PG&E's 2027 GRC Grid Modernization Workshop

March 13, 2025

Workshop Objectives

Background: Commission D.18-03-023 requires the IOUs to present their GRC Grid Modernization plans in a workshop 60 days in advance of filing their GRCs.

The workshop's objectives are to:

1. Present PG&E's 10-Year Vision for modernizing the grid
2. Provide outline of PG&E's Grid Modernization Plan in the 2027 GRC
3. Request initial input from parties on PG&E's Grid Modernization Plan and Vision

Agenda

Topic	Presenter	Time
1. Introduction and Safety	CPUC	9:00 – 9:10 am
2. Grid Modernization and PG&E's 10-Year Vision · Q&A	Alex Portilla	9:10 – 9:40 am
3. 2027 GRC Grid Modernization Plan		9:40 AM
a. Distribution Planning Tools · Where we have been (capabilities and progress) · Where are we going (planned capabilities and benefits) · Q&A	Bill Peter and Brad Detjen	9:40 – 10:10 am
Break		**10:10 – 10:20 am**
b. ADMS & Advanced Distribution Applications · Where we have been (capabilities and progress) · Where are we going (planned capabilities and benefits) · Q&A	Christopher Huff	10:20 – 10:50 am
c. DERMS · Where we have been (capabilities and progress) · Where are we going (planned capabilities and benefits) · Q&A	Salma Bakr	10:50 – 11:20 am
4. Open Discussion	All	11:20 – 11:55 am
5. Closing Remarks	CPUC	11:55 – 12:00 pm

PG&E's 10 Year Grid Modernization Vision

Alex Portilla

Director, Clean Energy Technology Platforms

OUR 10-YEAR TRUE NORTH STRATEGY

PURPOSE: WHY WE EXIST

Delivering for our hometowns

Serving our planet

Leading with love

STANDS: WHAT WE WILL DELIVER

PEOPLE

Everyone and everything is always safe

Catastrophic wildfires shall stop

It is enjoyable to work with and for PG&E

PLANET

Clean and resilient energy for all

PROSPERITY

Our work shall create prosperity for all customers and investors

WHERE WE ARE HEADED

CUSTOMERS

Rebuild trust with our customers and our local communities by delivering **affordable energy** & **excellent customer experiences** every day

ENERGY SYSTEM

Architect an electric system that is:
- **Resilient** to climate change
- **Decarbonized** 24 x 7 x 365
- **Optimized** to local and system needs

Unleash the **full potential of electric vehicles**

Electric

Gas

Continue to **invest in a safe and reliable gas system**

Boldly shape the future through:
- **Targeted electrification**
- **Greening** the gas supply
- **Shaping** California's policy

HOW WE WILL DO IT

FOUNDATIONAL CAPABILITIES

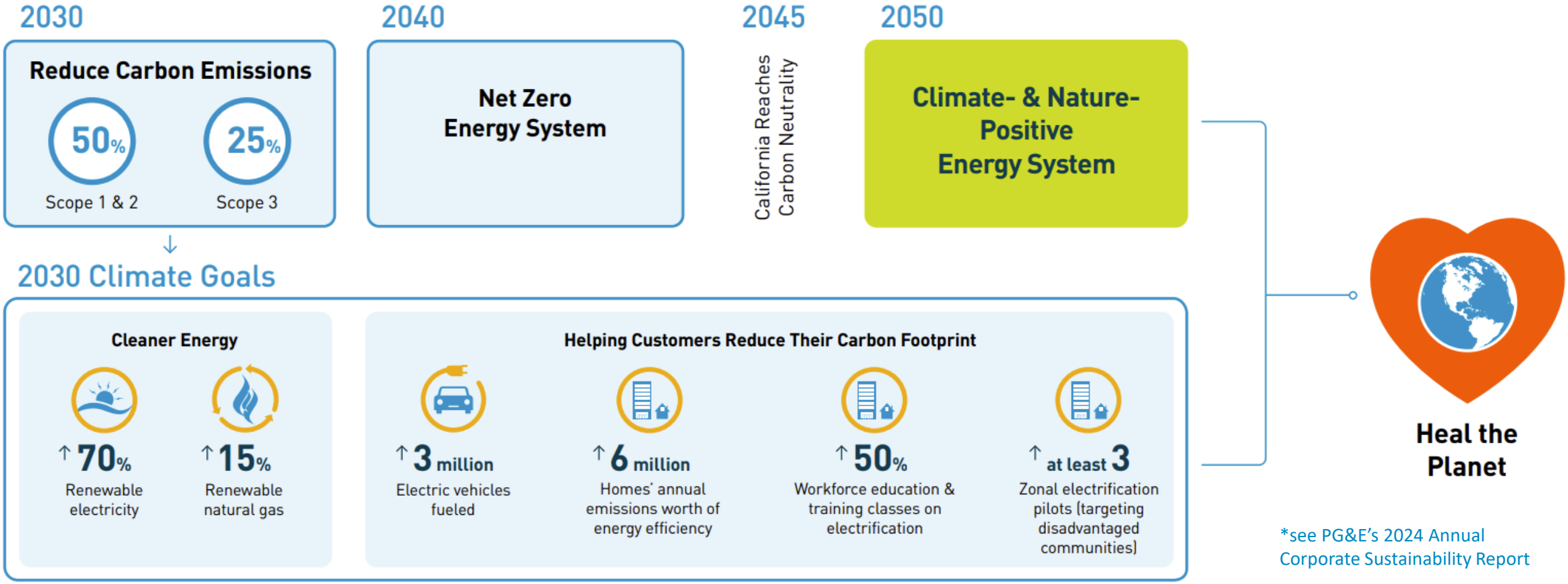
- Public & workforce safety and risk mitigation
- Diversity, equity, inclusion & belonging
- PG&E Performance Playbook
- Coworker development and well-being
- Simple, affordable financial model
- Effective and efficient end-to-end production system
- Regional service model
- IT platforms and data management capabilities
- Stakeholder, policy, and regulatory advocacy

VIRTUES: WHO WE ARE

Trustworthy, Empathetic, Curious, Tenacious, Nimble, Owners

PG&E's Commitment to Helping Heal the Planet

PG&E is committed to helping heal the planet by achieving a climate- and nature-positive energy system by 2050; a net-zero energy system in 2040 – five years ahead of California's current carbon neutrality goal; and a series of 2030 climate goals to reduce PG&E's operational carbon footprint and enable our customers and communities to reduce their carbon footprints.



*see PG&E's 2024 Annual Corporate Sustainability Report

Evolving Energy Landscape for PG&E

PG&E's grid is facing evolving forces driven by changes in technology, climate, policy and market, including soaring load growth driven by transportation and building electrification, new business growth (e.g. data centers) and continued adoption of distributed solar, storage and flexible loads. Grid modernization is needed to harness such forces to operate the high DER and electrified grid of the future, affordably.

