storage System (BESS)**: Energy storage solution (planned)

Project Overview

- **Specific Actions**:
  - Installation of **two V2G-capable EV chargers** at the CRC site
  - Incorporation of **on-site V2G-capable EVs**
  - Use of **predictive software** optimization for efficient battery use, integration of renewables (via solar/BESS), and **automated load management (ALM)** for charging/discharging
- **Project Impact**:
  - Demonstrates **energy discharge capabilities** to building and grid during CRC's peak demand periods and PSPS events
  - Acts as a **resilience mechanism** for community through:
    - Providing needed sources of backup power to CRC site/building
    - Critical public BEV charging during PSPS events
    - Adding to broader grid resilience by discharging energy back via V2G services
    - Building resiliency models and plans that incorporate BEVs as connected distributed energy resources (DERs)

V2G for Resiliency at Community Resource Centers

Problem

- Lack of public, community charging solutions in DVCs and near CRCs – community vulnerability during PSPS events and potential evacuations as more BEVs are brought into service in remote areas
- Need for reliable forms of backup power for CRCs during PSPS events in remote areas
- Lack of testing of interoperability across the range of resiliency tools available (Battery Electric Vehicles, BESS, Solar, etc.) and integration with local resiliency planning systems.

Project Objectives

- Enable a scalable model for community Battery Electric Vehicle (BEV) charging and discharging to enhance community safety and resilience during PSPS events.
- Integration of BEVs with Vehicle-to-Building (V2B) and Vehicle-to-Grid (V2G) technologies alongside planned solar installations and a Battery Energy Storage System (BESS).
- Data collection in service of building a replicable V2G resiliency model, offering valuable insights into the practical implementation of using BEVs as distributed energy resources (DERs) for community resilience and grid support.

Potential Outcomes

- Replicable model for integrating BEVs into wildfire preparedness and PSPS events through field testing hardware (bidirectional capable chargers and vehicles), software (energy management/optimization software), and running data analysis on effectiveness of V2G as a backup power source and its interoperability with other onsite resiliency and backup power tools (Solar, BESS).
- By dynamically managing energy flow between the vehicles, solar array, BESS, and the grid, the project illustrates a scalable model for enhancing grid stability, reducing energy costs, and promoting renewable energy use, particularly in DVCs

PMU-based Network Analysis for Increased Situational Awareness

Robin Manuguid – Principal Engineer

Electric Grid Operations April 24, 2024

PMU-based RTNA and Advance Apps @ SDG&E

Measurements (Sources & Types)

- Sources:
  - **PMU** (phasor measuring units; time-synchronized)
- Types:
  - Voltage and current **phasors** (magnitude and angle)
- Acquisition:
  - **30 frames per second**

RTNA (Real-Time Network Analysis)

- Input:
  - Same network model exported from EMS
  - **limited number** of PMUs (138kV – 30%, 69kV - 17%)
  - Mapping of measurements
- Process: solves **non-iteratively** (**fast**)
- Output:
  - **bad PMU measurements** (or bad model parameter)
  - **base case** but only those buses that have PMUs and those buses that become observable.
    - Voltage magnitude and angle
    - MW/MVAR injections and branch flows

Advance Applications

- From the base case created by RTNA
  - Runs RTCA (real-time contingency analysis screening for thermal overload or bus voltage limit exceedance)
  - Remedial action measures
    - Base case
    - Contingency case
- Near RTVSA (real-time voltage stability local areas only)

Existing Real-Time Tools @ SDG&E

Measurements (Sources & Types)

- Sources:
  - **RTU** (remote terminal units)
  - calculated points
  - ICCP (neighbors' measurements)
- Types:
  - Bus voltage magnitude (kV)
  - Real/reactive power (P/Q) branch flows
  - Transformer tap/phase settings
  - Phase angle difference * (CEC PIER funded)
- Data Acquisition:
  - **Scan/poll 2-6 seconds**

RTNA (Real-Time Network Analysis)

- Input:
  - SDG&E network model and truncated external network model
  - Limited measurements (**97%** coverage)
- Process: solves iteratively **every 5 minutes** (problem: doesn't always solve)
- Output:
  - **bad measurements** (or bad model parameter)
  - **base case** with a detailed representation of the SDG&E power system
    - Voltage magnitude and angle at every bus
    - MW/MVAR injections and branch flows (outside limits?)

Advance Applications

- From the base case created by RTNA
  - Runs RTCA (real-time contingency analysis screening for thermal overload or bus voltage limit exceedance) **WHAT IF**
  - Optimization (currently not used)
- Near RTVSA (real-time voltage stability analysis using RC West base case)

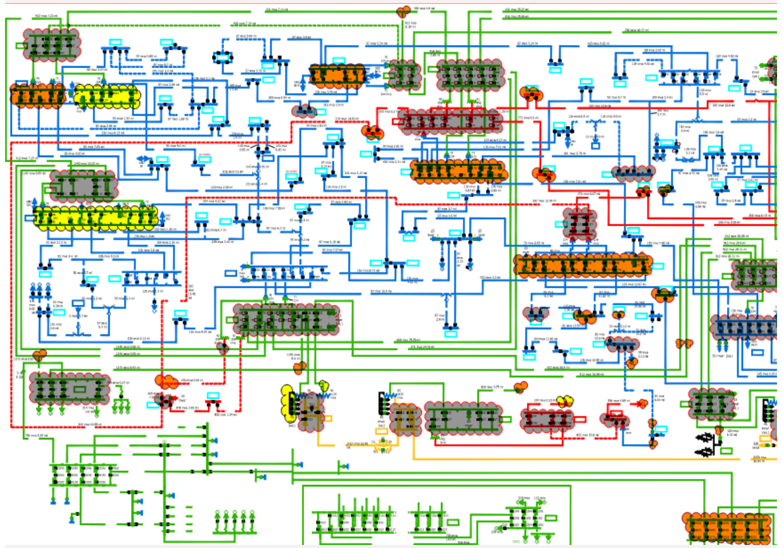
Benefits of PMU-based RTNA

Enhanced Reliability

- Faster Analysis
- High resolution state estimation
  - fast enough to track system dynamics
- Filter data issues

