

# Vehicle-Grid Integration (VGI) Forum

*Shiva Ourang*

*Utility Engineer | Transportation Electrification*

**Energy Division | CPUC**

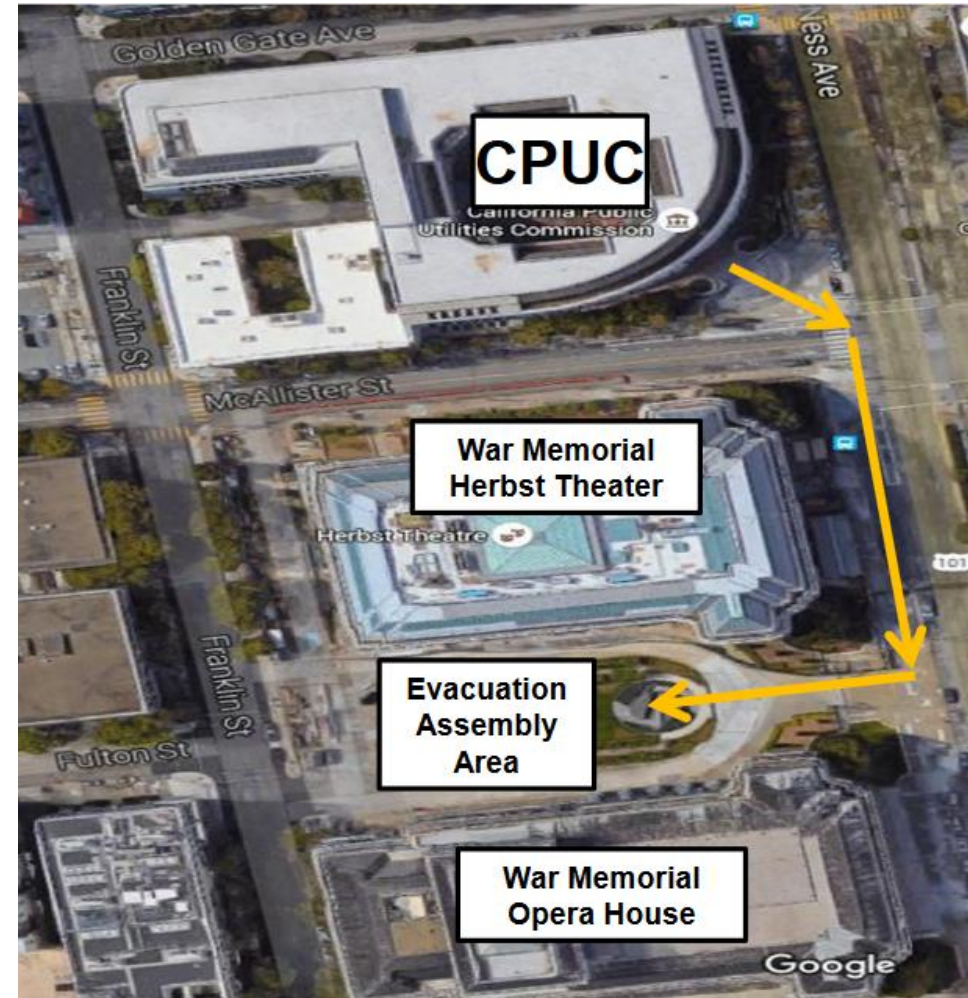
March 25, 2026



California Public  
Utilities Commission

# Welcome: Safety and Logistics

- In case of an Emergency:
  - Energy Division Staff will call 911
  - To evacuate, proceed out of 1 of 4 exits to Civic Center Plaza
    - Exit toward Van Ness / McAllister
    - Walk past City Hall
- Restrooms and water fountains can be accessed across the lobby.
- Please note that this forum is being recorded.
- Commissioners and/or their advisors may be in attendance.



# Webex + In-Person Participation Logistics

Questions will be addressed during Q&A periods.

Please share your name and organization before providing comments to assist with note-taking.

## Virtual Participants

- All virtual attendees will be muted on entry by default.
- Please write your questions in discussion panels.
- Alternatively, comments or questions can be provided verbally using the “raise hand” function.
  - The host will unmute you to ask your question.
  - Please lower your hand after asking your question by clicking on “raise hand” again.

## In-person participants

- Please come to the podium to ask questions or use hand microphones during the Q&A sessions.

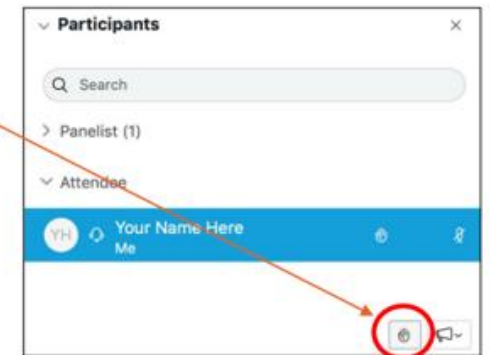
## WebEx Tips

Access the written Q&A panel here

1. Click here to access the attendee list to raise and lower your hand.



2. Raise your hand by clicking the hand icon.



3. Lower it by clicking again.

Access your meeting audio settings here



# 2026 VGI Forum Agenda (Morning Sessions)

## ❖ 9:30 – 10:00 AM | Welcome & Introduction

- Safety message, regulatory context, and opening remarks by President Reynolds

## ❖ 10:00 – 11:00 AM | Panel 1: Ratepayer Impact of VGI

- Current impact(s) of VGI on peak demand and daily load shapes.
- Secondary grid costs associated with enabling VGI, and how to defer or avoid distribution upgrade costs.
- Inputs, assumptions, and other components necessary to identify the cost-benefit of enabling managed charging and/or V2G on the distribution system.

11:00 – 11:15 AM | Break

## ❖ 11:15 – 12:00 PM | Panel 2: V2G Industry Trends

- OEM value proposition for V2G
- Availability of bidirectional vehicles and chargers
- Technical considerations: AC vs DC V2G and interoperability

12:00 – 1:00 PM | Lunch

# 2026 VGI Forum Agenda – (Afternoon Sessions)

## ❖ 1:00 – 2:00 PM | Panel 3: VGI Use Cases – Dynamic Rates

- Role of dynamic rates in VGI adoption
- Cost-benefit considerations for ratepayers
- Addressing potential cross-subsidies

## ❖ 2:00 – 3:00 PM | Panel 4: VGI Use Cases – Programs & Pilots

- Lessons from Demand Response and CalFUSE pilots
- Customer participation barriers and incentives
- Evaluation of pilot data for VGI valuation

3:00 – 3:15 PM | *Break*

## ❖ 3:15 – 4:00 PM | Panel 5: Policy Barriers, Q&A, and Closing

- Key barriers to VGI implementation
- Stakeholder policy recommendations

## ❖ 4:00 – 4:45 PM (Optional to Participate) | Panel 6: VGI Reporting

- Discussion on VGI reporting requirements for TE compliance reports

# Context for the 2026 VGI Forum

- As EV adoption grows and bidirectional charging technologies develop, VGI may allow EVs to export power to the grid and provide grid services.
- However, there is still limited understanding of how VGI export affects distribution infrastructure and system operations.
- A key question is whether VGI can provide grid benefits such as delaying or avoiding distribution upgrades, or whether it may require new infrastructure investments to safely enable export.
- Understanding these impacts is important for determining the net benefits of VGI for the electric system and for all ratepayers.
- The forum is intended to explore how VGI benefits and costs should be evaluated, including potential impacts on grid operations, infrastructure investments, and ratepayer outcomes.
- Additionally, Decision 25-12-005 directs the Energy Division to work with IOUs and stakeholders to evaluate VGI reporting questions in the VGI Forum, as an opportunity, as we will discuss in Panel 6.