Climate Drivers

Policy Drivers

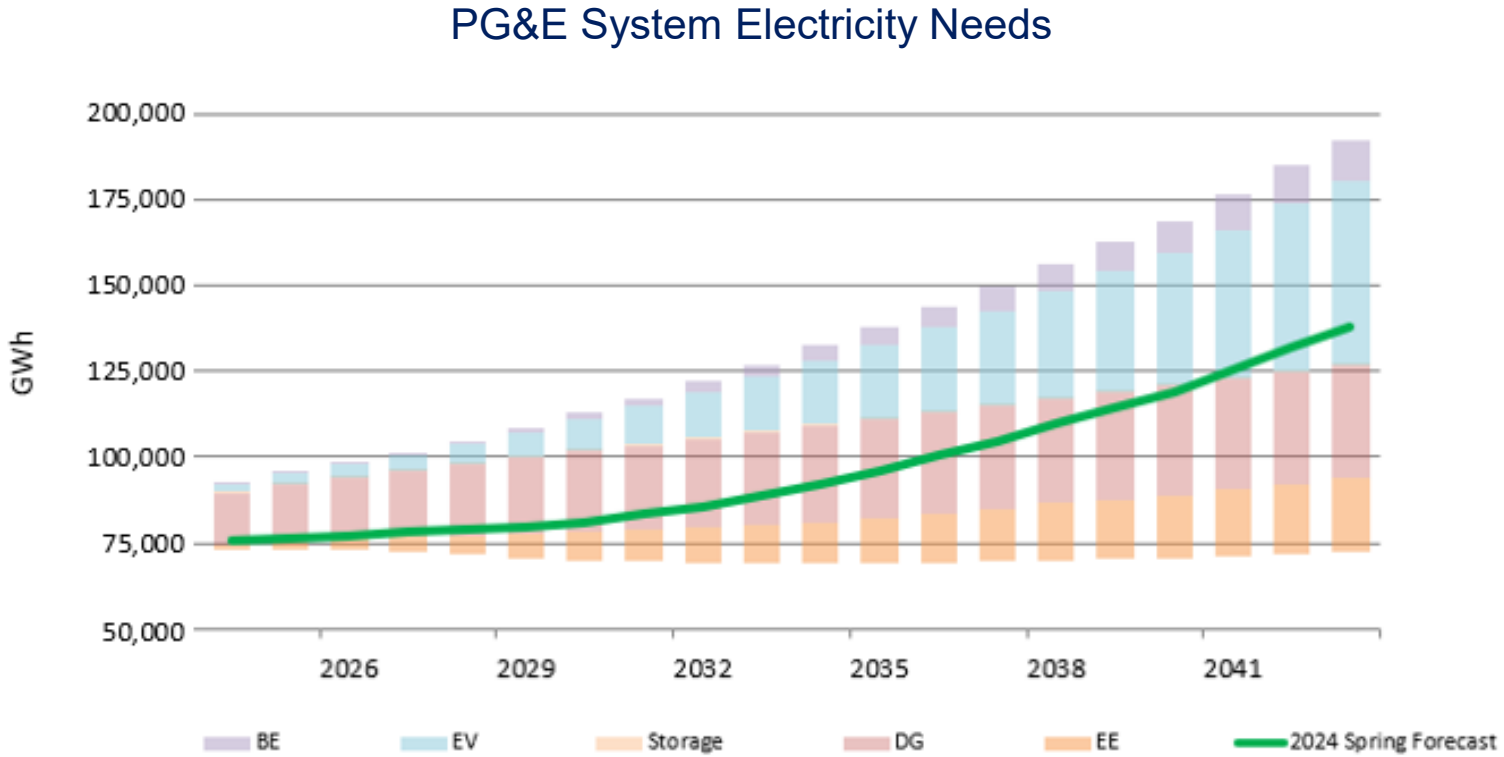
NBT

Market Drivers

CAISO

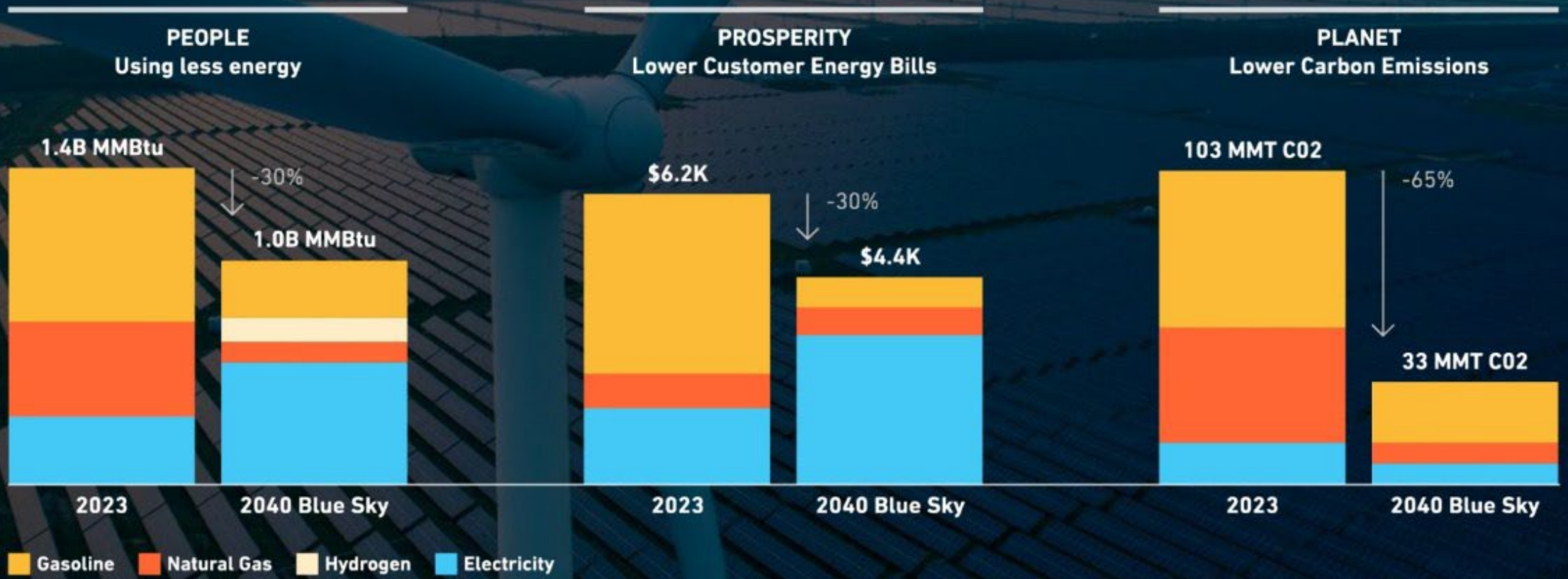
Technology Drivers

- 80% energy needs
- 10X EV
- 7X BTM Storage
- 2X DG



Source: PG&E's Spring 2024 Annual Load Forecast

AN ELECTRIFIED FUTURE SERVES OUR TRIPLE BOTTOM LINE.



Source: Energy System Databook; Enterprise Financial Model; CARB; IGP

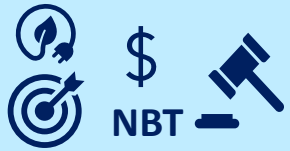
PG&E's 10-Year Grid Mod Vision & Investments

PG&E's 10-year grid modernization vision is driven by evolving technology, climate, policy and market trends. This vision is defined as modernization efforts in grid infrastructure, system monitoring and control, DER grid services, and DER orchestration. To bolster this vision, PG&E is investing in foundational as well as scaling capabilities in distribution planning tools, ADMS and DERMS.

Drivers

Technology Drivers

Climate Drivers



Policy Drivers

Market Drivers

Vision

Grid Infrastructure

System Monitoring & Control

DER Grid Services

DER Orchestration

Investments

Dx Planning Tools	ADMS	DERMS	AMI Upgrade
Enhanced Automation Utilization Planning Capabilities Tx & Dx Planning Alignment Dx Planning and Execution process Integration Capacity Analysis Grid Resource Integration Portal	Volt-Var Optimization Load Flow / State Estimation Load Forecasting Engineering and Protection Analyses Field Switching Digital Transformation AI for Faster Issue Troubleshooting	Operational Flexibility Vehicle-Grid-Integration via V1G and V2X VPP Orchestration Integration with Grid Edge Computing Tx & Dx Reliability Coordination	Grid Edge Computing for Customer Electrification, DER Management, Wildfire Risk Mitigation, Grid and Asset Management Improvements

Distribution Planning Tools

Bill Peter

Brad Detjen

High DER Proceeding Background

- The overall objective of the High DER proceeding (R.21-06-017) is to prepare and operate the grid for high electrification through proactive planning and understand the impact on costs while meeting customer needs, accommodating increased energization load, and maintaining affordable rates.
- The proceeding is broken up into three tracks with multiple phases within each track:
    1. Distribution Planning and Execution Process and Data Improvements
    2. Distribution System Operational Needs and System Operator Needs
    3. Smart Inverter Operationalization and Grid Modernization Planning (DERMS, Load Management/Flexibility, etc.)
- As electrification has grown, and in response to SB410 and AB50, the CPUC amended the proceeding to focus the proceeding on ensuring the IOUs are able to meet load growth and expanded the scope to include distribution capacity funding and project execution.
- A decision was issued in October 2024 laying out various changes and improvements to the distribution planning and execution processes to lay the foundation to meet electrification needs.

Work completed as part of High DER

Distribution Investment Deferral Framework (DIDF)

- DIDF included annual filings on PG&E's Distribution Planning Process (DPP) via a Grid Needs Assessment (GNA) and Distribution Deferral Opportunities Report (DDOR).
- Solicited and contracted with Distributed Energy Resources (DERs) for distribution deferral.
- DIDF was reprioritized and renamed as the Distribution Planning and Execution Process (DPEP), including conversion of the DDOR to the Distribution Upgrade Project Report (DUPR) on identifying and meeting grids needs.

Integration Capacity Analysis (ICA)

- ICA quantifies the maximum amount of power that can be injected to, or drawn from, the distribution system while requiring minimal to no distribution mitigations, upgrades, or operational restrictions.
- ICA Improvements and Validations: Initiated ICA 2.0 improvements that are underway that include the use of forecast data, known loads, and planned upgrades instead of just historical data.
- Bi-annual reporting for ICA and data portals and quarterly workshops to discuss ICA accuracy and provide updates.