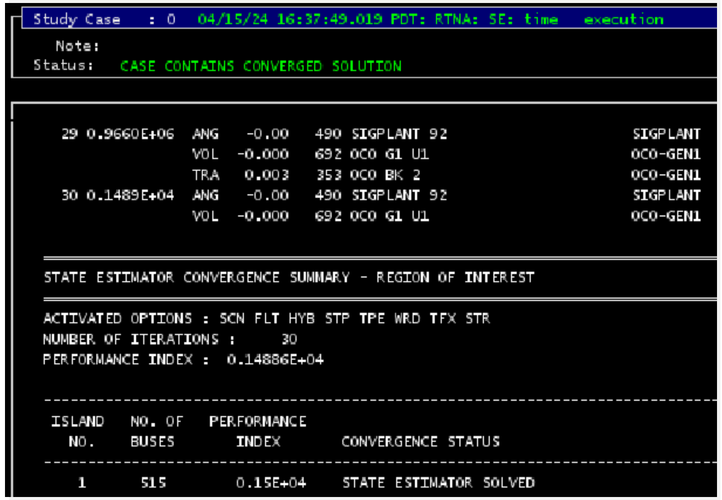
Expanded Observability

- Expands beyond existing PMU coverage for analysis such as oscillation source identification



Enhanced Resilience

- Back up to conventional State Estimator when not solving
  - Iterative solution and slow



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High Resolution State Estimation

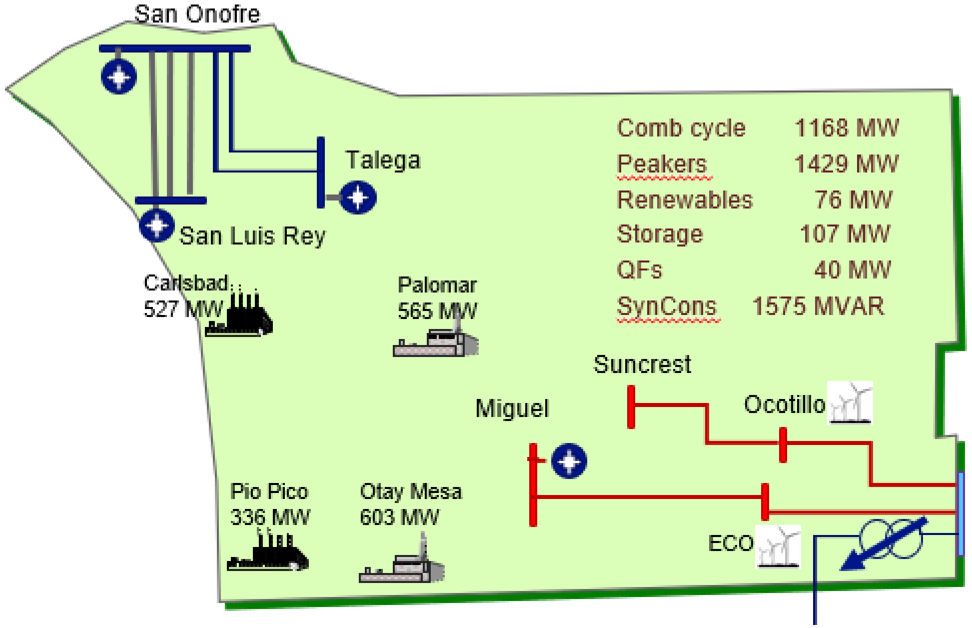
2/15/24 230kV Line Fault Event:
Current and Voltage from PMU

Same event showing estimated/conditioned
Current and Voltage values

Basecase Creation

SE Real-time Basecase (from RTU)

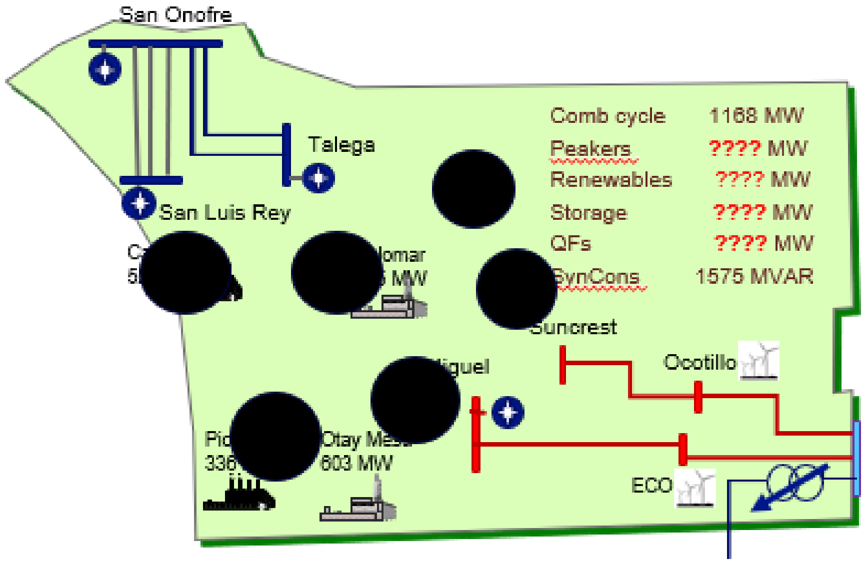
SCADA coverage: 97%
Observable buses: 278 (all SDG&E buses)
Complete picture (more granular) of the system