# Objectives for VGI Forum 2026

- Develop a clearer, quantifiable understanding of VGI's value to the electric grid and the costs required to enable it.
- Examine how dynamic rates and demand flexibility programs translate grid needs into customer-facing signals that shape EV charging behavior.
- Discuss VGI impacts on distribution infrastructure and system operations, including potential secondary and upgrade-related costs.
- Identify initial approaches for assessing VGI value and how that valuation could inform potential VGI compensation mechanisms.
- Provide insights to inform staff and decision-makers on potential policy considerations related to VGI deployment.

# CPUC Regulatory Context

# VGI Definition from D.20-12-029

**D.20-12-029** defines vehicle-grid integration as:

- Any **method of altering the time, charging level, or location** at which grid-connected light-duty electric vehicles, medium-duty electric vehicles, heavy-duty electric vehicles, off-road electric vehicles, or off-road electric equipment **charge or discharge in a manner that optimizes** plug-in electric vehicle or equipment **interaction with the electric grid**

Provides **net benefits to ratepayers** by doing any of the following:

- a) Increasing electrical grid asset utilization and operational flexibility.
- b) Avoiding otherwise necessary distribution infrastructure upgrades and supporting resiliency.
- c) Integrating renewable energy resources.
- d) Reducing the cost of electricity supply.
- e) Offering reliability services consistent with the resource adequacy requirements established by Section 380 or the Independent System Operator tariff.

# Three Strategic Focus Areas for VGI According to D.22-11-040

## Rates and Demand Flexibility

### Objectives:

- Ensure rates for charging and discharging are revenue neutral.
- Develop rates and price signals to ensure EVs can benefit the grid and encourage third-party innovation.
- Ensure vehicles are a flexible load that can provide grid benefits and services.

## Technology Enablement

### Objectives:

- To further VGI, enable technology adoption and reduce/eliminate barriers to deployment.
- Role of the IOUs and CPUC is to reduce and eliminate barriers and provide opportunities for the market to deploy novel VGI-focused technology.

## VGI & Planning

### Objectives:

- Develop common VGI inputs and assumptions for use across planning processes to ensure we do not over or under build grid infrastructure.

D.22-11-040 also established annual VGI forums for the purpose of exploring these strategic focus areas.

