Overview: PG&E Load Management Programs

November 2024

About PG&E

PG&E is focused on providing safe, reliable, clean and affordable natural gas and electricity to our customers

Service Area

70,000

SQUARE MILES

Service area population

16 million

CALIFORNIANS

(That's 1 in 20 Americans!)

25,000

EMPLOYEES WHO LIVE AND WORK

in the communities we serve

MORE THAN

715,000

SOLAR CUSTOMERS

representing **>6,900 MW** of solar energy generated

NEARLY

500,000

ELECTRIC VEHICLES

registered in our service area

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PG&E's 2022 Power Mix

95% **greenhouse gas-free energy** in 2022

NEARLY

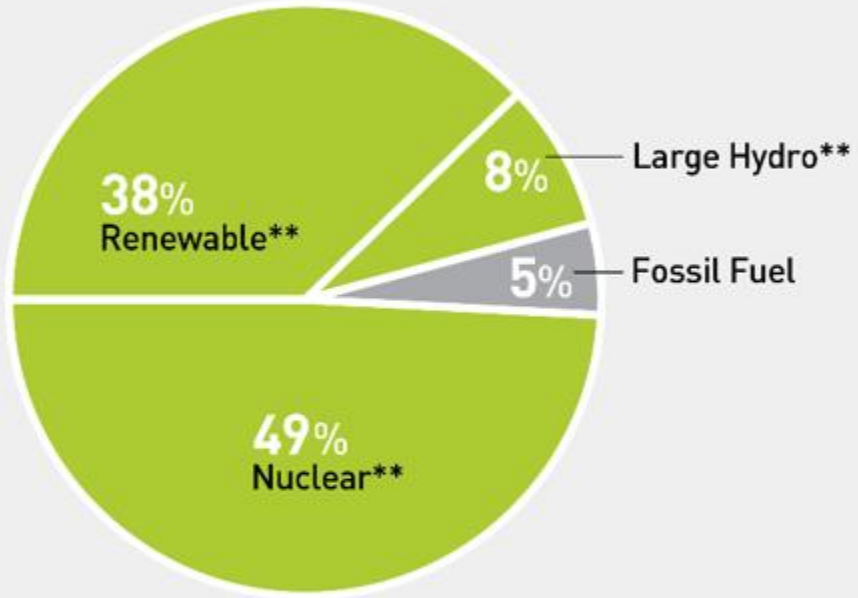
40% **renewable energy** in 2022

On track to meet California's goal:

60% **renewable energy by 2030**

2022 Power Mix*

PG&E-owned generation and power purchases



*Numbers are rounded for presentation

**Greenhouse gas free and/or renewable resources

PG&E delivers a range of clean energy resources, such as solar, wind, hydropower and nuclear and is also integrating innovative technology to make the power grid smarter and more resilient.

The future of battery storage

THIRD PARTY-OWNED

Moss Landing Power Plant:

400 MW

largest lithium-ion battery energy storage system in the world

PG&E Moss Landing Substation:

182.5 MW

TESLA MEGAPACK SYSTEM

largest utility-owned battery energy system in the world

MORE THAN

~1,200 MW

battery energy storage projects

Currently under PG&E contract = **>4 GWh**

55,000

residential, business and government energy storage customers =

500 MW

CPUC Loading Order

The California Public Utilities Commission's (CPUC) Loading Order is a clean energy policy that establishes a priority list for electricity sources. The order requires utilities to:

- Prioritize energy efficiency and demand response: Utilities must first use these methods to meet customer demand.
- Use renewable energy: After using energy efficiency and demand response, utilities must use energy from renewable sources like solar, wind, and geothermal.
- Use fossil fuels as a last resort: Utilities can only purchase power from fossil fuel plants after exhausting all other supplies