Complete Model Estimate

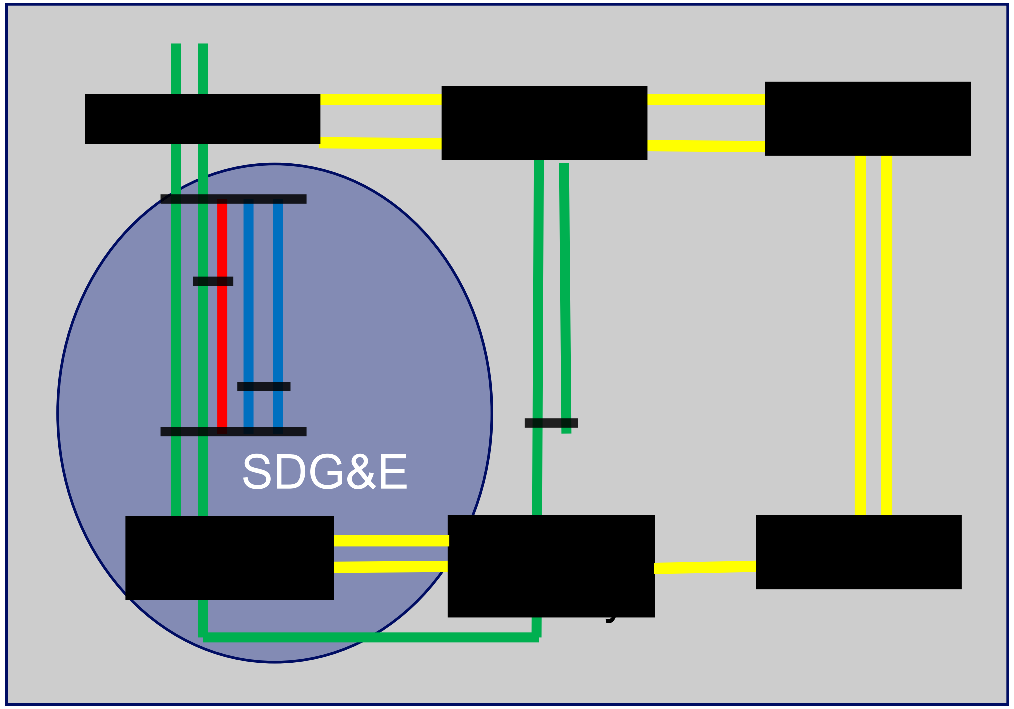
LSE Real-time Basecase (from PMU)

PMU coverage: 35%
Observable buses: 127 (44 buses with PMUs)
Holes in the picture of the system



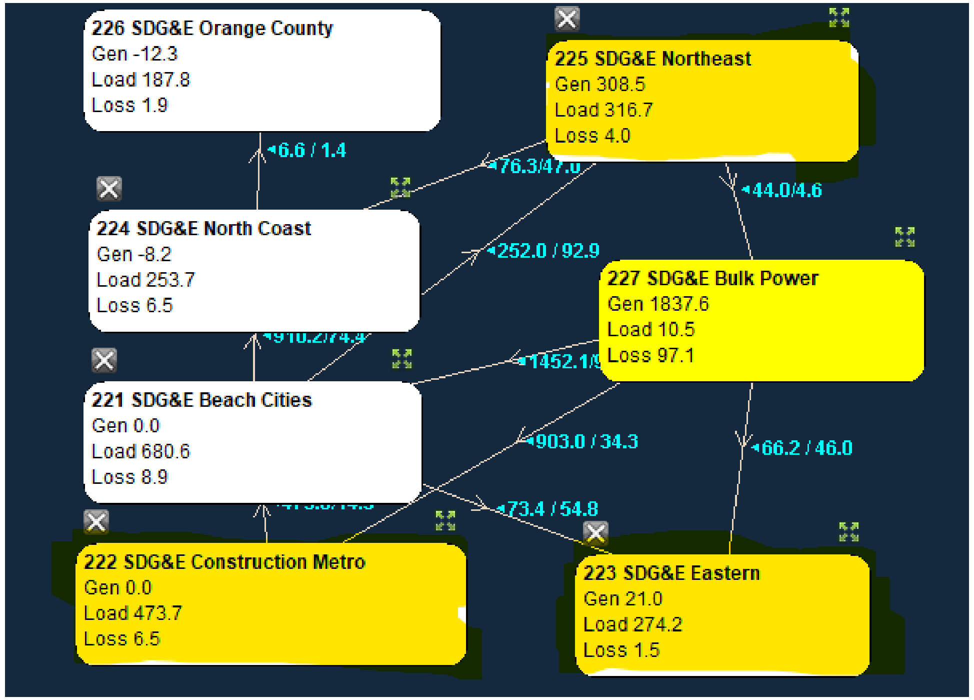
Incomplete Model Estimate

Basecase Creation – Pacific Southwest to local 69kV areas



Pacific Southwest Major Corridors

Adding PMUs of external entities will be a near-future endeavor to expand observability into external areas.



Shifting focus to local areas

As more IBRs connect to the local areas, creation of the LSE case for contingency analysis is more important as the actual condition changes quicker with batteries.

Project Costs & Benefits

Help expedite enhanced real-time monitoring, analysis, situational awareness, and control of SDG&E's grid. Facilitate transition to the dynamic grid of the future.