Grid Resource Integration Portal (GRIP)

- Public data portal that provides information about capacity and forecasts on the electric distribution system.
- Customers use the GRIP portal prior to submitting their applications for interconnection or energization.
- Multi-year incremental upgrade to the DRP Data Portal necessitated by a dramatic increase in use by customers.

DIDF DER Distribution Deferral Contracts

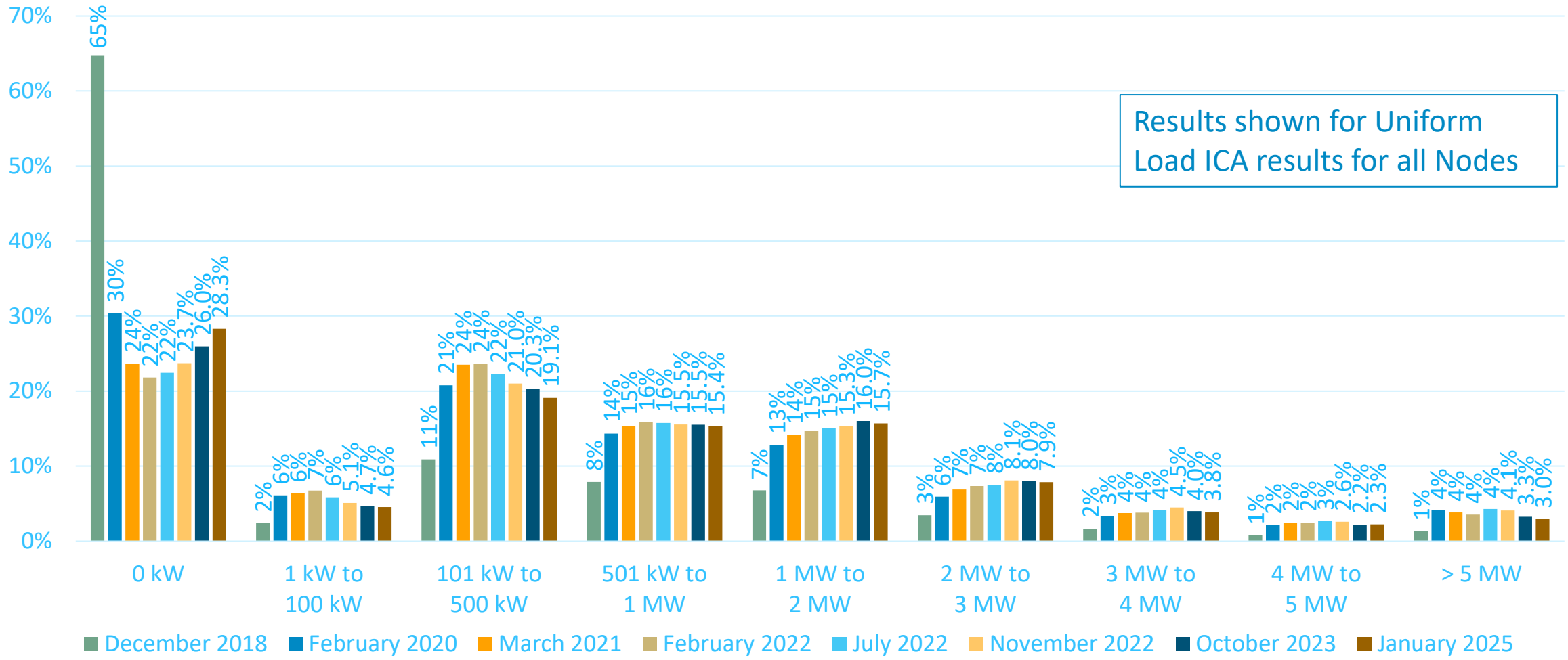
PG&E has executed a number of DIDF contracts, the first of which are expected to come on-line June 2025

Project	Grid Needs	Solicitation Year	In Service Date	Status	Reason
Gonzales	2	RFO 2018	6/1/2021	Terminated	Vendor withdrew
Huron	1	RFO 2018	4/1/2021	Terminated	Vendor withdrew claiming Force Majeure
Santa Nella	2	RFO 2018	5/1/2021	Terminated	Vendor withdrew claiming Force Majeure
Lakeview 1110	1	RFO 2021	6/1/2025	Delayed*	Delay in project development
Mormon Bank 2	2	RFO 2021	6/1/2025	Terminated	Vendor could face headwinds in getting subscribers
Saratoga 1102	1	RFO 2021	5/1/2026	Terminated	Vendor shut down operations
Blackwell Bank 1	1	SOC 2021	6/1/2025	Delayed*	Delay in project development

PG&E will continue to administer and manage the existing DER contracts and the operational dispatch of the DER projects.

Integration Capacity Analysis (ICA) Trends

ICA results improved in quality with ICA modernization and remained relatively stable since



Grid Resource Integration Portal (GRIP)

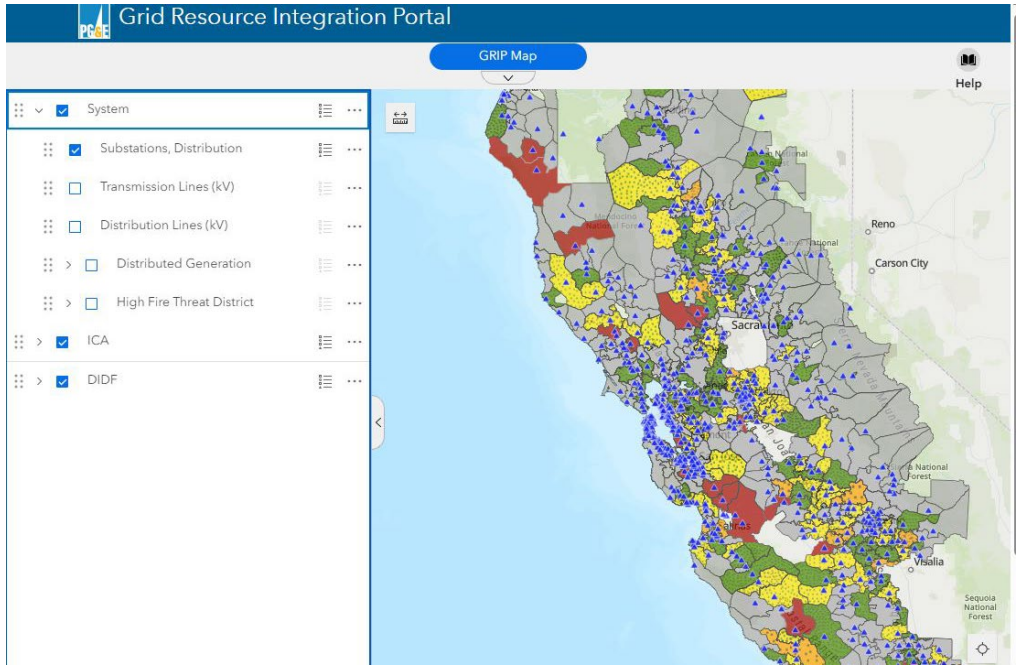
Launched the GRIP portal October 2024

Capacity and Forecast data

- ICA (hosting capacity)
- Forecast DERs
- Forecast Load
- Planned Projects

New Features

- Standardized interface functions
- Enhanced filtering functionality
- New analysis functionality
- Enhanced user control of data and visibility
- Merged Distribution Planning data and layers
- Public access without authentication
- Introduces a new Geographic Information System (GIS) platform
- Enhanced Application Programming Interface (API) capabilities



Link: GRIP.pge.com

Improvements and Changes to Planning in High DER

Distribution Planning and Execution Process (DPEP)

- New reporting and tracking of Capacity projects, Project Execution, and Customer impacts.
- Provision of pending load data, equity data and metrics, known load data, and expansion of reporting of forecasting and planning horizons.
- Bottoms Up Forecasting and Incorporation of Pending Loads into DPEP.
- Scenario Planning to utilize multiple forecasts to develop a single, actionable investment plan.
- Incorporation of Community Engagement
- Incorporation of Transportation Electrification Proactive Planning Framework
- Incorporation of Electrification Impact Study (EIS) Findings

Integration Capacity Analysis (ICA)

- ICA Improvements and Validations to implement a remediation plan, including the use of forecast data, known loads, and planned upgrades instead of just historical data.
- Load ICA Use Case: Use of ICA data to streamline early stages of the new business application process, improving efficiency by identifying capacity constraints early.
- Limited Generation Profiles: PG&E is modifying its ICA maps to enable straightforward customer creation of Limited Generation Profiles.