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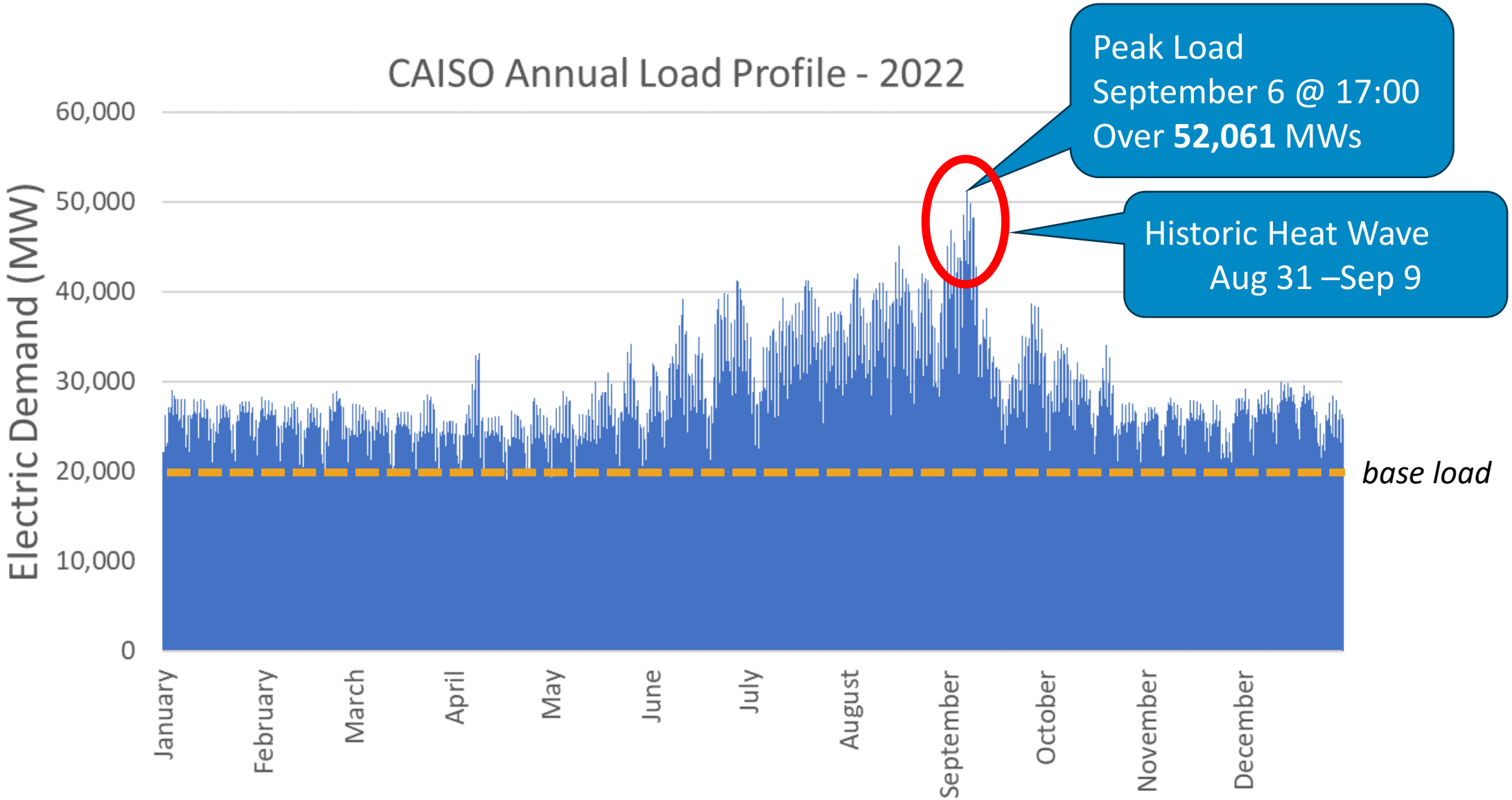
Summer 2022: setting a new record peak