Estimated Budget: **$2.5M** | Estimated Project Duration: **24-36 Months**

Outcomes

- Increase reliability
  - Faster analysis
  - Fast enough to track system dynamics
  - Improve data accuracy
- Increase observability
  - Oscillation identification
- Increase resilience
  - Backup to current real-time tools

Community Benefits

- Inverter based resources (IBR) connection at the transmission and distribution system.
- System Operators
- Plant Operators

Communities

- Select 69kV local areas
  - Existing batteries/new batteries
  - Existing remedial action schemes in place
- High Fire Threat Districts

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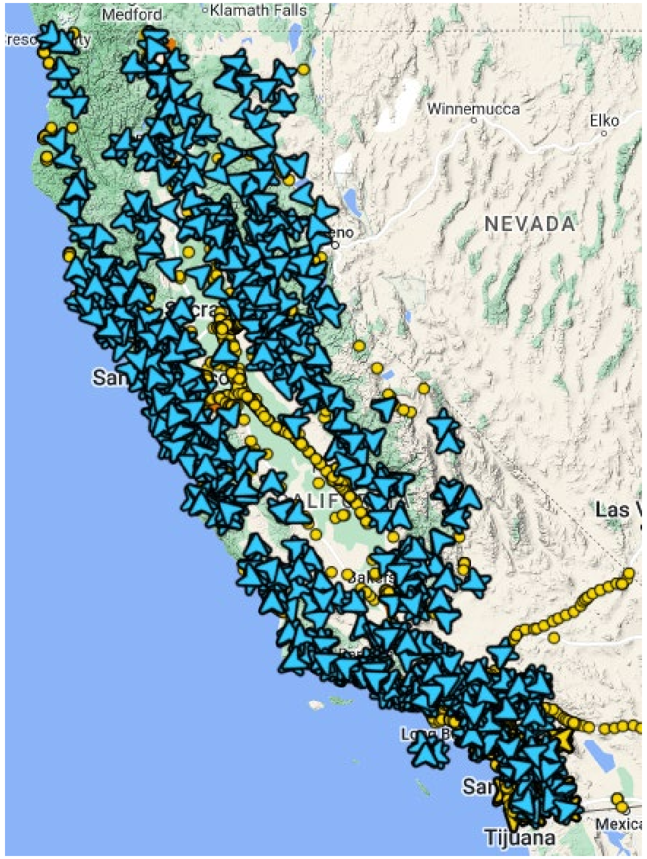
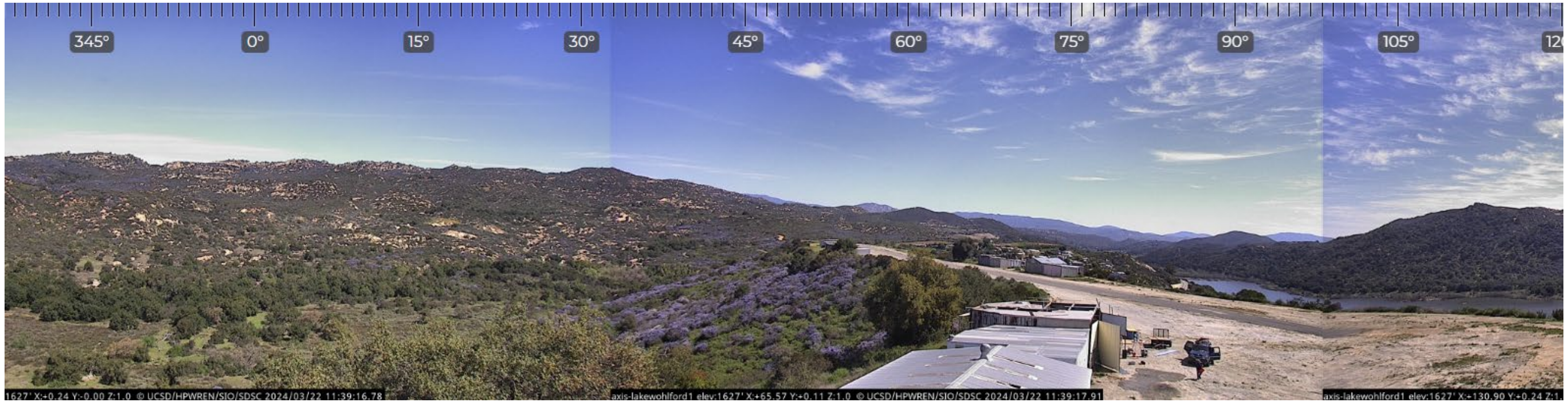
Power Quality and Fire Detection Camera Integration

Mike Colburn – Construction Operations Manager - Major Projects

Fire Detection Cameras



ALERTCalifornia aggregates real-time on-line images, from cameras across the more fire prone parts of the state.



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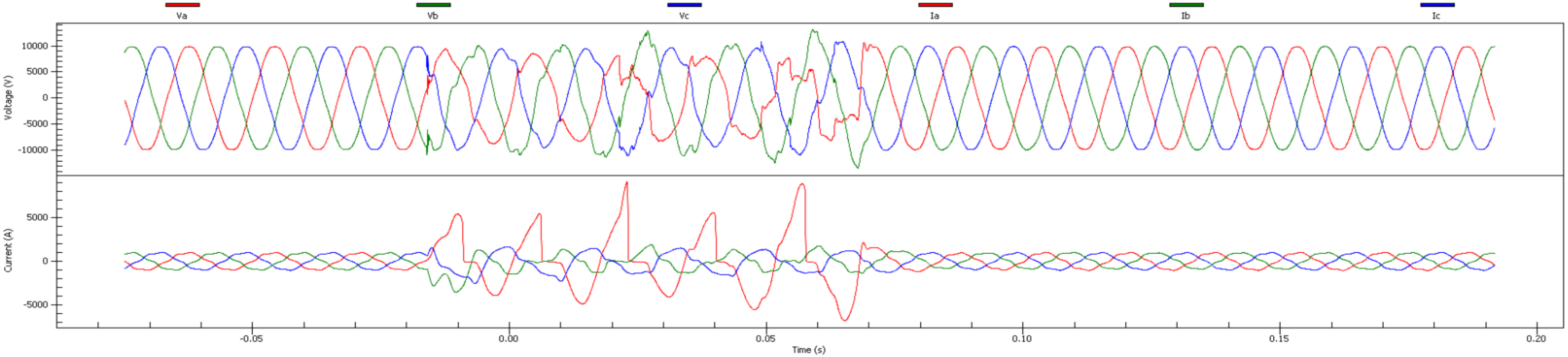
Power Quality