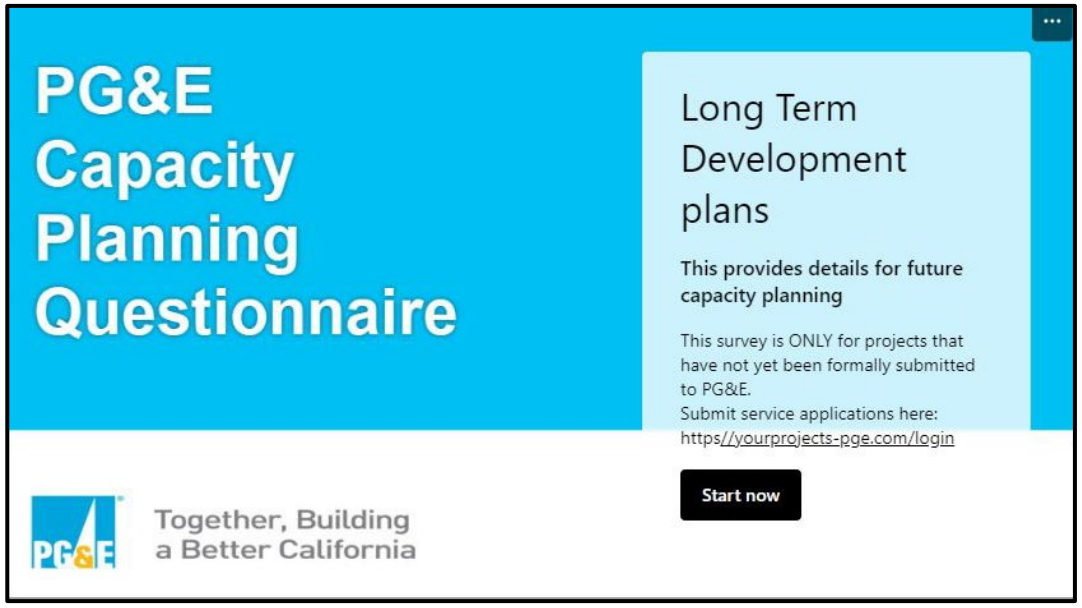
Grid Resource Integration Portal (GRIP)

- The Grid Resource Integration Portal (GRIP) is a public data portal that provides information about capacity and forecasts on the electric distribution system.
- The GRIP portal will incorporate the enhancements shown and provide actionable data to customers.
- Additional customer use cases for Load ICA and Electrical Vehicle Supply Equipment (EVSE) underway.

Community Engagement for Distribution Planning

Improve engagement with our communities regarding distribution planning to better meet California's increasing energization needs

- SB 410 and AB 50: CPUC shall require PG&E to improve information gathering for their Distribution Planning Process (DPP).
- PG&E launched a Capacity Planning Questionnaire to:
  - Inform our distribution planning forecasts by obtaining community plans for future development.
  - Provide pathway for communities to provide their long-term development plans with our Distribution Planning Engineers
  - Consider these plans in our Distribution Planning Processes (DPP) to be able to better service future community needs.
  - Improve coordination with Federal Tribes, Environmental & Social Justice groups, and local governments on longer term planning for city & county developments



Link to Webform: Capacity Planning Questionnaire

Benefits:

Longer Term Outlook than service planning application adjustments

Improved location and temporal accuracy over propensity based spatial adjustments

Better inform proactive capacity upgrades

Opportunity for customers to align long-term forecasts with capacity outlook

PG&E EIS Part 2

The IOUs will individually lead Part 2 of the EIS study to estimate the costs of preparing the grid for electrification

- EIS Part 2 will expand on the EIS Part 1 Study by leveraging expertise to:
  - Forecast grid impacts across 4 scenarios for 2030, 2035, 2040
  - Estimate costs across the distribution and secondary grid through solutioning
  - Examine DER adoption for DAC customers
  - Examine the impact of enhanced demand flexibility
- Study timeline:
  - Study began in Q3 2024, concludes Q4 2025
  - Incorporate lessons learned into PG&E's future DPEP cycles

Scenario 1	• Base Case (2023 IEPR)
Scenario 2	• Base Case + Equity DER Dispersion (e.g., DAC)
Scenario 3	• Base Case + Enhanced Demand Flexibility (e.g., Load Management)
Scenario 4*	• Bottoms-up charging port-based Transportation Electrification (TE)

Load ICA Internal Use Case

Objective Incorporate Load ICA data into the internal energization process to enable *early* capacity check for new load applications

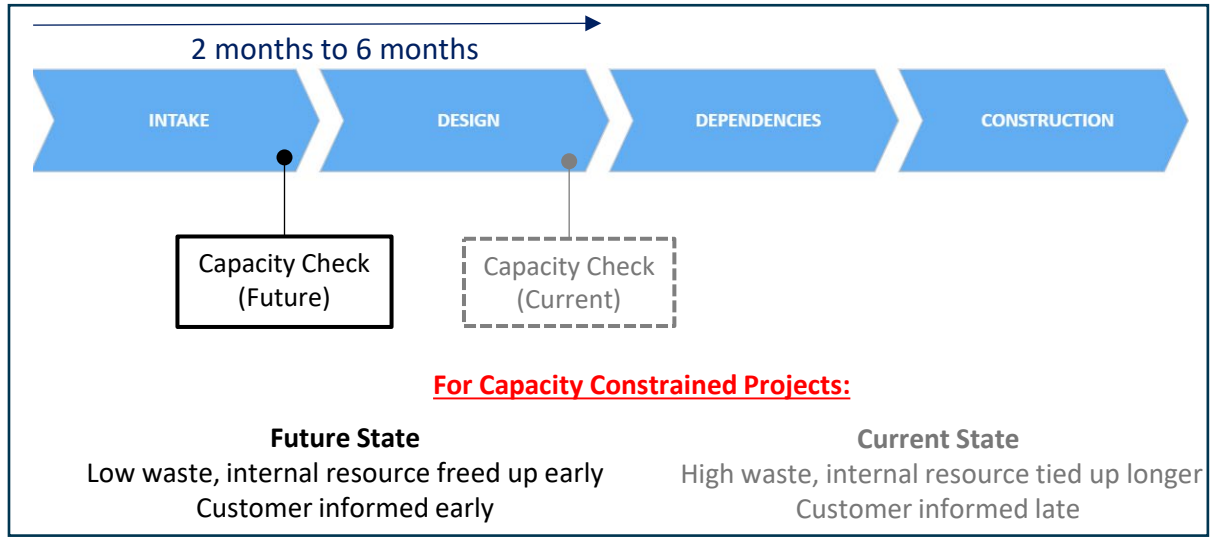
Scope

1. **Automatic Calculation of Load:**

   Implement automatic calculation of load directly from customer submissions in Your Projects based on methodologies from Electric Design Manual.

2. **Internal Screen for Available Capacity:**

   Implement check for capacity in the Intake phase of the energization process via SAP and CYME integration. Make capacity data available in internal visualization tools.



Benefits

- **Identify capacity constraints significantly earlier in the energization process** to improve transparency and enable customers to make informed decisions regarding their projects in a timely manner.
- **Optimize resources and reduce waste by screening at-risk applications before Design** by avoiding unnecessary design work on applications for which there is no capacity
- **Reduce manual tasks and minimize rework due to human errors** by implementing standardized load calculation methodologies and automation across platforms

Milestones

- Launch solution by end of 2025
- Begin reporting expected benefits in 2026 Bi-annual ICA report

Evolution of PG&E Planning Tools

PG&E placed two major integrated planning software releases into production and is using them in its DPEP

Distribution Planning Automation Project
Production release: 2023

Distribution Time-Series Analysis Project
Production release: 2023

CYME Forecast Integration Tool
Line section load flow modeling

- Evolves load flow modeling from desktop to server-hosted analysis
- Load Flow With Profiles combines hourly forecast data (LoadSEER) with detailed new customer load shapes for accurate load diversification
- Manage-by-exception process focuses engineering effort on thermal and voltage constraints
- Load Warehouse receives new service applications directly from SAP
- Project Database linked to CYME models provides scope, cost, and justification for projects

LoadSEER 4.0
Forecasting engine

- Transitions historical load basis from SCADA to AMI
  - Eliminates sources of error e.g. abnormal switching, short-duration load readings
  - Vastly increases spatial resolution
- Hosts hourly feeder shapes and typical day service point loading: facilitates timeseries analysis in CYME
- Exchanges project, transfer, and known load data with CYME multiple times daily
- Hosts Report Server to automate and standardize aspects of GNA/DUPR reporting
- Establishes basis for scenario planning

Planning Tools: Architecture

3rd-party customer adoption models

Hourly AMI Data

Forecast Integration Tool

- Incoming load warehouse with adjustable shapes, magnitudes, ramp rates
- Web-based load flow modeling
- Desktop engineering analysis: design projects and transfers
- Project database with cost, scope, justification