# Opening Remarks

John Reynolds  
President,  
California Public Utilities Commission



# Session #1: VGI and Ratepayer Impacts

**BLAKE HEIDENREICH, SCE**

STRATEGIC ADVISOR, CUSTOMER SOLUTIONS PROGRAM DESIGN & DEVELOPMENT

**MICHAELA LEVINE, ENERGY + ENVIRONMENTAL ECONOMICS**

SENIOR MANAGING CONSULTANT

**BILL PETER, PG&E**

SR. MANAGER, ELECTRIC PLANNING POLICY & MODERNIZATION

**RICHARD KHOE, PUBLIC ADVOCATES OFFICE**

SUPERVISOR, ELECTRIC DISTRIBUTION PLANNING & POLICY

**CLINTON CHAN, CPUC ENERGY DIVISION**

REGULATORY ANALYST, RETAIL RATES

# Distribution System Value of VGI and Ratepayer Impacts

CPUC VGI Forum 2026

March 25, 2026



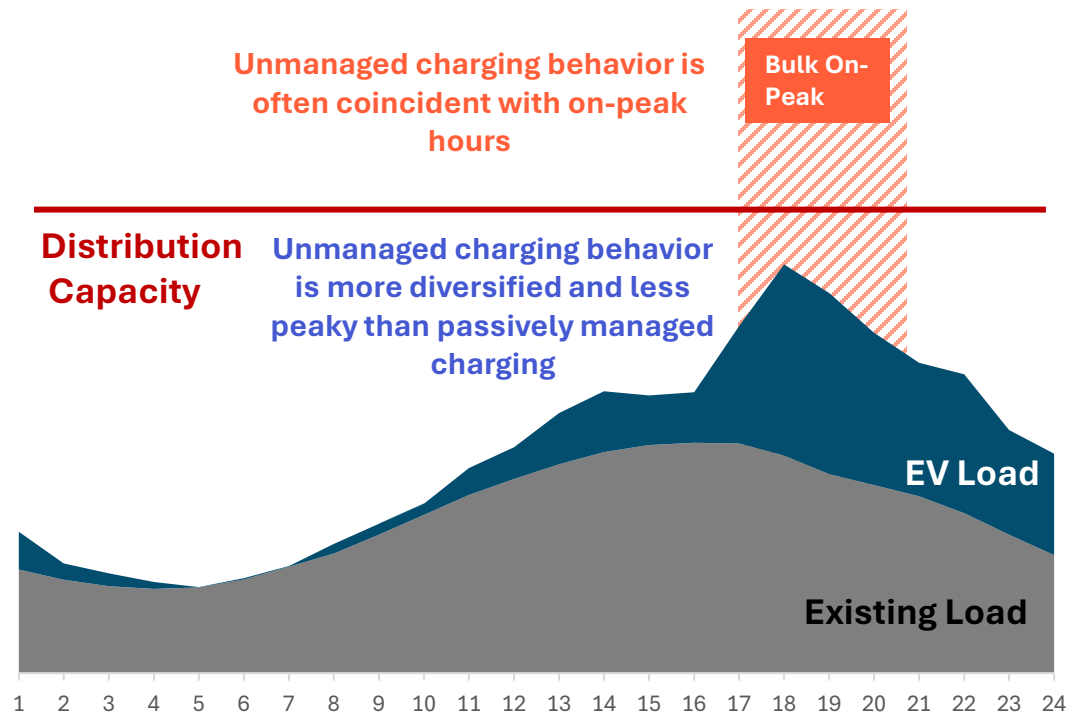
Energy+Environmental Economics

Michaela Levine, Senior Managing Consultant  
Eric Cutter, Partner

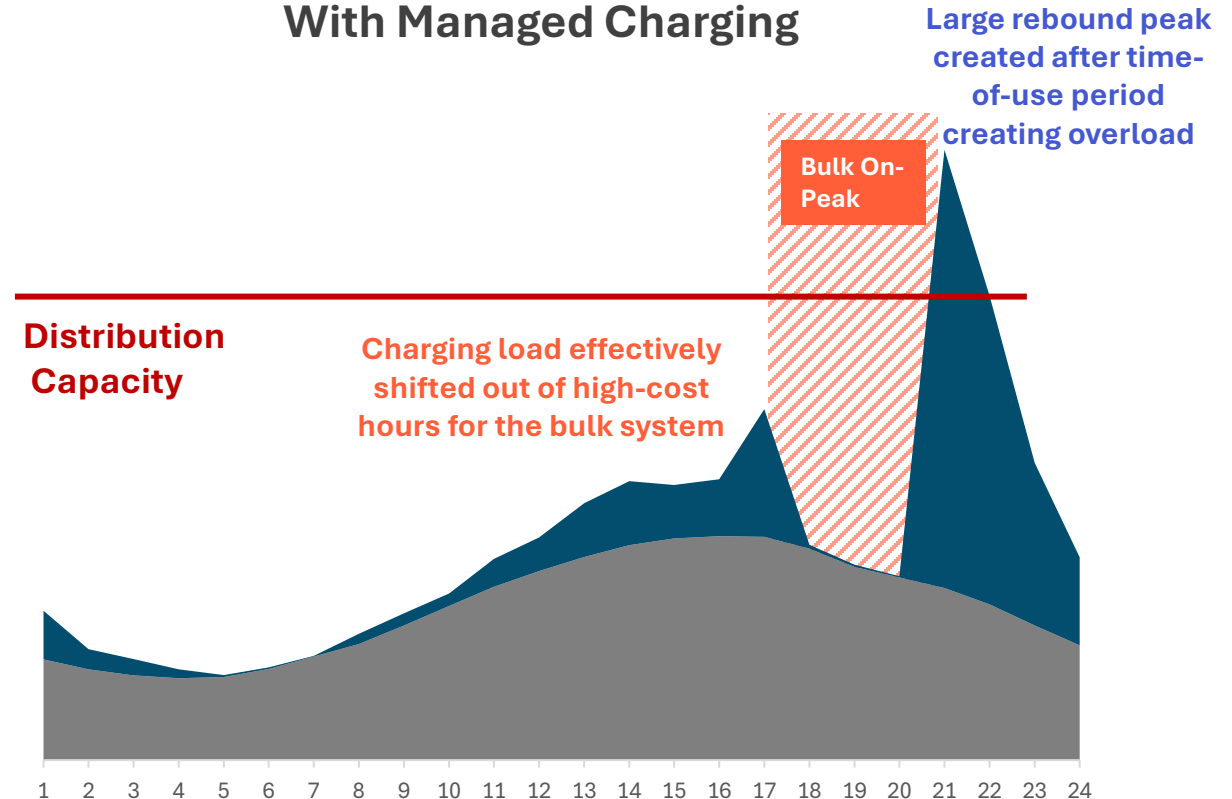
# Passive management with retail rates can create local distribution challenges, increasing costs

## Example Peak Day Distribution System Load

### With Unmanaged Charging



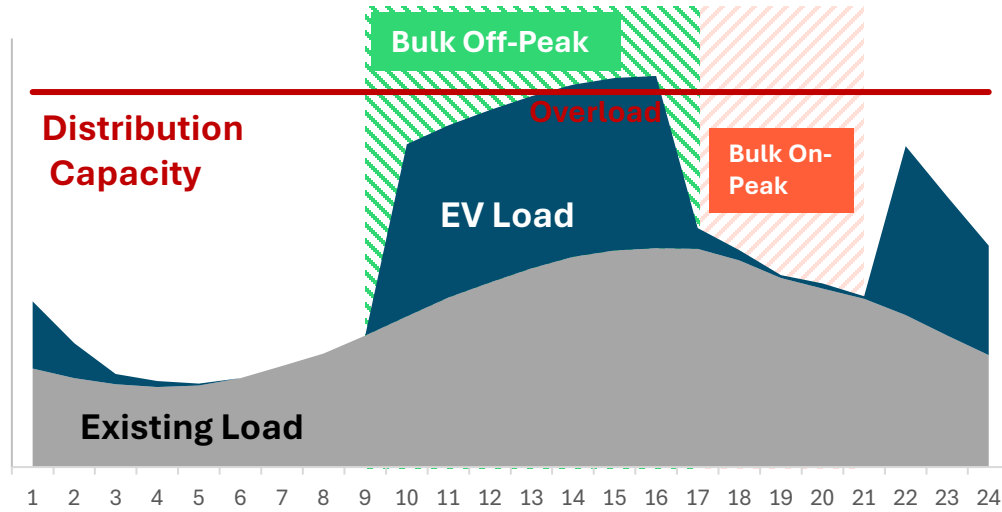
### With Managed Charging



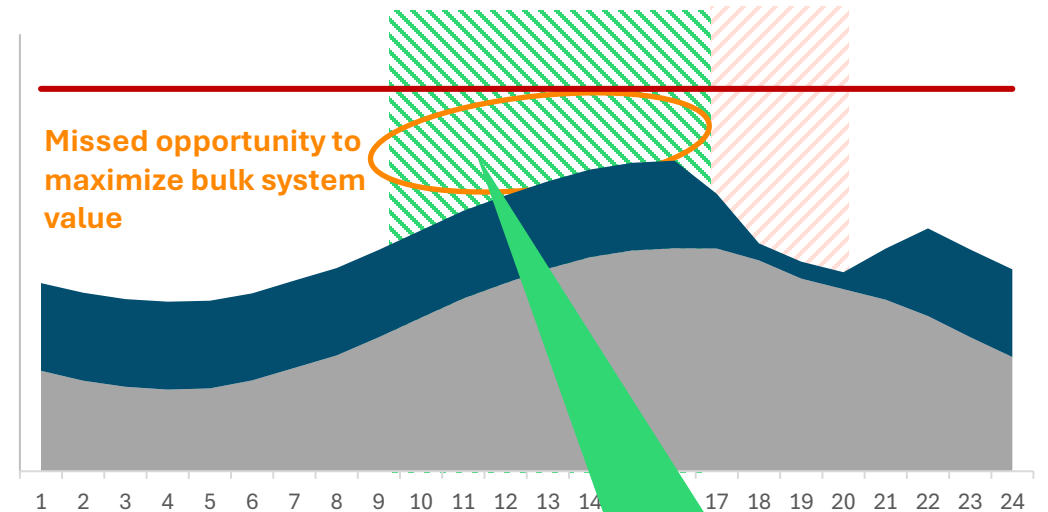
In recent studies, E3 and Integral Analytics have seen TOU rates increase peaks on >20% of distribution feeders

# Locationally aware, active managed charging programs can maximize benefits of VGI, but there are many technical hurdles

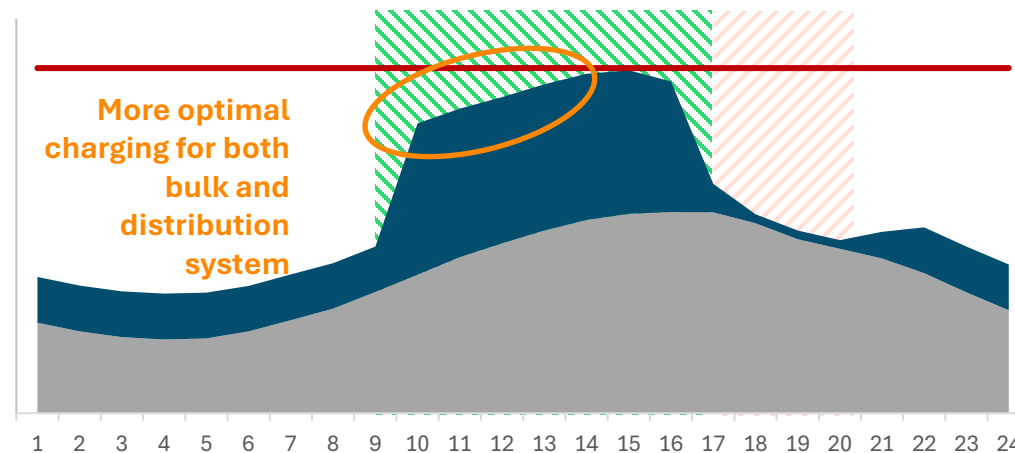
## Managed Charging to Maximize Bulk System Value