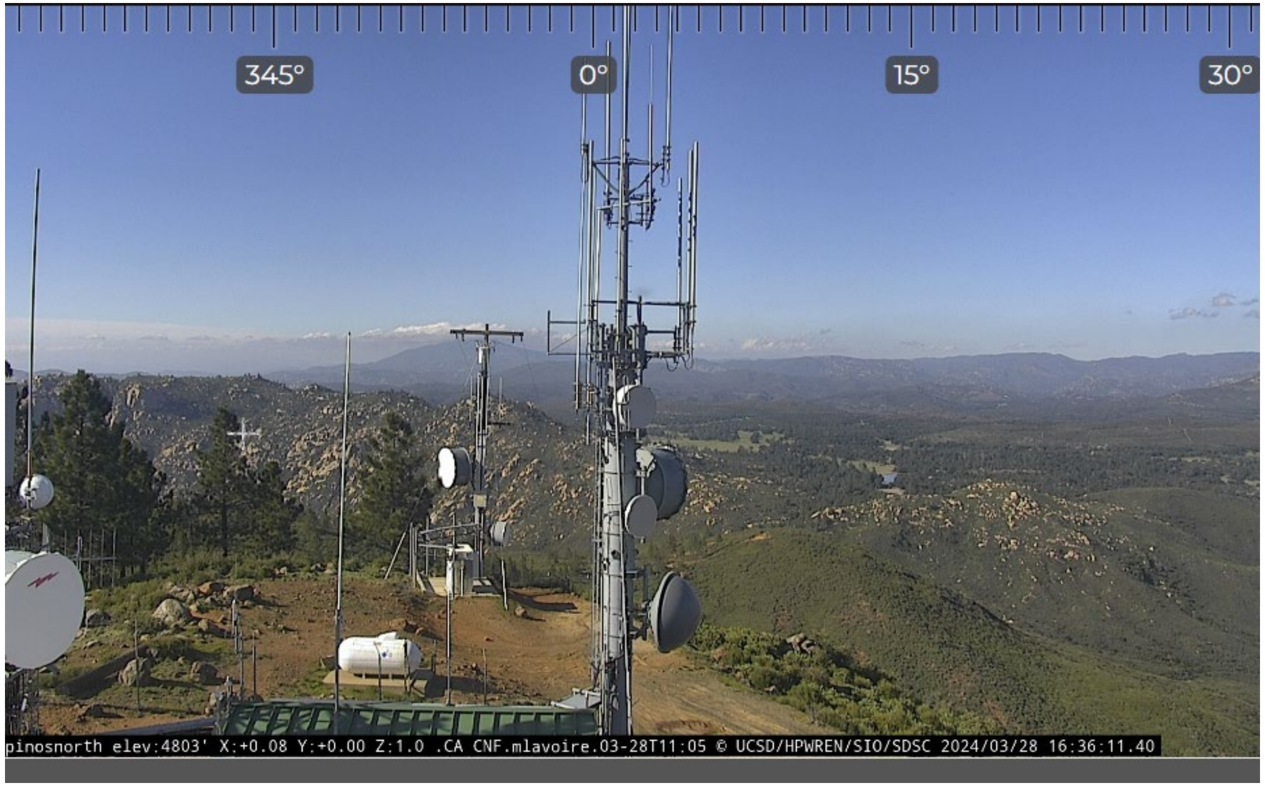
SDG&E™ operates over 200 power quality (PQ) nodes at major substations, **providing real-time** high resolution power system waveforms **useful for event analysis** of all types



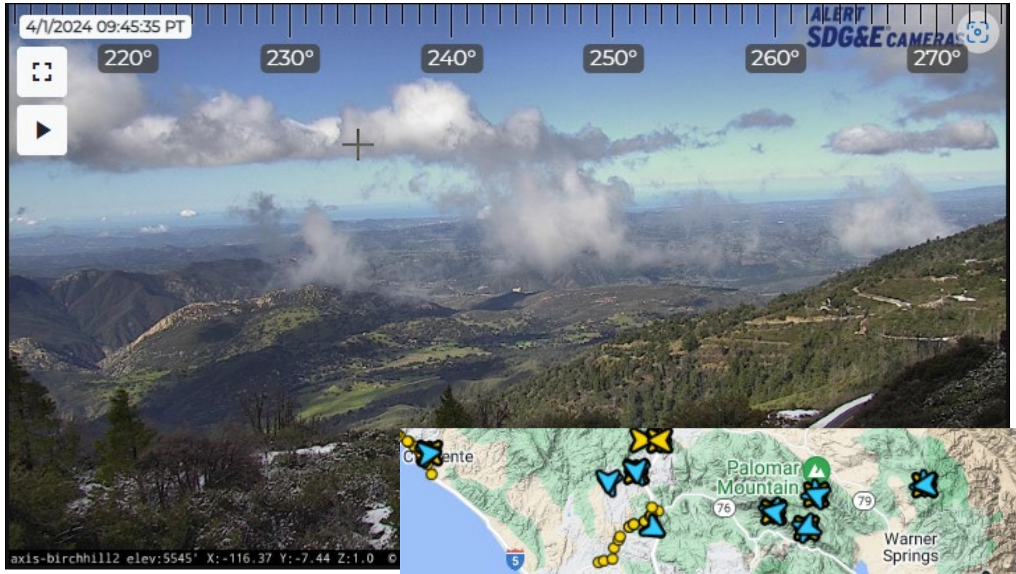
Use Case 1

Quicker Fault Identification

Can real time camera images be broken down into **coded messages** and combined with PQ data to **quickly predict a fault location**?