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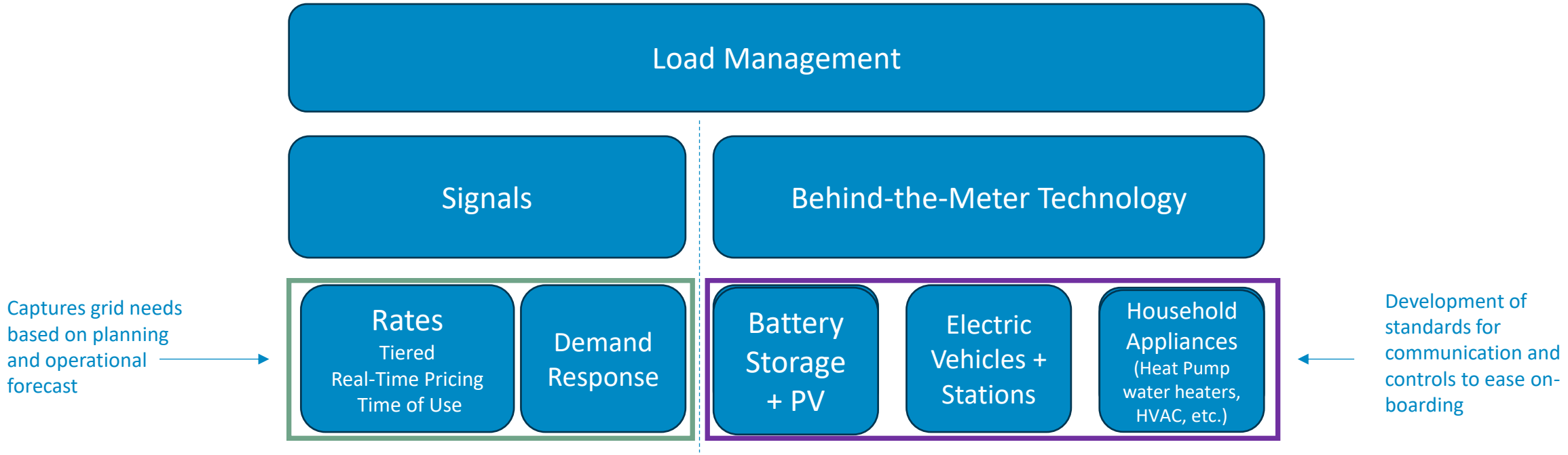
Development of Customer Load Management

Key Takeaway: Load management = fx (customer **technology**, **signal**)

PG&E's load management strategy acknowledges there are many load management options to shape customer load and help balance the grid (Transmission, Distribution, Generation-Energy) while meeting the customer's energy agenda (comfort, bill reduction, clean energy).



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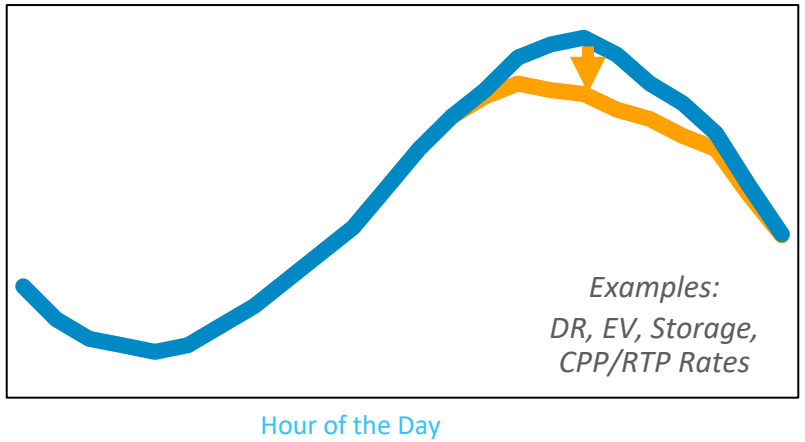
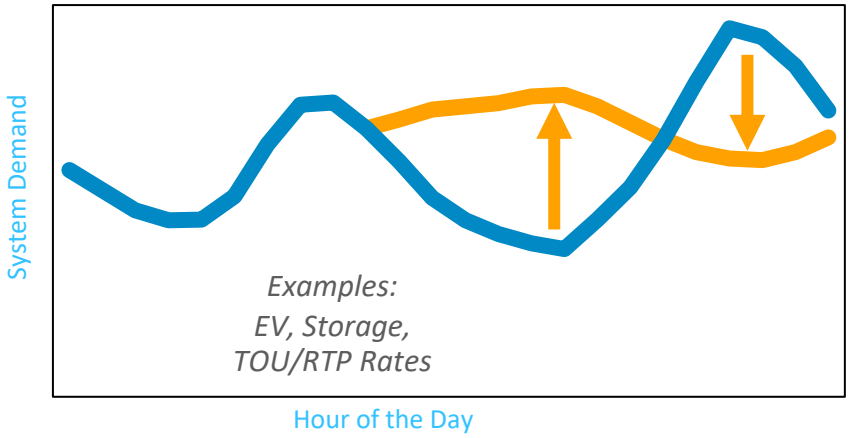
Customer load strategies

Traditional demand response (DR) provides load reduction during peak times and high price periods, and often to helps to prevent power interruptions due to supply shortages.