Forecast future service point load

Planned projects
Planned transfers
New business applications

Load Forecasting

- Load aggregation, weather normalization
- IEPR disaggregation via agent simulation
- 12-year bank and feeder load forecasts

ED GIS

As-Built Network Model

Mapping

SAP

New Business Applications

Service Planning

Distribution Plans, Reports, & Approvals

- New Business Reviews
- Large Load Studies
- Capacity Project Packages
- Grid Needs Assessment (Annual)

Substation + Transmission Engineering

Other Related Projects and Activities (2027-2030)

Enhanced Automation

- Build on Distribution Planning Automation platform
- Run new study types on web servers: N-1 contingency studies, protection studies
- Automate recommended solution identification
- Enable study of more hours, more future scenarios
- Evaluate machine learning and AI tools
- Integrate planning into a “single pane of glass”

Asset Utilization Planning Capabilities

- Use timeseries forecasting to identify opportunities to increase asset utilization
- Evaluate asset health and operational impacts of leveling load to inform changes to standard planning limits
- Study load flexibility, programs, rate designs, and dispatches in forecasting and solutioning
- Study bridging solutions and improve modeling of DERs to accelerate energization
- Integrate with DERMS to leverage flexible assets for capacity planning

Transmission & Distribution Planning Alignment

- Study distribution forecast impacts on transmission
- Align transmission and distribution forecasting methods and tools
- Assess effects of transmission load flow on distribution power quality
- Evaluate alternatives to co-optimize T&D costs

Benefits of Distribution Planning Enhancements

Prepare the grid for a high DER and high electrification future

Affordability

- Integrate and enable DERs and the provision of grid services
- Improve distribution planning and execution outcomes, including greater visibility and transparency into the Distribution Planning and Execution Process
- Increasing asset utilization enables energization of more load with efficient capital outlay
- T&D Alignment optimizes engineering solutions and investments to serve transmission and distribution system needs
- Automation allows for exploration of a greater range of scenarios and solutioning to identify more optimal investments

Improved Customer Outcomes

- Accelerate energization of electrification projects
- Access to grid, planning, and interconnection data for load energization and generator interconnection
- Increased incorporation of community input into Distribution Planning
- Visibility into equity outcomes for Distribution Planning

Reliability

- Automating N-1 studies ensures outages can be restored timely
- Study of asset utilization will inform changes to planning limits to mitigate impact of load shifting and shaping on asset health and operational flexibility

Compliance

- Decision D.24-10-030 required Distribution Planning and Execution Process improvements to prepare the electric grid for a high number of DERs, including those specific to transportation electrification, and for a high electrification future.

ADMS & Advanced Distribution Applications

Christopher Huff

Sr. Manager, ADMS Applications and Strategy

Advanced Distribution Management System (ADMS)
Program Overview

The Advanced Distribution Management System (ADMS) enables "single pane of glass" operations where critical information can be accessed from one single system.

RELEASE 1
100% complete

SCADA

Distribution SCADA

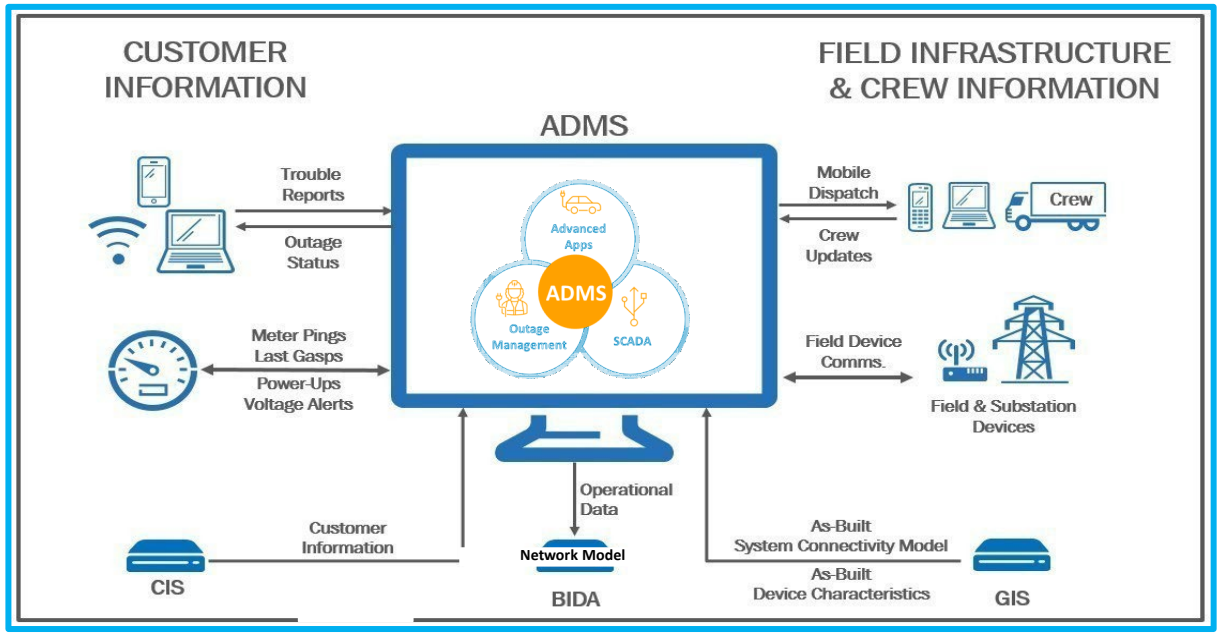
- Remote Real-time Device Monitoring
- Device Control
- Integration of SCADA with Network Model

RELEASE 2
66% complete

OMS

Outage Management System

- Outage Analysis and Prediction
- Trouble Call Mgmt.
- Outage Reporting & Notifications
- Planned Outage Mgmt.
- Crew Dispatch & Mgmt.
- Storm Management
- Public Safety Power Shutoff (PSPS)



RELEASE 3
75% complete

Advanced Distribution Apps

Advanced Distribution Applications (The envisioned end-state will be achieved incrementally over time with distinct stages of implementation)

- Fault Locations, Isolation, and Service Restoration (FLISR)
- Load Flow / State Estimation Pilot
- Distributed Energy Resource Management System (DERMS) Integration
- Enhanced Powerline Safety Settings (EPSS)
- Load Shed
- Line Sensor Integration
- Microgrid Enablement

Advanced Distribution Management System (ADMS)
Key Benefits

The following are examples of benefits to customers and PG&E of deploying ADMS

Safety

- Reduced cybersecurity risk from retirement of RT-SCADA system.
- Reduced risk of operator error through improved situational awareness and reduced manual data transfer steps.
- Enhancing future visibility into thermal, voltage, and protection issues, including on non-telemetered circuit points.

Customer Benefits

- Improved reliability through streamlining of outage response processes, improved fault location applications, and adoption of more flexible, model-based FLISR schemes.
- Reduced customer energy usage, peak demand, and energy procurement costs through future enablement of Volt-Var Optimization

DER Integration

- Improved management of DER-related grid issues through real-time awareness of masked load and of DER impacts on thermal, voltage, or protection issues.
- Foundational to realization of DERMS value streams such as proactive dispatch of DER to mitigate real-time or forecasted grid constraints.

Operational Efficiencies

- Consolidation of ~10 systems to a single, integrated user interface
- Improvement in efficiency of EPSS and PSPS event execution
- Intelligent alarm filtering for grid operators
- Automated switch log writing, including “clash checks” alerting operators to conflicts or constraints from proposed switching.

Advanced Distribution Management System (ADMS)
Accomplishment & Roadmap Summary

What have we achieved?	*What is in progress?*	*What do we have planned?*
2021 - 2024	**2025 - 2026**	**2027 - 2030**
ADMS Release 1 – SCADA deployment		
ADMS Release 2 – Outage Management System		
ADMS Release 3 – OMS and Advanced applications		

Achieved

- 2023 – ADMS SCADA pilot Go-live (5 of 19 regions)
- 2023 – Load Shed functionality deployed
- 2023 – Standardized Microgrid Enablement in SCADA
- 2024 - ADMS SCADA Go-Live across all regions (19 of 19)
- 2024 – DERMS integration operable and sites live within ADMS

In Progress

- 2025 – 1000+ FLISR feeders validated
- 2025 – Enhanced Powerline Safety Settings (EPSS) functionality deployed
- 2025 – Line sensor integration
- 2025 – Load Flow / State Estimation pilot on 54 feeders
- 2026 – Deploy Release 2 Outage Management system, including PSPS functionality

Planned

- 2027 - Enable ADMS mobile field solution to enable digital switching end-to-end
- 2029 – Upgrade to latest SE ADMS software version
- 2030 - Enable Load Flow/State Estimation across 500 feeders, and Volt-Var Optimization across 85 substation banks.
- 2030 - Deploy Forecasting, and Protection/Engineering Analysis applications

Benefits

- Integration of SCADA with the Network Model, eliminating “swivel-chair” process to maintain As-Operated model via manual data transfer across applications
- Improved cybersecurity through retirement of legacy RT-SCADA system
- Creation of a unified data model for future ADMS applications, including SCADA telemetry, GIS device properties, Powerbase device settings, etc.