Use Case 2



Area Of Concern

Can PQ events be used to **actively notify** ALERTCalifornia cameras to focus on an **area of concern** and **identify fault precursors**?

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Project Costs & Benefits

PQ and fire detection camera integration **supports a more nimble grid** to increase **public safety** and **reliability**.

Estimated Budget: **$1.8M** | Estimated Project Duration: **24 to 36 Months**

Outcomes	Community Benefits	Communities
• Integrates fault data with fire detection cameras • **Increases reliability** • Leverages existing infrastructure • Advances PQ technology	• **Increases public safety** • Reduces troubleshooting costs • Reduces outage times	• IOU service territory • **High Fire Threat District (HFTD)** • Disadvantaged Communities (DAC)

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Zonal Electrification With Integrated Distributed Energy Resources (IDER) Operational Flexibility

Alton Kwok, Decarbonization & Resiliency Portfolio Manager

Kirsten Petersen, Electric Distribution Operations Manager

Current Regulatory, Utility, and Market Landscape

Continued Interest & Growth in Building Electrification

CPUC Long Term Gas System Planning Proceeding

California Clean Energy Mandates

SDG&E's Path to Net Zero & Sustainability Strategy

A 2-Part Project

1. Explore customer in Disadvantaged Communities (DAC) decision-making process for electrification

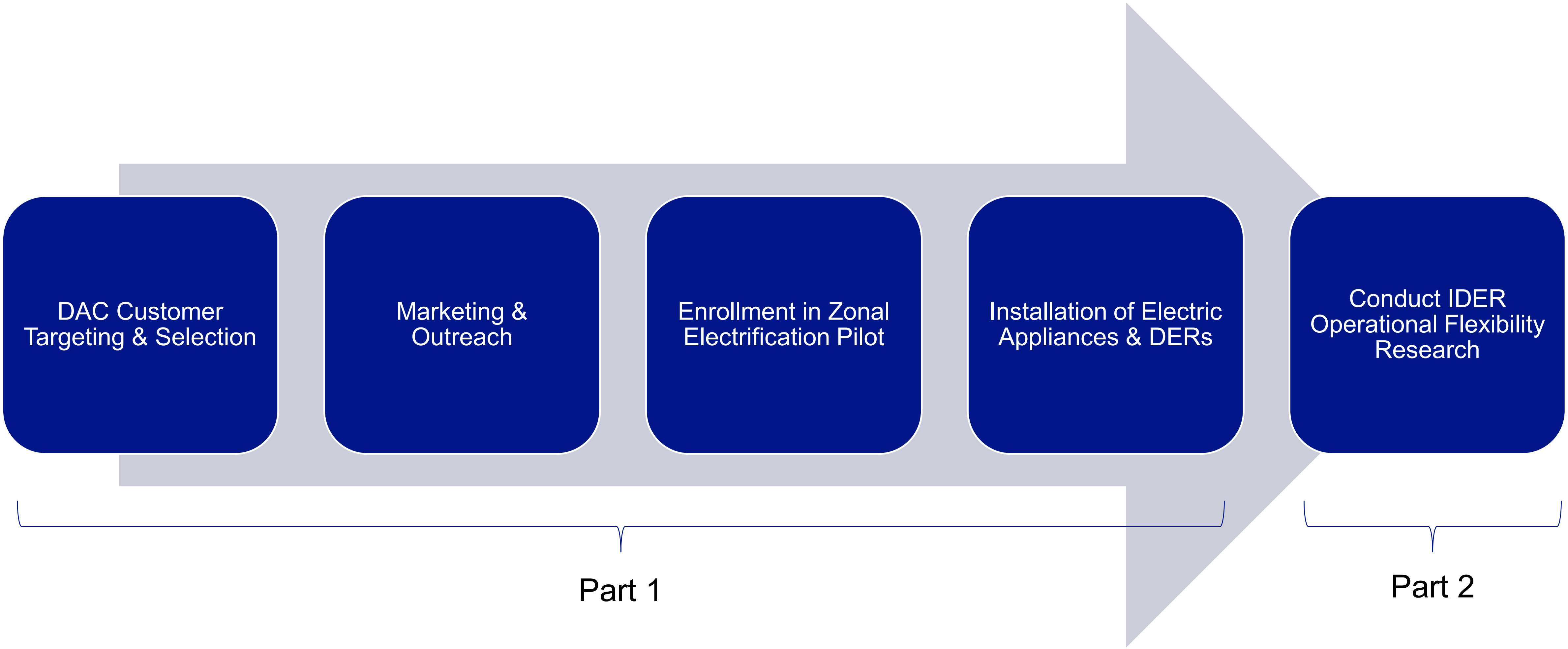
2. Explore Integrated Distributed Energy Resources (IDER) Operational Flexibility

Initiative

Project Name	Zonal Electrification With Distributed Energy Resources For Operational Flexibility
Project Context	Part 1: SDG&E's zonal electrification project seeks to capture and understand customer's decision-making process by integrating DER flexibility and enabling electrification for customers (including underserved customers). Part 2: Part of our roadmap to establish our production DERMS integration requirements including the coexistence of DERMS with existing SDG&E technology components to leading to the optimization of our overall distribution system operator environment.
Project Duration	• Zonal electrification portion of the project is estimated to take 36 to 48 months. • IDER research on operational flexibility is estimated to take up to 18 months. • Some activities will happen concurrently.
Target Audiences / Potential Locations	With a **lens on DACs**, customers will be identified using **defined internal and external metrics**. Potential to overlay prospective target audiences with: • Existing and future programs that target similar markets • Customers who don't typically qualify for AMI/CARE programs • Less dense geographical locations