## Managed Charging to Flatten Peak

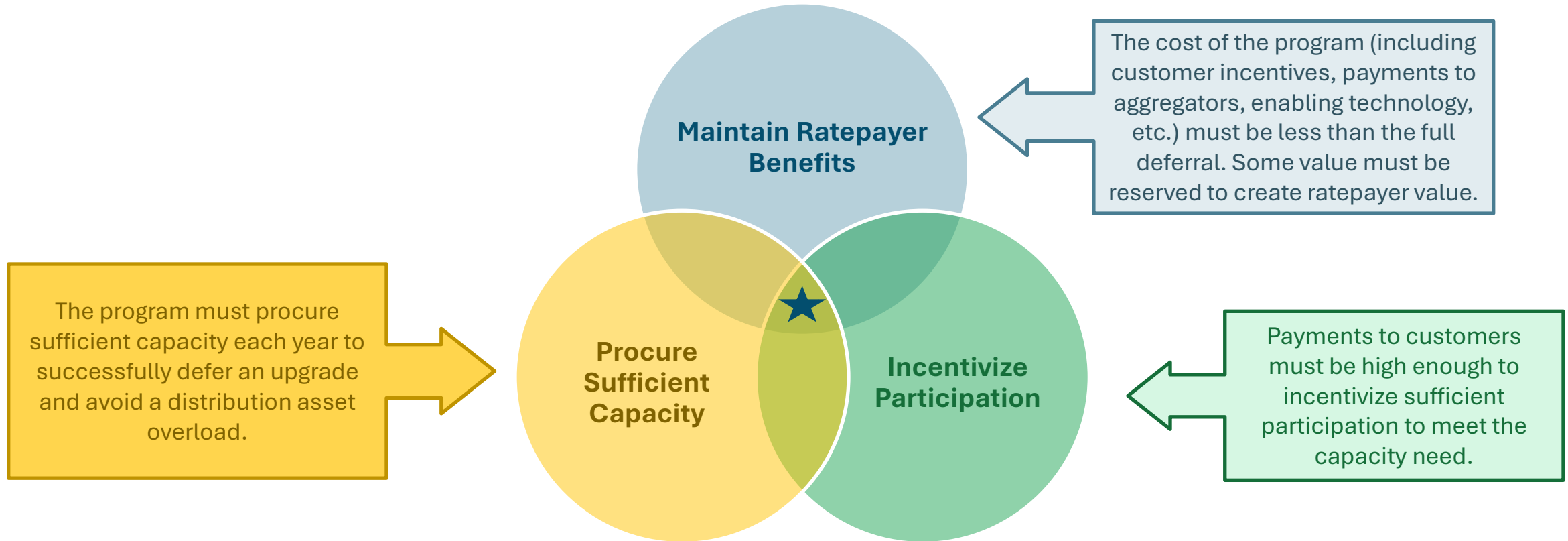


## Distribution Aware Solution



Missed opportunity to maximize bulk system value

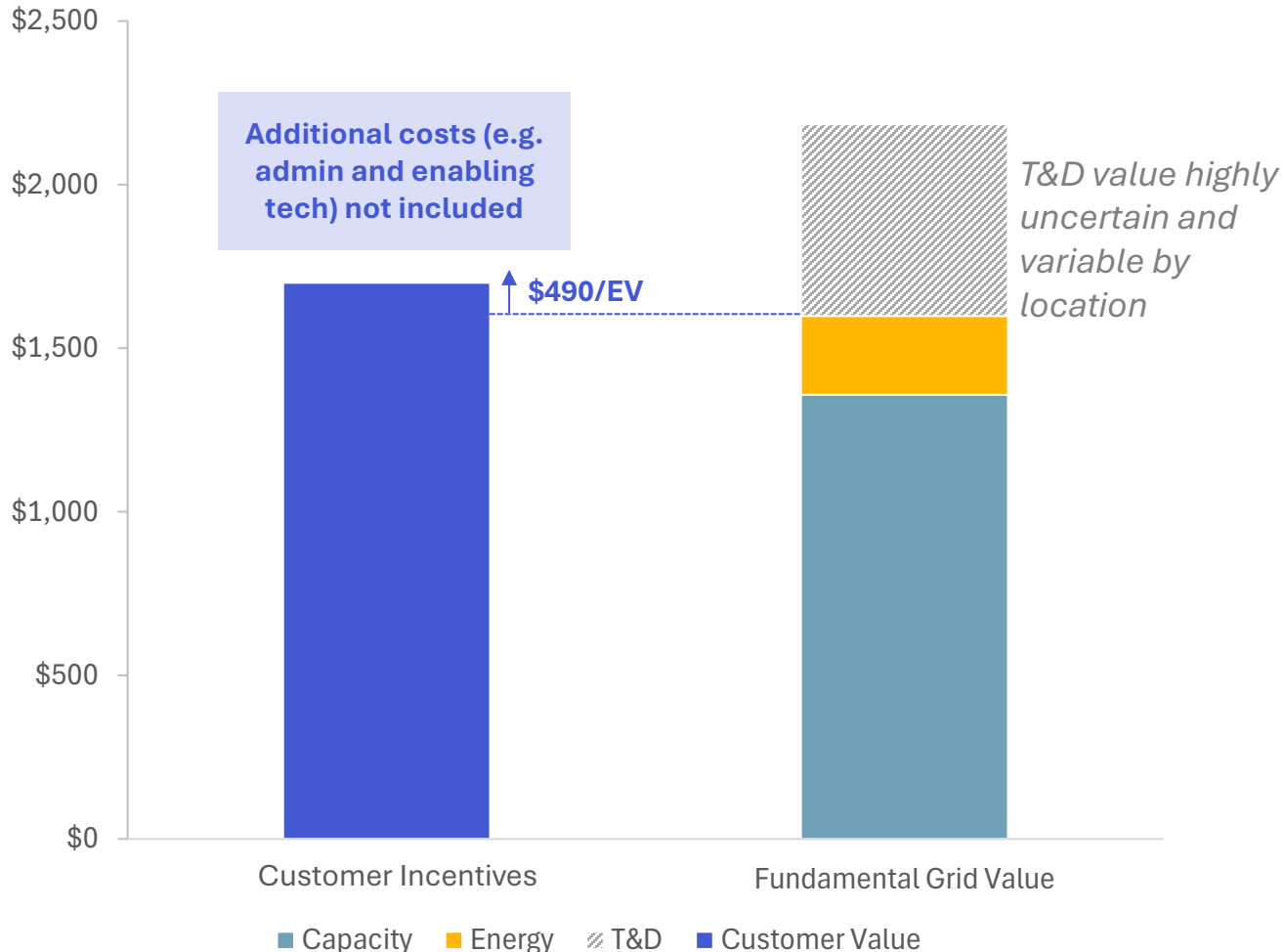
# To achieve distribution deferral and realize its value, a VGI program must balance 3 goals