- ~10 applications consolidated into Schneider Electric ADMS platform
- Significant operational efficiency for EPSS and PSPS event execution within ADMS
- SAIDI & CAIDI metric improvements via streamlined outage response processes
- Retirement of legacy DMS application and of the highly custom-built ecosystem of legacy outage management applications.

- Improved reliability and situational awareness through new mobile field switching application
- Reduced customer energy usage and procurement costs through Volt-Var Optimization
- Improved situational awareness and enablement of many new advanced capabilities in ADMS and DERMS via Load Flow/State Estimation
- AI capabilities to support software guidance for faster issue troubleshooting and resolution

ADMS Road Map Focus Areas

Future enhancements to the ADMS platform in the 2027 rate case cycle will be highlighted by:

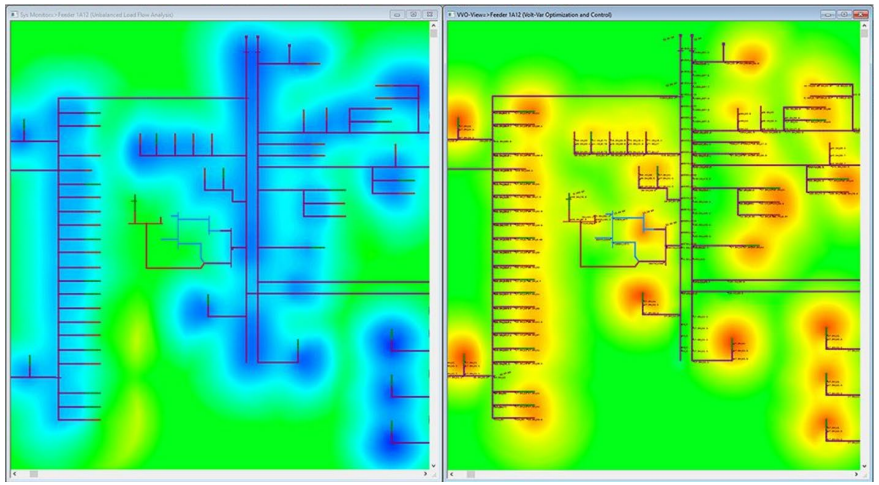
1. Volt-Var Optimization
2. Advanced Application Enablement
    a. Load Flow / State Estimation
    b. Load Forecasting
    c. Engineering Analysis
    d. Protection Analysis
3. Field Switching Digital Transformation

Roadmap Scope Area Details – *Volt-Var Optimization*

Status: *Not Started*

Scope Area: *Volt-Var Optimization (VVO)*

Scope Description: *Volt-Var Optimization (VVO) is a software-based solution that senses grid conditions, determines the device-level adjustments necessary to optimally regulate voltage and reactive power, and communicates control commands to grid devices in real-time. In essence, VVO control systems act as a centralized voltage and reactive power control brain of the electric distribution system, evaluating and signaling the actions needed for better voltage and reactive power regulation.*



Goals

- Reduction of customer energy usage and generation capacity procurement
- Greater hosting capacity for distributed generation
- Reduced Rule 2 customer voltage delivery violations
- Enhanced distribution grid visibility and situational awareness
- Improved operational efficiency through remote adjustment of device voltage and power factor regulation settings & closed-loop voltage and power control schemes

Deliverables/Expectation

- Implement VVO on 85 substation transformer banks, or approximately 6.5% of PG&E's service territory
- Completion by 2030

Roadmap Summary – *Advanced Application Enablement*

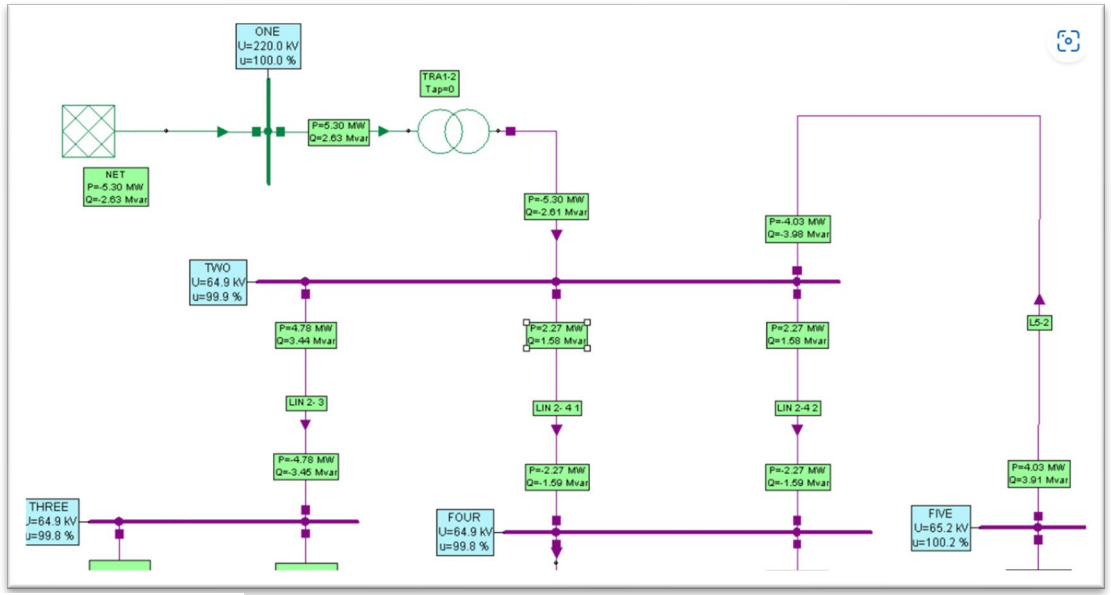
Load Flow & State Estimation

Status: *Pilot in progress (to complete Q2 2025). Work to scale significantly during 2027-2030 period*

Scope Area: *Load Flow and State Estimation*

Scope Description: *An engineering analysis that calculates the voltage, power flows, losses, and phase angles throughout the distribution system, using SCADA measurements to estimate the actual operating state of non-telemetered power system components.*

Provide Grid Operations with system-wide visibility of power system performance to ensure the system operates within safe limits, maintaining stable and reliable power delivery.



Goals

- Provide voltage, power flows, and losses throughout the pilot/development feeders
- Enable the implementation of the Advanced App pilots
- Inform on the effort and duration of system-wide rollout
- Define the data needs for enablement of the entire network

Deliverables/Expectation

- New model symbology, specifically to account for DER resources
- Low-voltage radial and meshed networks
- Identify commonly missing or inaccurate data properties
- Load Profile Generator (LPG)
- Expanded asset catalog with required engineering properties and parameters
- Successful Load Flow convergence on all development/pilot feeders
- Enablement on 500 feeders by 2030

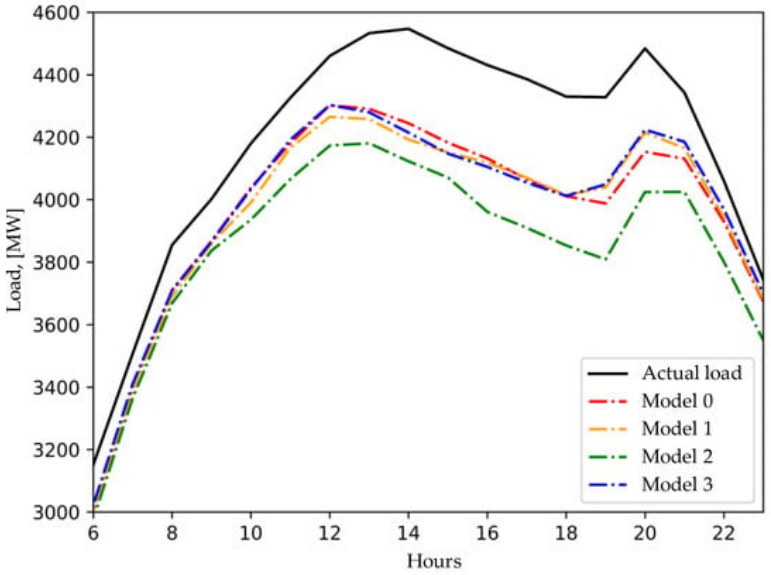
Roadmap Summary – *Advanced Application Enablement*

Load Forecasting

Status: *Not Started*

Scope Area: *Load Forecasting*

Scope Description: *Develop a Load Forecasting solution within ADMS, enabling prediction of future power flows at any point in the distribution grid. Load Forecasting requires expanding ADMS integration with support systems, evaluating the ADMS vendor's solution, and developing code to meet data and use case requirements.*



Goals

- Support the operation of Load Flow State Estimation-based feeders in ADMS and DERMS environments
- Study how a dynamic distribution grid, empowered by DERMS and Load Forecasting, will impact EMS-based operations to identify enhancement opportunities for overall grid management.