Customer Journey

Zonal Electrification With Integrated Distributed Energy Resources (IDER) Operational Flexibility

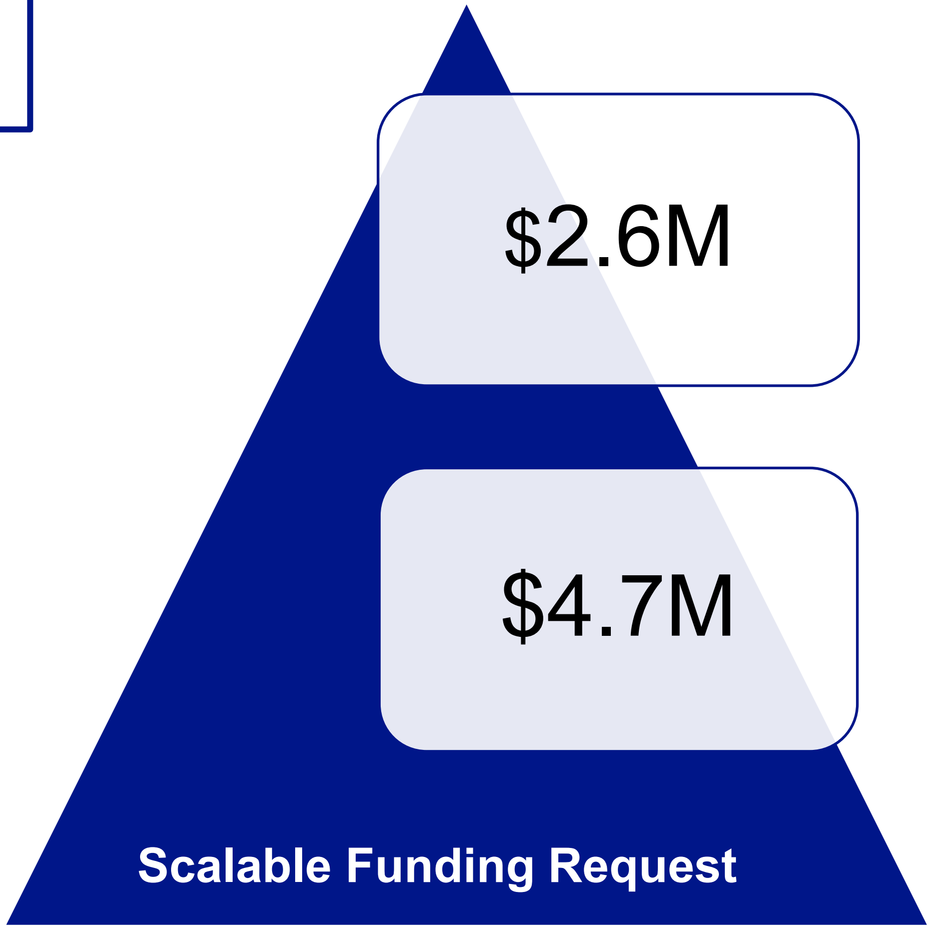


Zonal Electrification: Flexible Funding Approach

EPIC funding could support **full electrification of customers** and better understand **their decision-making** throughout the process

Project funding could range from $2.6M - $4.7M. With more funding, the scope may be enhanced.

- Development of supporting analytical IT tools & approaches
- Incorporation of different and/or multiple target audiences
- Variety of electrification scenarios
- Pursuit of partnerships for further leverage



Distribution System Operator (DSO) High DER Impacts

Quantification of “True Load”

Resources

Monitoring & Visibility

Training

Model Validation

Controllability

Forecasting

Roadmap to DERMS

Pilots and Pre-Commercial Demonstrations

DER-Aware ADMS

- Day Ahead Forecasting
- FLISR
- Etc.

Pilot Projects (Including EPIC pre-commercial demonstration)

Distributed Energy Resources Management System (DERMS)

This project is part of our roadmap to establish our production DERMS integration requirements including the coexistence of DERMS with existing SDG&E technology components to leading to the optimization of our overall distribution system operator environment.

Integrated Distributed Energy Resources (IDER) Operational Flexibility

2030.5 Experience

2020

BTM grid interconnection applications with CA IOUs require Rule 21/IEEE 2030.5 compliant smart inverters

Today

Limited real-world experience exists in its use beyond test laboratories.

2024+

Need to further explore 2030.5 use in leveraging DER to meet one or more of the distribution level services as defined by the IDER and derivative use cases developed from the IDER services such as Operational Flexibility.

Project Costs and Benefits

Estimated Budget: **$4.7M + $2.5M** | Estimated Project Duration: **18 Months – 48 Months**

Communities

- IOU Service Territory
- Disadvantaged Communities (DAC)

Community Benefits

- Educating customers on bill impacts and long- and short-term benefits of electrification
- Electrified businesses and/or residential customers
- Incorporation of advanced, connected technologies that enable seamless integration with renewable energy and DERs for demand flexibility and cost management

Outcomes (Part 1)

- Better understanding on customer decision-making processes to enable future electrification program design and customer support
- Identifying how IOUs can best provide value in the customer electrification journey
- Support Long-Term Decarbonization and GHG Reduction
- IT Analytical Tool that identifies perfect "zones" for electrification

Outcomes (Part 2)

- Expand our understanding of communication compatibility across multiple DER devices and inform how SDG&E can establish production DERMS integration requirements
- Better understanding on electrification's impact to grid reliability and stability
- Gain real world experience on how self-generation, demand-side management, and electrified appliances can work together to enable dispatchable DER and minimize impacts on customer costs

Questions?