The balance of these goals ultimately informs compensation

# VGI program compensation must be aligned with grid value provided to maintain ratepayer benefits

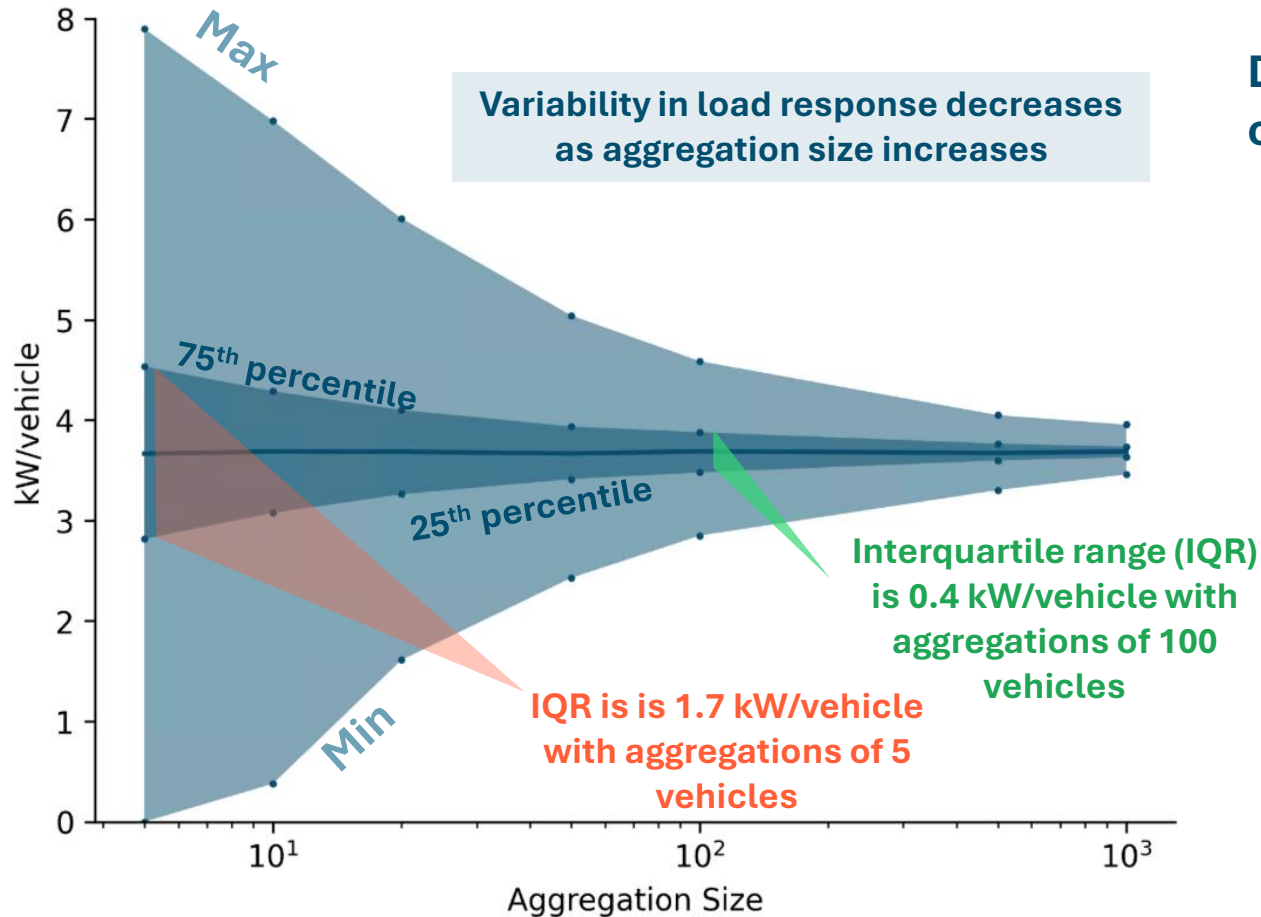
V2G Grid Value vs Customer Bill Savings on PG&E's Hourly Flex Pricing Program, \$/vehicle



- + E3's analysis of PG&E's V2G pilot<sup>1</sup> showed net benefits if T&D value can be realized by the utility, but T&D value will not be universally high and available across the service territory
  - The analysis of grid value relied upon publicly available data sources from the Avoided Cost Calculator and simulated charging customer charging behavior with E3's RESHAPE-EV model . It did not evaluate actual program impacts.
- + As VGI programs scale, it will be critical to set incentive levels such that the utility does not overpay the customer while also encouraging participation.
- + Larger scale programs may be needed to justify the setup and enabling technology investment.

# Procuring sufficient VGI capacity to defer distribution upgrades presents several uncertainties

Distribution of V2G load response with varying aggregation size



## Deferring infrastructure upgrades with VGI must overcome several uncertainties:

1. EVs are parked and plugged in when and where it is needed
2. Sufficient number of customers can be enrolled before capacity is needed
3. Customer load response is predictable and reliable at the scale of the aggregation size available to defer the capacity upgrade
4. Communication pathway to and from ADMS → DERMS → Aggregator → EV → EVSE will work reliably
5. Others ...

# Electrification Impact Study (EIS) Part 2

2026 Vehicle-Grid-Integration Forum

March 25, 2026

**Panelist:** Bill Peter, Senior Manager of Electric Planning Policy & Modernization (EPPM), PG&E

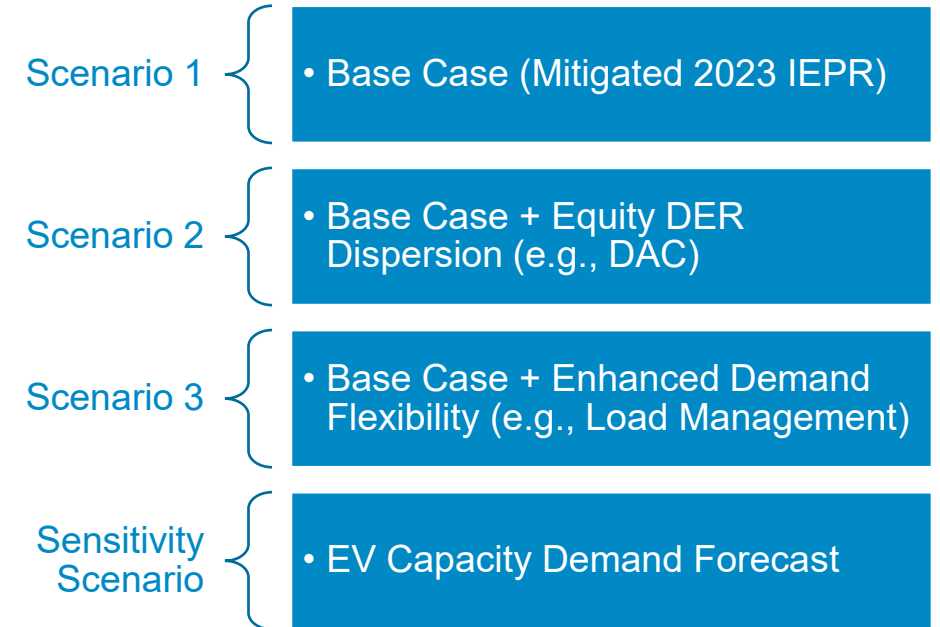




# PG&E Electrification Impact Study (EIS) Overview

The EIS estimates long-term distribution grid infrastructure costs associated with achieving California's electrification goals through 2040.