Deliverables/Expectation

- Load forecasting functions successfully enabled within ADMS
- Completion by 2030

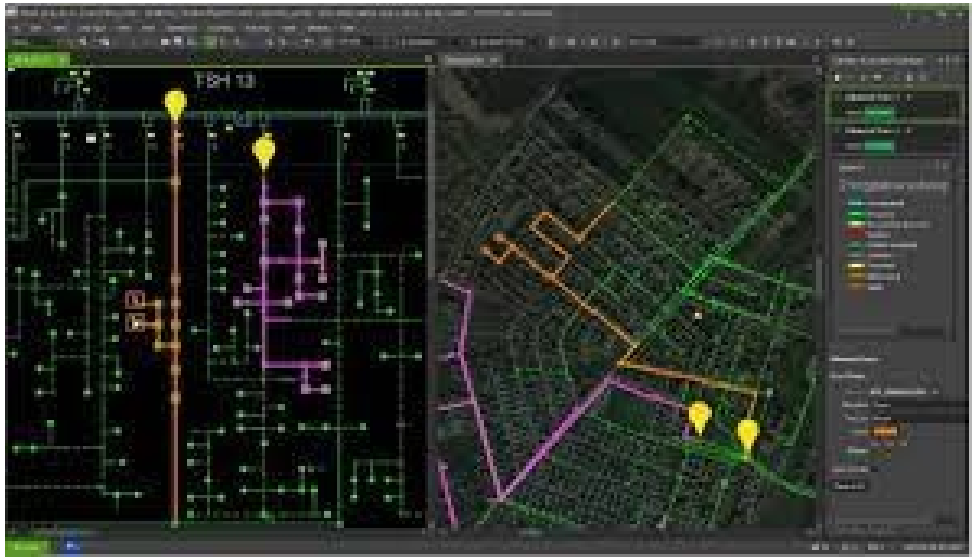
Roadmap Summary – *Advanced Application Enablement*

Engineering Analysis

Status: *Not Started*

Scope Area: *Engineering Analysis*

Scope Description: *Enable advanced applications that streamline engineering studies of voltage and VAR regulation device placement (i.e., Capacitors and Voltage Regulators).*



Goals

- Enhance the power quality of the electrical distribution grid by identifying optimal locations for device deployments
- Enable PG&E to achieve better voltage control and minimize losses in the distribution system

Deliverables/Expectation

- Engineering Analysis functions successfully enabled within ADMS
- Completion by 2030

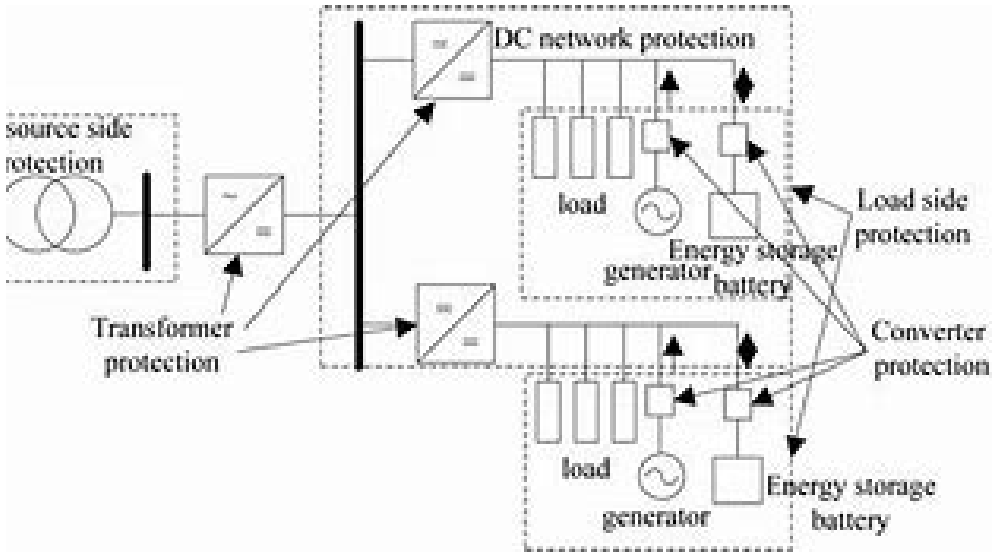
Roadmap Summary – *Advanced Application Enablement*

Protection Analysis

Status: *Not Started*

Scope Area: *Protection Analysis*

Scope Description: *Deliver a suite of electrical system protection-oriented applications to aid in identifying the location of faults within the electrical distribution grid and to consider breaker and fuse capacity limits to prevent overloading conditions, reducing the risk of equipment failure.*



Goals

- Support prevention of overloading conditions, reducing the risk of equipment failure
- Provide study coordination between protective relays in response to fault conditions to improve relay configurations
- Help prevent outages while setting a foundation for future enablement of adaptive protection functionality

Deliverables/Expectation

- Deliver a suite of electrical system protection-oriented applications by 2030
- Supports automatic reconfiguration of protection settings in response to loading conditions or circuit topology changes

Roadmap Scope Area Details – *Field Switching Digital Transformation*

Status: *Implementing field switching application with Outage Management System release*

Scope Area: *Field Switching Digital Transformation*

Scope Description: *PG&E will develop uniform mobility platform to be used across all field users that receive ADMS-initiated work.*

This project proposes the implementation of the ADMS Field Client module, which is a web-based mobile application that enhances the safety of the field personnel and provides tools and information required to perform field operations activities. This project will include 1) implementation of vendor software with some customized functionality to PG&E, 2) deploying mobility devices to field resources and 3) set up the IT and communications infrastructure to support the full user base of the application.

Goals

- Both field and control center personnel can view the same version of the switching plans and each switching step can be directly dispatched to and updated by the field resource, improving safety
- Improved situational awareness with access to the real time as-operated network
- Improved field assessment and troubleshooting

Deliverables/Expectation

- Cross-platform, progressive web app. Screen size-adaptable layout
- Streamlined user actions
- Instant awareness through push notifications
- Training and rollout to field users beginning in 2027

Distributed Energy Resource Management System (DERMS)

Salma Bakr

Principal Product Manager, DERMS

DERMS Current Status & Roadmap Overview

In 2023, the deployment of DERMS was accelerated to ensure PG&E builds foundational capabilities to create value out of DERs. Initially, DERMS focused on maximizing capacity utilization on constrained distribution circuits. Over time, DERMS will scale to orchestrate DER aggregations into virtual power plants (VPPs) to unlock benefits to the grid, our energy system, and our customers.

Current GRC – To Date (2023-2024)

- Deployed foundational DERMS platform including 2030.5 DER headend for low-cost telemetry
- **28** customer-owned telemetry sites 1MW+ DERs to comply w/ Rule 21
- Operated **two** flexible service connection (Flex Connect) sites, adding **~1300MWh** of new load
- Enable V2X residential and commercial pilots using RTP
- Provide Dx Ops with visibility into flexible capacity available from **2** Demand Response programs at the feeder level

Current GRC - Mid-Term (2025-2026)

- Scale Flex Connect program for operational flexibility geographically and across four customer types
- Enable grid and program mgmt capabilities for emergent DER programs including EV managed charging (V1G) & DER orchestration
- Dispatch DERs on constrained feeders for summer reliability in South Bay (VPP MVP)
- Dispatch DERs as NWAs to defer Dx capacity upgrades and relief load during summer

Next GRC - Longer-Term (2027-2030)

- Scale Flex Connect, further operational flexibility use cases, and NWAs
- Scale VGI use cases including V1G and V2X
- Develop VPPs by orchestrating heterogenous DERs to solve one or multiple grid constraints
- Integrate DERMS w/ grid edge computing platforms to optimize at the hyper local level
- Coordinate data sharing between Dx & Tx to ensure reliable and resilient grid operations

Live Flexible Service Connection & Benefits

This is an example of deployed capabilities in a live flexible service connection site with a 24hr ahead limit on customer imports, unlocking more capacity on the grid, increasing asset utilization, and allowing customers to connect sooner.