Since 2014, PG&E has also integrated DR resources into the CAISO wholesale market as both day-ahead and day-of resources where resources are deployed more locally, at the sub load aggregation level (sub-LAP).

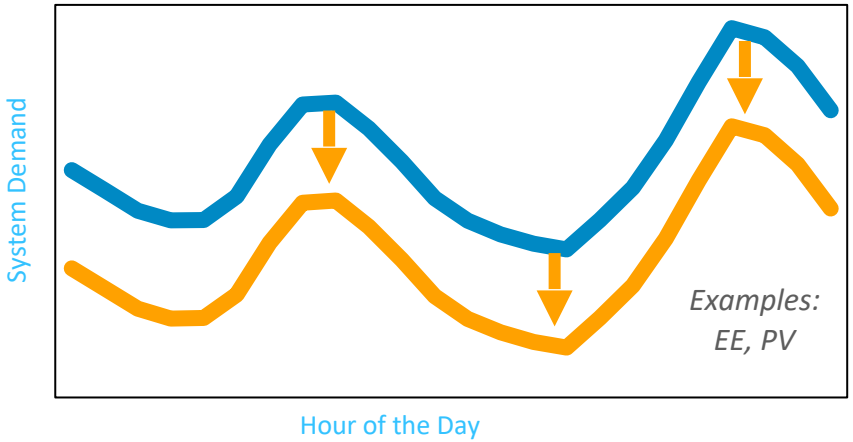
Peak Load Shed: MW of load reduction during annual/ monthly peak conditions