Mobile Nanogrid for Climate Resilience

What is a NanoGrid?

- Small-scale, self-sufficient power grid system
- Smaller than microgrid, faster, easier to deploy and more affordable.
- Renewable energy resilient solution.
- Operational in of stand-alone mode or in conjunction with stationary resources.
- Support both planned and emergency outage events.

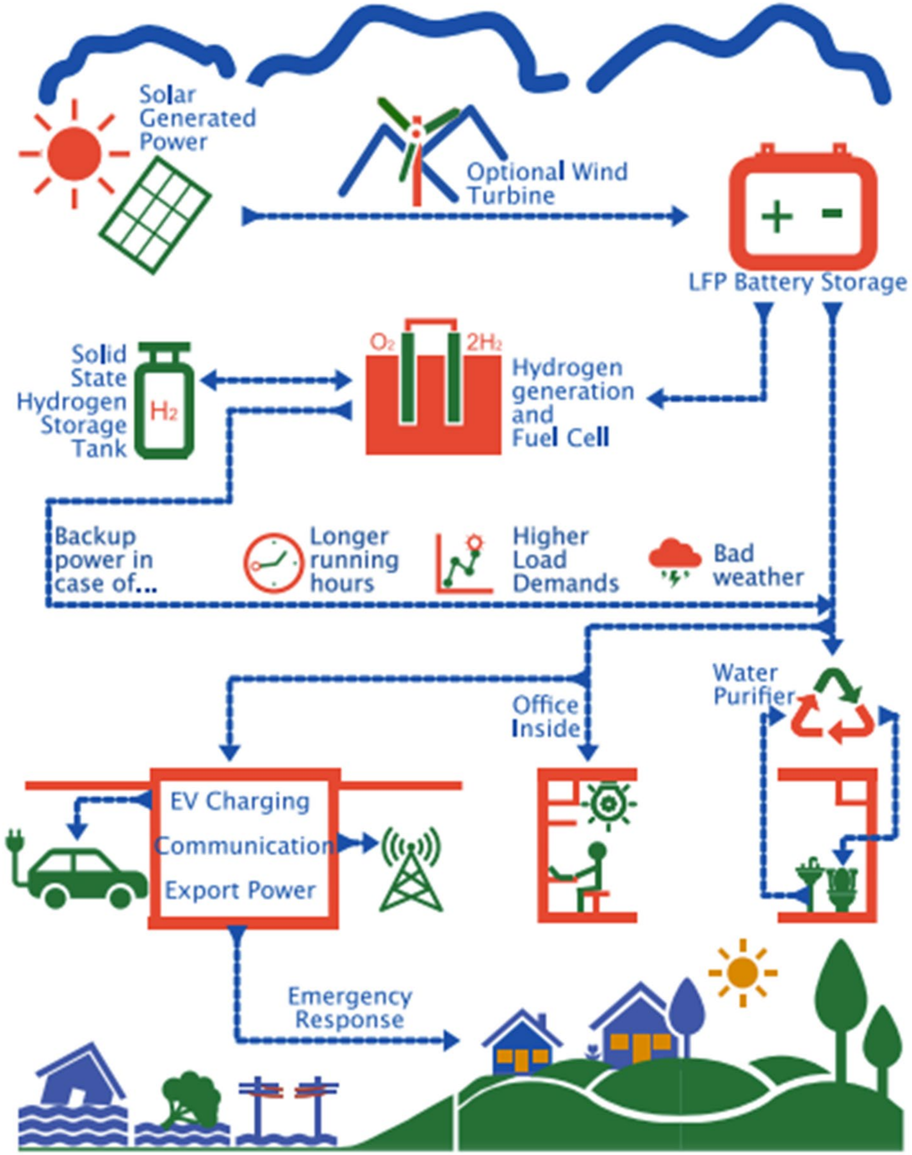
Curtesy of Sesame Solar, https://www.sesame.solar

How does a Nanogrid work?

- Nanogrid Components:
    - PV Generation
    - Battery Storage
    - Hydrogen Energy Storage System:
        - Capture water from atmosphere
        - Electrolyzer
        - Solid State Hydrogen Storage
        - Fuel Cell
    - Inverter and Power equipment
    - Building connection capability
    - Level II EV Chargers

Solar Sesame Unit Benefits:

- EV Charging
- Communication
- Export Power
- Office
- Water Purification



Courtesy of Solar Sesame, https://www.sesame.solar/faqs

Benefits of Nanogrid System

Decentralized Energy Generation

Reliable Energy Resource

Contribution to Net-Zero Goals

Autonomous Operation and Customization

Disaster Resilience

Smart City Integration

Mobile Nanogrid -EPIC Use Case

USE CASE

Use built-in solar canopy, hydrogen production and storage, and batteries to provide power for EV chargers or Wildfire Resiliency/ Mobile Command Center

- **Deployable for stand-alone operation or in conjunction with stationary resources**
- **Support planned and emergency events**
- **Improved reliability**
- **Improved system resilience**
- **Reduced GHG emissions**
- **Reduced O&M Cost**

Project Costs & Benefits

Make renewable power fast and easy, leveraging solar power, batteries, and clean hydrogen to provide mobile, reliable and renewable energy

Estimated Budget: **$0.5M** | Estimated Project Duration: **36 Months**

Outcomes	Community Benefits	Communities
• Increase reliability • Flexibility and mobility • Nimble Clean Energy Resource	• Distributed energy resources are key components of California's clean energy future and economy-wide decarbonization.	• IOU Service Territory • High Fire Threat District • Remote Communities • Disadvantaged Communities

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Questions?

Next Steps:

Slides and all SDG&E EPIC Information can be found here: www.sdge.com/EPIC

Solicit feedback until May 3, 2024. Send questions/comments to EPIC@sdge.com