- A comprehensive assessment of a high electrification future:
  - Forecast grid impacts across the required scenarios for 2030, 2035, 2040
  - Estimate costs across the distribution and secondary grid<sup>1</sup> through solutioning
  - Examine DER adoption for DAC customers using equity ratio provided by the Energy Division
  - Examine the impact of enhanced demand flexibility
- Additional study requirements:
  - Includes historical and resource impact for PG&E
  - Provides transparency of data of DER disaggregation.
  - Provides Equity and Demand Flex takeaways
  - Aligns closely to existing planning process and mitigations



Study performed in support of California Public Utility Commission (CPUC) proceeding to Modernize the Electric Grid for a High Distributed Energy Resources Future (“High DER Proceeding”)



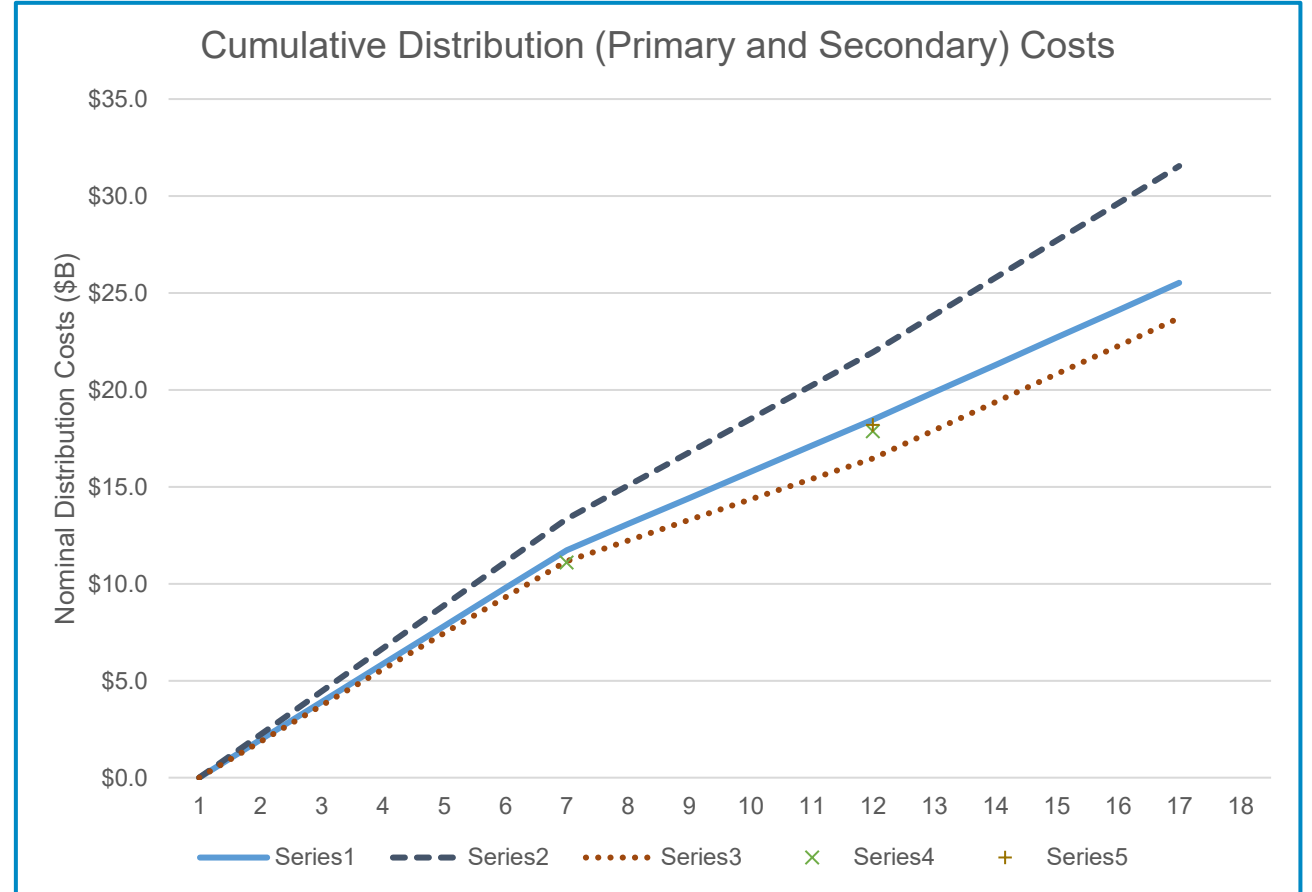
# Electrification Distribution Infrastructure Costs

Electrification Requires ~\$23B to ~\$32B in Distribution (Primary and Secondary) Investment by 2040

## Distribution (Primary and Secondary) Upgrade Costs (\$B)

Scenario	2030	2035	2040	Difference
Base Case	11.0	18.5	25.5	--
Equity	12.6	22.0	31.6	\$6.00
Enhanced Demand Flexibility	10.4	16.5	23.7	(\$1.80)

- Rate of investment slows down slightly after 2030 and is relatively consistent across the study period
- The equity scenario requires \$6B additional investment consistent with higher electrification loads.
- The enhanced load management scenario reduces infrastructure costs by \$1.8B through 2040.
- All costs include inflation of 2.6% and exclude project contingency dollars