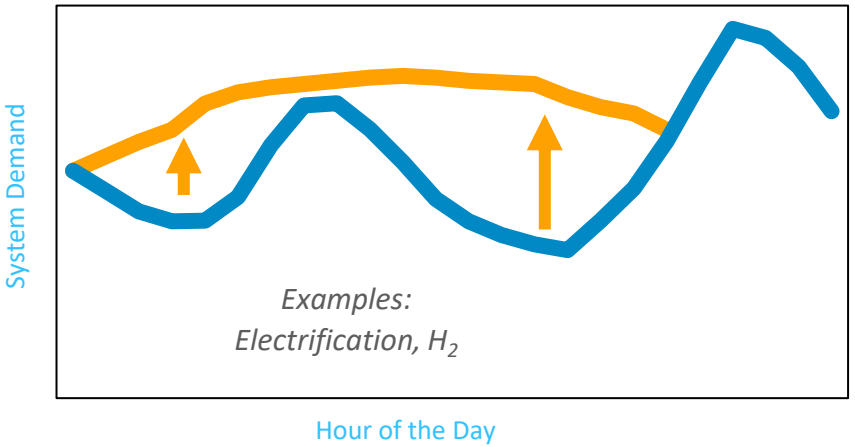




Daily Load Shift: MWh shifted from peak hours to non-peak hours

Permanent Load Reduction: MWh reduced relative to a baseline





Strategic Load Growth: MWh increased in non-peak hours

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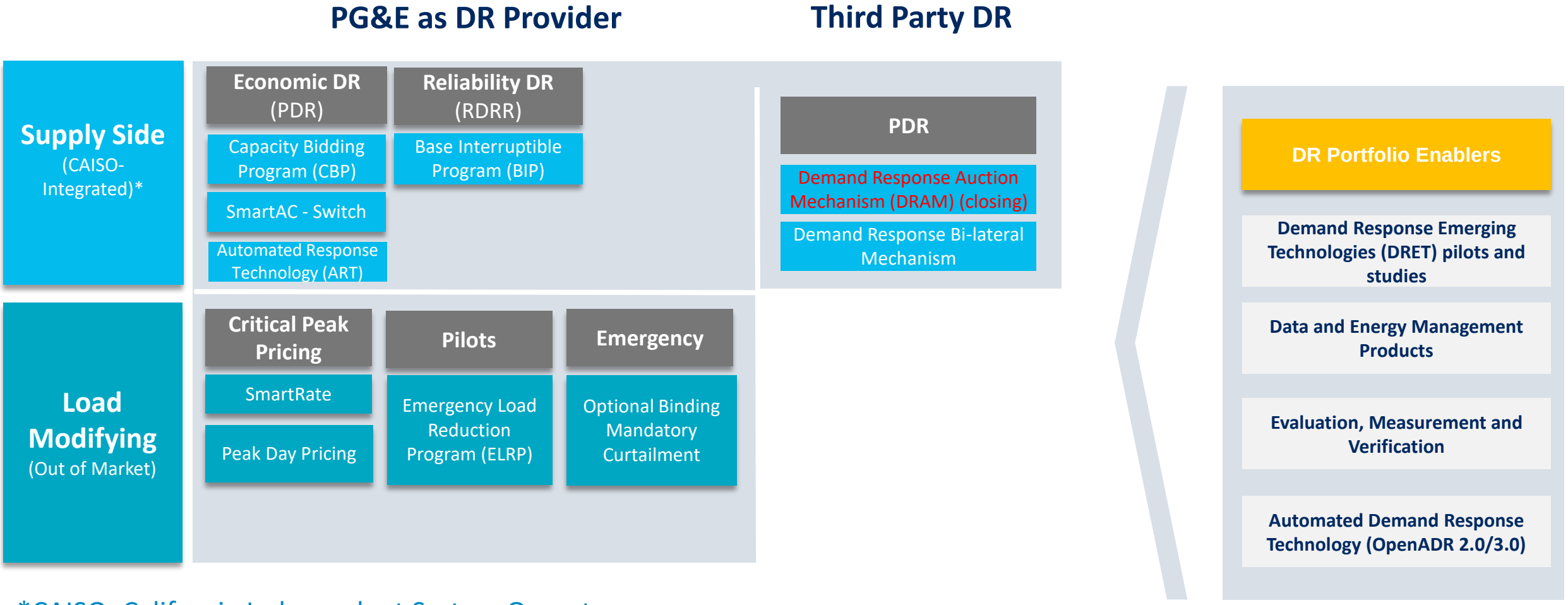
PG&E's Demand Response portfolio

Today, PG&E's DR portfolio offers a range of market-integrated and load modifying programs to address generation capacity and energy shortfalls. Portfolio Enablers facilitate data and insights driving portfolio modernization and continuous improvement.



*CAISO: California Independent System Operator

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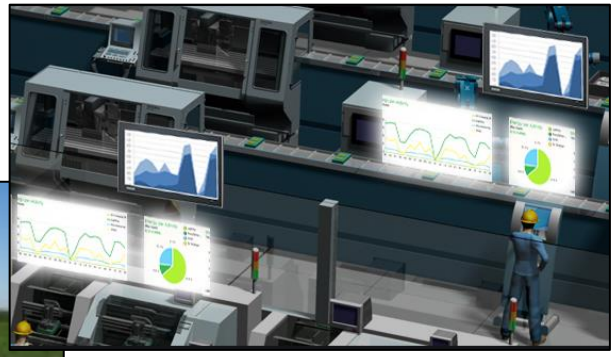
Automated Demand Response Program

Program Summary

- One-time incentives ($200/kW) to offset the costs of automated control technologies
- Customers work through their account manager to assess automation projects for DR potential
- Projects receiving incentives must commit to participate in an eligible DR program for three years.



CA Building Code (Title 24)

SECTION 110.12 – MANDATORY REQUIREMENTS FOR DEMAND MANAGEMENT

(a) Demand responsive controls. 1. All demand responsive controls shall be either:

A. A certified OpenADR 2.0a or OpenADR 2.0b Virtual End Node (VEN), as specified under Clause 11, Conformance, in the applicable OpenADR 2.0 Specification; or

B. Certified by the manufacturer as being capable of responding to a demand response signal from a certified OpenADR 2.0b Virtual End Node by automatically implementing the control functions requested by the Virtual End Node for the equipment it controls.