Benefits of EV Fleet Site

- Gained additional capacity **18 months earlier**
- Estimated **reduction of $1M in fuel cost** and **8,000 tons of CO2** over 18 months of early energization

2025 YTD Site Benefits

- Customer gets additional flexibility **91% of time**
- **+325MWh** usage above planning limit
- **+2.7MW** average limit increase
- **~162k additional electric fleet miles**

Customer & DER Data

DER Contract Info

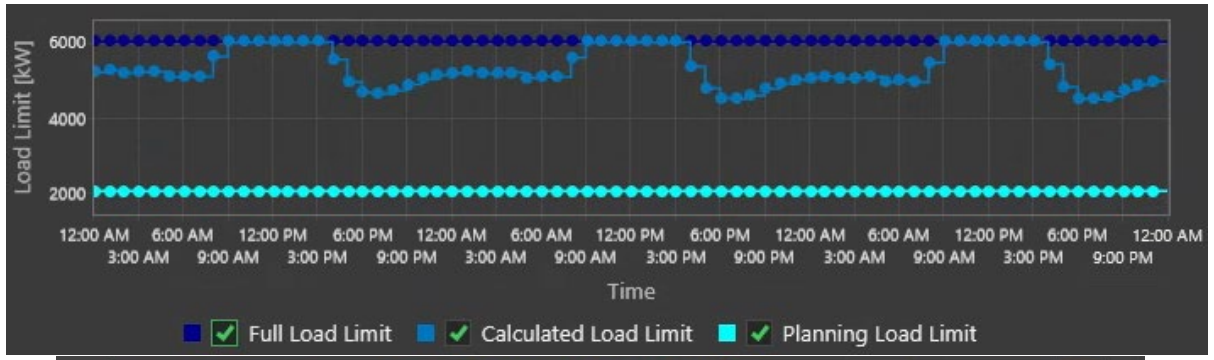
As-Operated Network (ADMS Integration)

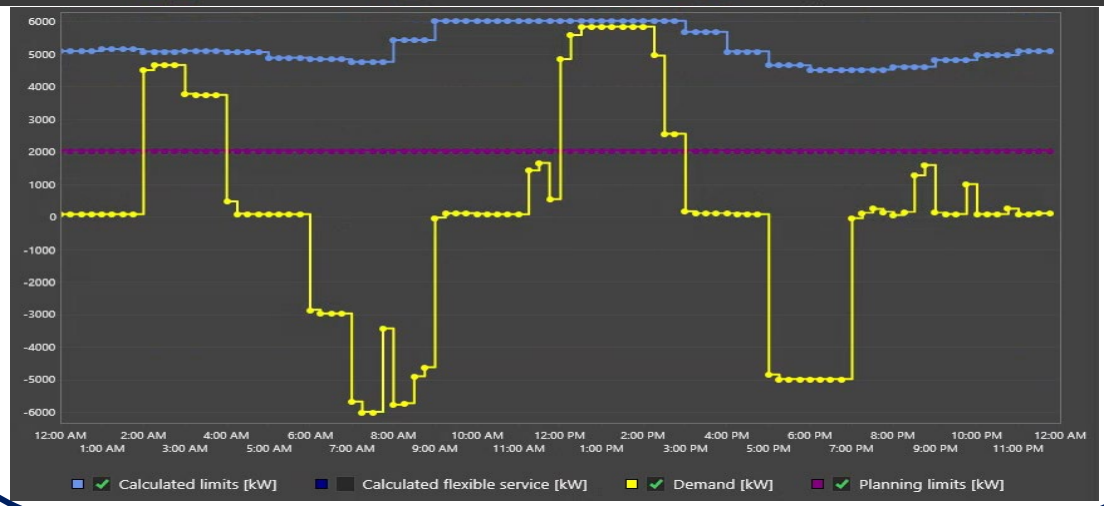
Historical Data

Weather Data

Microsoft Azure

Schneider EcoStruxure DERMS

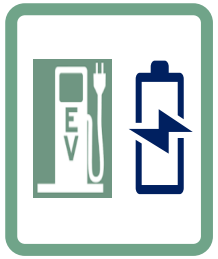




Forecast & detect capacity constraints and dispatch 72-hour dynamic site limits via IEEE 2030.5

Controls

Telemetry



Measurement and verification for benefits and compliance

Overview of DERMS in 2027-2030

In 2027-2030, DERMS capabilities and benefits will stem from scaling PG&E's Flex Connect program and VGI via managed charging and V2X, orchestrating and value stacking DERs into VPPs, integrating DERMS with grid edge computing and coordinating data sharing between Tx & Dx, to enable PG&E to operate a safe, reliable, optimized, electrified, decarbonized and affordable grid.

Scale Flex Connect program, NWAs and other operational flexibility use cases	Scale Flex Connect program, NWAs and other Op Flex use cases across multiple customer types, 800 feeders, and 20 concurrent PG&E users for faster energization and bridging until upgrades, improved asset utilization, and system throughput
Scale VGI via managed charging (V1G) and Vehicle-to-Everything (V2X)	Scale grid and program management capabilities and real-time pricing reflecting grid conditions for up to 300MW of load managed via EV managed charging and V2X to avoid or defer distribution asset upgrades, and free up capital for other more critical projects
Develop VPPs by orchestrating heterogenous DERs to solve grid needs	Aggregate and orchestrate heterogenous DERs providing multiple grid services across multiple modes of engagement into virtual power plants (VPPs) to solve grid needs, stack value per MW of DER, and enable PG&E's distribution system operator (DSO) role
Integrate DERMS with grid edge computing to optimize hyper locally	Integrate DERMS with grid edge computing devices to bridge the centralized control center with customers to enable various benefits including customer electrification and DER management
Coordinate data sharing between Dx & Tx to enable reliable and resilient grid operations	Provide capabilities to bolster reliability coordination and data sharing between transmission and distribution to ensure resilient and reliable grid operations in a high DER and electrified future

DERMS Current and Future Benefits

DERMS provides scalable benefits by turning DERs into grid assets and unlocking program-centric benefits, which creates value to PG&E, participating and non-participating customers, society, and the broader economy.

Example Benefits of EV Fleet Flex Connect Site

- Gained additional capacity **18 months earlier**
- Estimated **reduction of $1M in fuel cost** and **8,000 tons of CO2** over 18 months of early energization

2025 YTD Benefits

- Customer gets additional flexibility **91% of time**
- **+ 325MWh** usage above planning limit
- **+ 2.7MW** average limit increase
- **~ 162k additional electric fleet miles**

DERMS presents a unique opportunity for PG&E

- **Downward rate pressure by increasing throughput with same infrastructure** by providing operational flexibility to customers, bridging and faster energization
- **Freeing up capital for other projects** by deferring distribution upgrades via NWAs and/or VGI
- **Creating more value per MW of load managed** by improving existing programs, or adding new capabilities only possible via DERMS (e.g. new VPP)

Other DERMS benefits include

- Avoided IT system costs
- Improved operational efficiencies
- Incremental value to participating customers
- Societal and economic benefits

R&D Portfolio Positions Grid Mod Investments

PG&E's R&D portfolio, notably through many of the EPIC projects and various pilots planned and underway, develops PG&E's learnings to better inform and position our grid modernization vision and planned investments.

EPIC 4.02 - "Socket of the Future" & Residential Single Family Home EV Charging	Coordinates and optimizes EV charging and behavior of other home electric loads (including smart panels) using grid edge technology to avoid panel and service upgrades
EPIC 4.04 - EV Managed Charging for Dx Asset Deferrals	Manages at-home EV charging to mitigate service transformer overloading and thus defer service transformer upgrades
EPIC 4.08 - Non-Wires Alternatives (NWA) Integration into Dx Planning	Systemically evaluates the impact of combining load flexibility, DERs and wire solutions to add load flexibility to the distribution planning process forecast and evaluate DER-enabled solutions in that process
EPIC 4.09 - Advanced Load Management Analytics (ALMA), and Aggregated Customers on Distribution Circuits (ACDC)	Develops a "grid simulator" to analyze various grid stressor scenarios to inform grid investments and decarbonization targets; and investigates potential DER aggregations in dynamically shaping load on distribution circuits
EPIC 4.10 - Local Distributed Energy Resources (DER) Orchestration	Develops foundational capacity to optimize the behavior of heterogenous DERs providing various DER grid services across multiple modes of engagement to solve a grid need
EPIC 4.21 - Transmission and Distribution Co-simulation Modelling	Models scenarios for co-simulating transmission and distribution systems simultaneously to support transmission planning processes, run T&D holistic planning optimizations and optimize use of current and future T&D capacity

Q&A / Discussion

Thanks for your attention and interest!