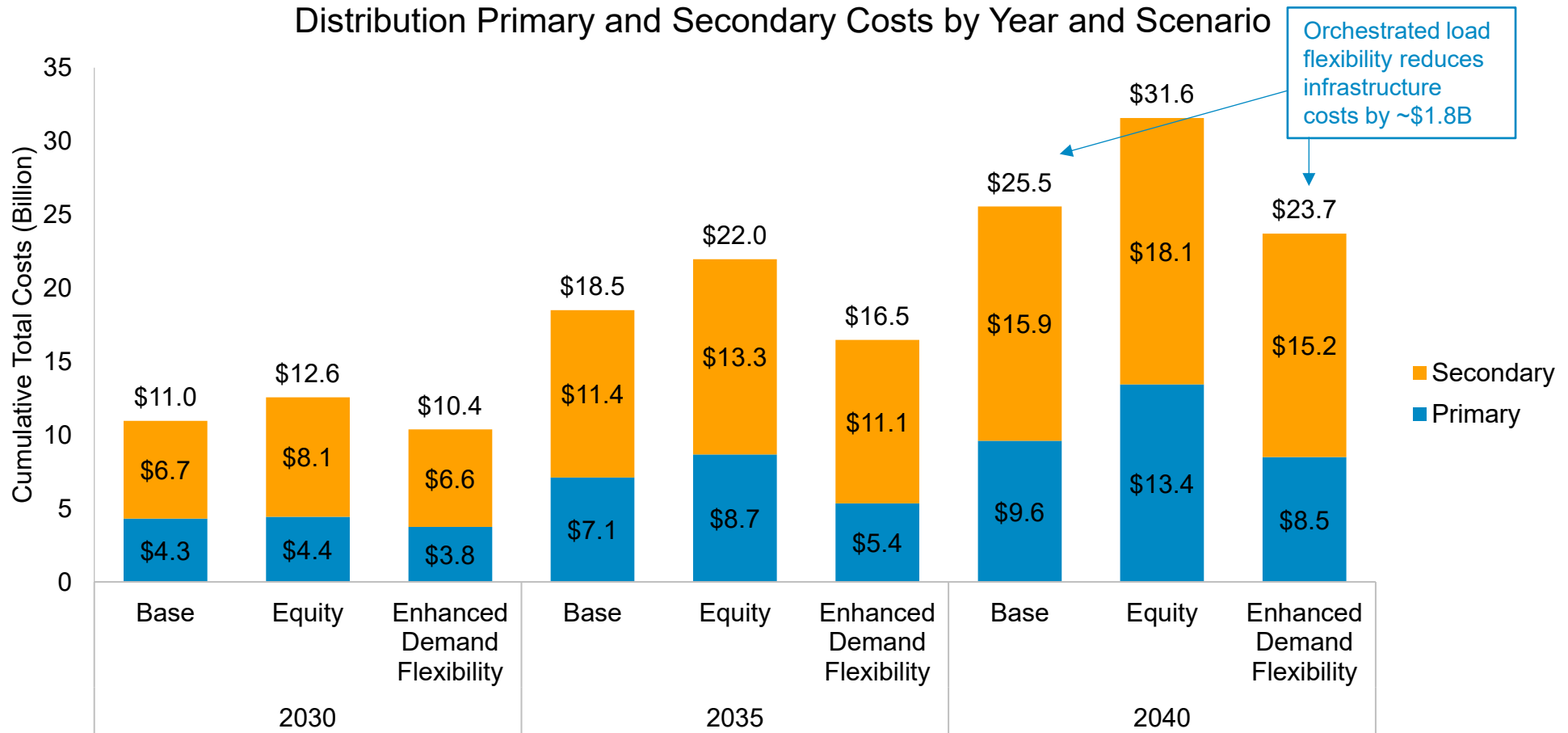


Linear Interpolation of costs used between study years.



# Distribution System Infrastructure Costs – Primary and Secondary

By 2040, costs will range between \$8.5B - \$13.5B in Primary and \$15B-\$18B in Secondary infrastructure costs.



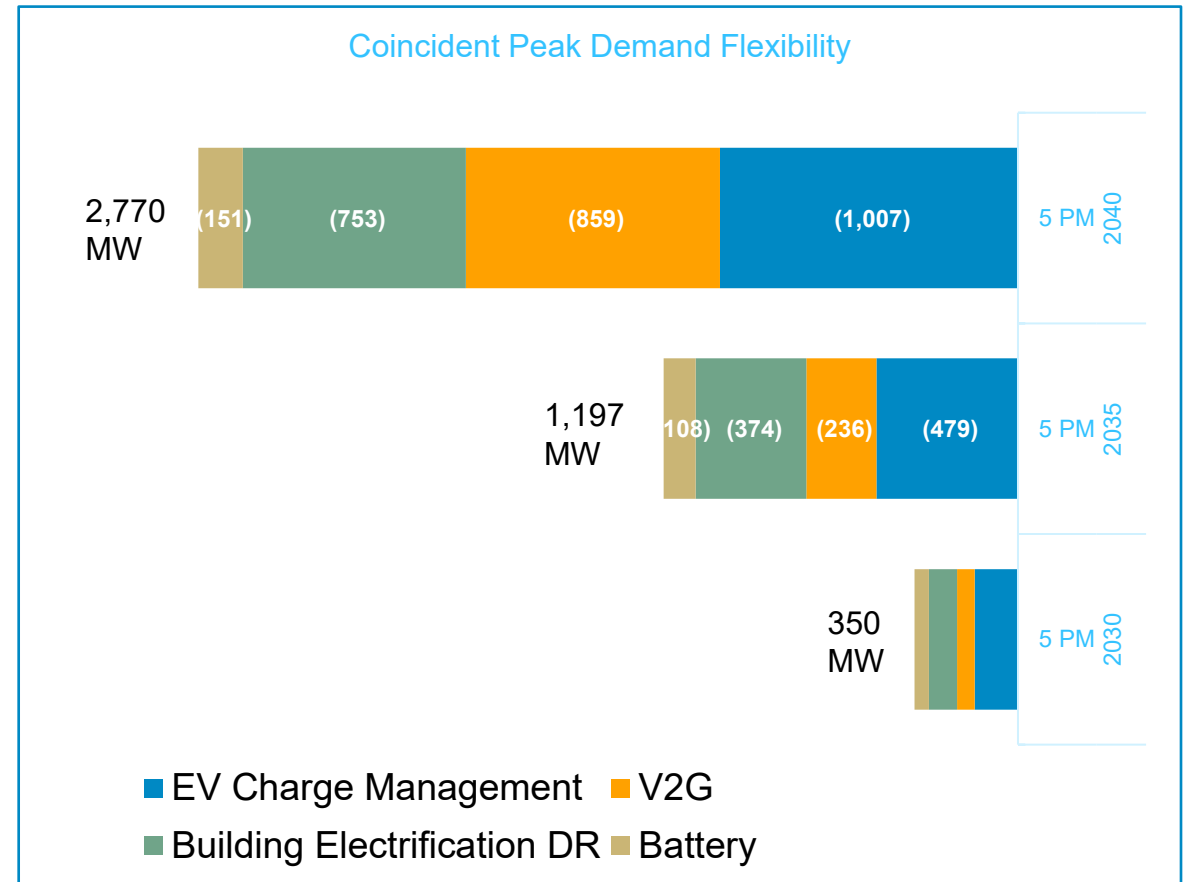
The EV Capacity Sensitivity Scenario (not shown) only modeled secondary costs, with total secondary costs of \$7.3B, \$12.5B, and \$17.5B through 2030, 2035, and 2040, respectively.



# VGI in EIS Part 2

## PG&E's Enhanced Demand Flexibility Scenario identified a potential \$1.8B reduction in distribution infrastructure costs if orchestrated

- The Base Scenario and PG&E's existing planning include business-as-usual passive managed charging (TOU rates).
- To increase flexibility of EV charging load shapes in the Enhanced Demand Flexibility Scenario, PG&E modeled 3 changes relative to the Base:
  1. Introduce active management and increase passive management enrollment
  2. Modify passive + active management load shapes to respond to local feeder peaks
  3. Vehicle-to-grid (V2G)
- Active managed charging can help reduce costs, but “grid-aware” orchestration is needed to avoid triggering additional grid upgrades/costs.