(b) Demand Responsive Zonal HVAC Controls
(c) Demand Responsive Lighting Controls
(d) Demand Responsive Electronic Message Center Control
(e) Demand Responsive Controlled Receptacles

Reference - https://www.energy.ca.gov/sites/default/files/2022-12/CEC-400-2022-010_CMF.pdf

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CA Appliance Code (Title 20)

The California Energy Commission is responsible to adopt and periodically update standards for appliances to facilitate the deployment of flexible demand technologies that enable appliance operations to be scheduled, shifted, or curtailed to reduce emissions of greenhouse gases (GHG) associated with electricity generation.

1) Pool Pump
- All pool control devices manufactured on or after September 29, 2025 and sold in California must meet the flexible demand appliance standards.
- Communication Requirements (OpenADR 2.0, IEEE 2030.5, etc.)
- Clock Requirements
- Default Operating Schedule
- Consumer Control

2) Water Heater
3) Smart Thermostat
4) EV/EVSE

California Energy Commission

- Appliances Call Center: (888) 838-1467 or outside California (916) 651-7100. Questions may also be emailed to flexdemandstandards@energy.ca.gov
- California Flexible Demand Appliances website
- Pool Controls Rulemaking Documents: docket # 23-FDAS-01
- CEC Staff Report - Introduction to Flexible Demand Appliance Standards

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PG&E 24-27 RTP Pilots using OpenADR 3.0

PG&E has a ~$50M portfolio of RTP rates that will be evaluating program and rate design elements ahead of full implementation.

Pilot By Priority	Electric Vehicles (CET Team)	Agricultural Sector	Res/Commercial Sector
Target Use Cases	Vehicle to Grid (V2G)	Water Pumps/Sanitation, Electric Tractors	Box stores, industrial, Smart EV charging (V1G), BTM Batteries, TBD
Timeline	Sept '24-'25	Sept '24 (compliance) – Dec '27	Sept '24 (compliance) – Dec '27
Budget	Up to $13M	Up to $21.5M	Up to $15.2M
Goals	1,000 Residential Service Points 250 Commercial Service Points	50 MW	50 MW
Key Challenges and Areas of Focus	1. CCA Adoption 3. Partnerships with Automation Service Providers (ASP)		2. Complex Rate Design 4. Partnerships with other PG&E programs
Price signal standard	**OpenADR 3.0**		

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PG&E's Residential Battery VPP Pilot

VPP Pilot objectives:

2021

Tesla VPP

- Tesla Powerwall

Use customer battery storage, typically sitting idle, to participate in California ISO emergency events when the system grid is near its operating limits. Provide backstop response from load when generation resources cannot.

Designed to help with system generation needs by responding to emergency triggers.

2022

SolarEdge VPP

- SolarEdge batteries

Identify how customers are using their existing battery storage and understand what opportunities the customers may want to see from a program/rate. Test customer enrollment approach and multi-use of the battery storage.

Designed to learn about customer preference including incentive design, use of battery storage and to evaluate if battery VPP programs can scale.

2023

Sunrun VPP

- Tesla Powerwall
- SolarEdge batteries
- Delta batteries

Evaluate the efficacy of a static and non-dispatchable VPP (akin to a nuclear plant providing base load) comprised of battery storage/PV and smart thermostats to reduce net peak demand.

Designed to help with reducing daily evening net peak (7-9pm) by proactively discharging the battery.

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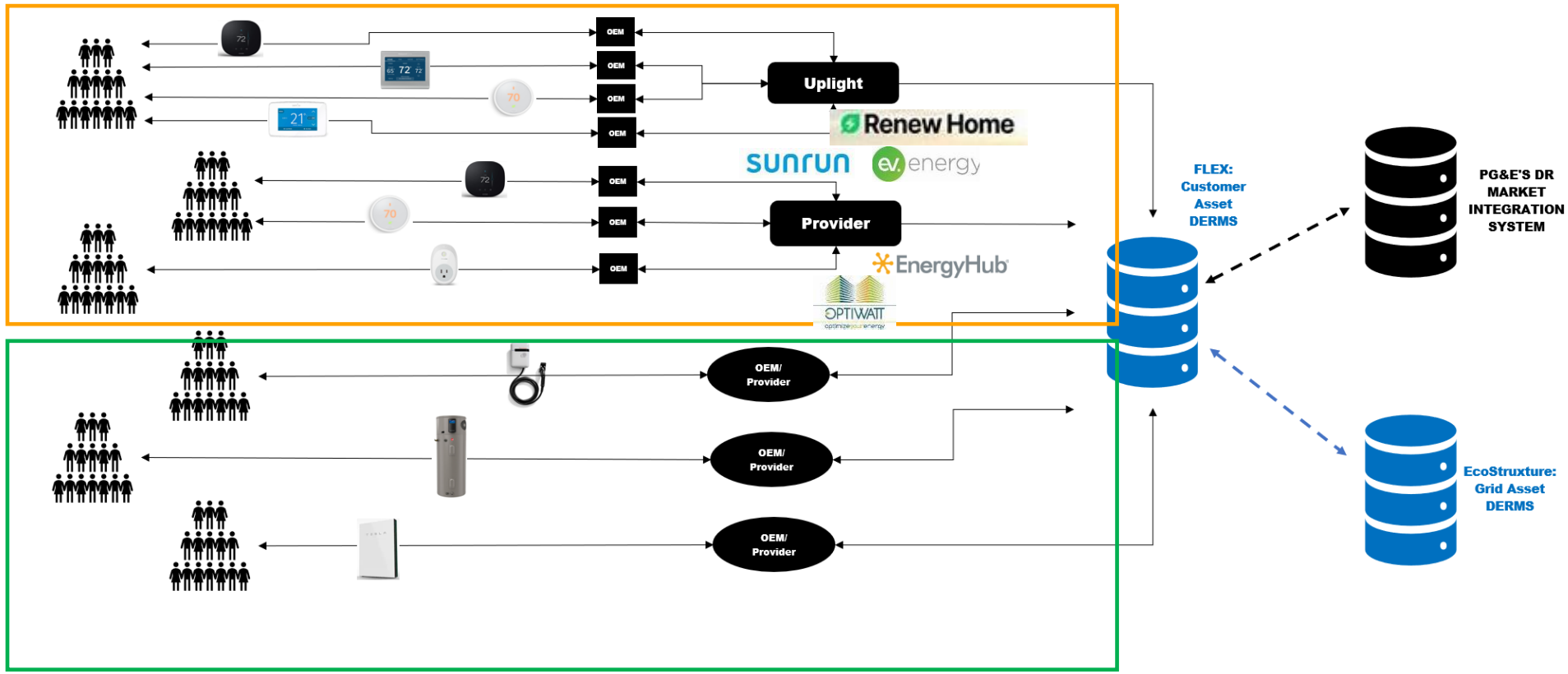
Design considerations: enterprise management system

Ecosystem (Distributed Energy Resource Management Systems / DERMS) for Virtual Power Plants can take shape in a variety of ways, based on the *business and operational* model of the Provider/OEM.

A: Working with providers that work with various OEMs to provide an integrated resource

B: Working directly with OEMs, with a system to manage all devices / DERs



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Design considerations: grid, customers, and technology

Identifying the problem(s) **the Grid** is facing and its characteristics
- Is the issue system wide or more local?
- Is it for distribution or generation (capacity and energy)?
- Duration of what is expected by operators and when issues are likely to occur.
- Is the grid issue short-term or longer term?

Understanding **the customers**
- Making the end-to-end process from enrollment to payment simple is key for engagement and participation. Use mobile app if appropriate for engagement.
- Know what the customers want. Often the assumption is that customers only care about the incentives to enroll and participate. However, some customers respond to clear messaging and intent without a lucrative incentive.

Understanding **the technology** provided by OEMs and the services Providers can deliver
- Not all device/technology manufacturers are created equal. Test before deploying large scale.
- DERMS can be a powerful tool especially for operators. However, depending on the needs of the user, a light version of DERMS may be enough as opposed to all the functionality.
- Open communication standards like OpenADR is desirable to avoid stranded assets. But most Providers/OEMs prefer APIs. Identify which pathway may be more secure, reliable and cost-effective in the long haul.

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Thank you