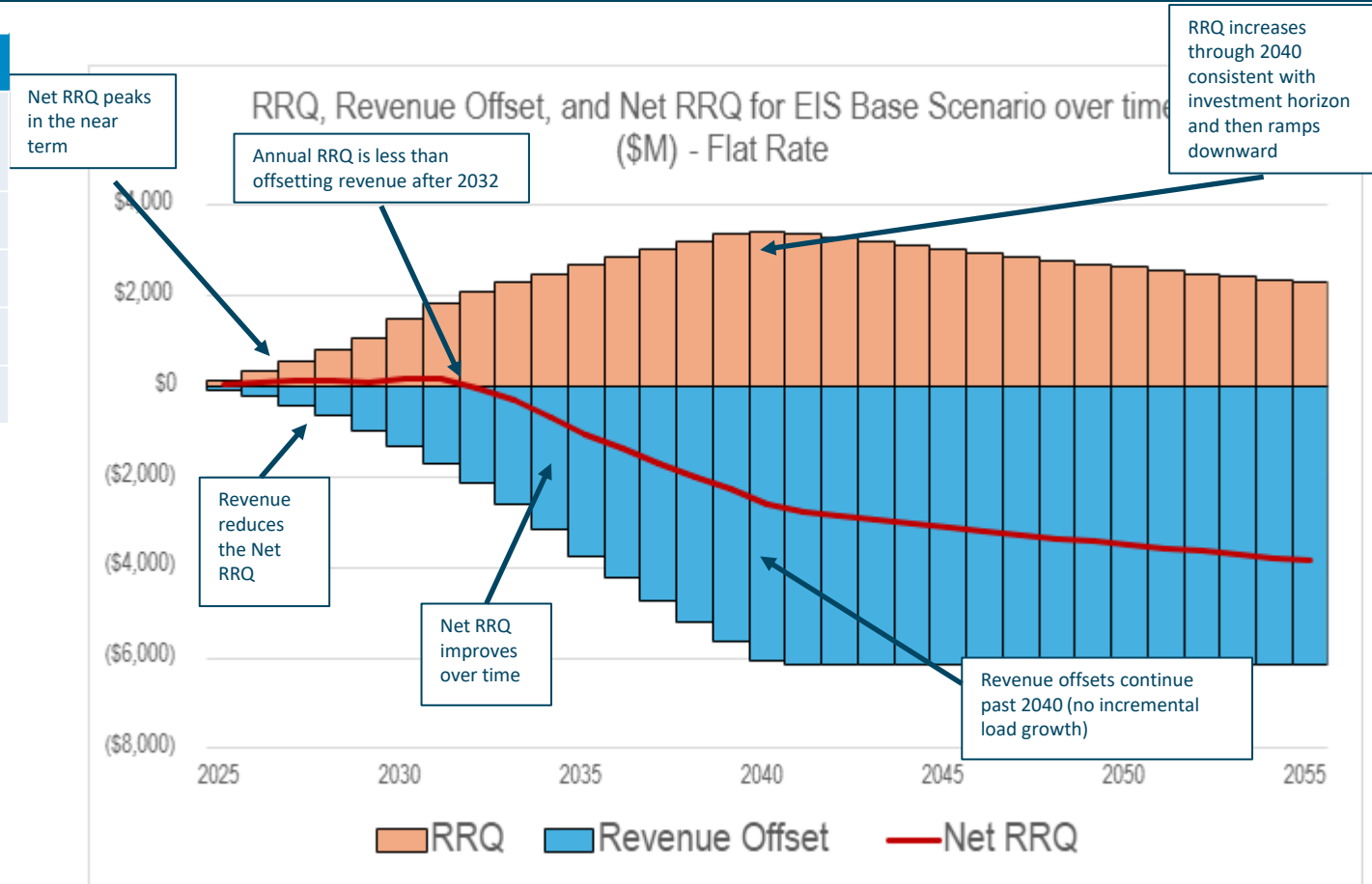


# Preliminary Analysis shows significant downward pressure on Distribution Rates over time

All scenarios show a long-term downward pressure on distribution rates from energization investments that drive electrification growth.

Year	2030	2035	2040
Annual Revenue Requirement (RRQ) [\$B]	\$1.5	\$2.7	\$3.4
Annual Offsetting Revenue [\$B]	\$1.3	\$3.7	\$6.1
Net Annual RRQ [\$B]	\$0.2	(\$1.1)	(\$2.6)
Rate Pressure (%)	1.6%	(10%)	(25%)
Net Present Value (NPV) [\$B]		\$14.2	

- Near-term rate increases due to capital outlays are offset by sustained revenue growth from increased energization, indicating long-term value of energization investments.
- Net Present Value of Energization of \$14.2B, showing a small upward rate pressure in the near term followed by downward distribution rate pressure from 2031 onwards.
- Costs are **solely** for Distribution Energization Investments and does not include other incremental costs (e.g., safety, reliability, etc.). This is not a rate forecast.





# Key Strategical Findings

**Electrification Requires ~\$23B to ~\$31B in Distribution Investment by 2040,  
in line with current investment trends**

## KEY FINDINGS

### Distribution Engineering Mitigations

- PG&E's Base Scenario includes mitigations (e.g., load transfers, TOU rates) by distribution engineers to optimize infrastructure investments that resulted in as much as \$3.4B in primary savings through 2040.

### New Approach to Long-Term Secondary Planning

- The EIS represents a pioneering, data-driven evaluation of secondary system planning, establishing a foundational framework to optimize our secondary investments for serving load energizations.

### Enhanced Demand Flexibility with Orchestration

- Enhanced demand flexibility reduces system peak demand between 2.2 and 3.1 GW and reduces distribution infrastructure costs by an additional \$1.8B (7%) through 2040 but only if orchestrated to avoid triggering new investments.

### Electrification Provides a Downward Distribution Rate Pressure

- Electrification growth may provide downward pressure on distribution rates by as much as 25% (~3.5 cents/kWh) by 2040.

# VGI and Ratepayer Impacts

**RICHARD KHOE, PUBLIC ADVOCATES OFFICE**  
SUPERVISOR, ELECTRIC DISTRIBUTION PLANNING & POLICY

# Bill Impacts of VGI

*Clint Chan (Retail Rates Team)*

March 25, 2025



California Public  
Utilities Commission

# Summary

**Summary:** Flexibility value is real, but system cost savings may be limited to avoidable costs.

- Load flexibility is a powerful tool but may not guarantee across-the-board cost savings for all of a utility's costs of service.
- The PG&E EIS shows electrification can reduce rates by up to ~25% by 2040, under favorable load growth assumptions. At the same time, it requires **\$23–31B in distribution investment**.
- DGEM (Cal Advocates) also finds that managed charging can reduce distribution upgrade costs by \$5B–\$18B by 2040.
- These benefits exclude implementation and maintenance costs and results vary significantly by circuit.

# ED Reflections on VGI Bill Impacts (pt 1)

**Takeaway 1:** Rate impacts may be modest amidst other cost drivers

- DGEM finds that electrification leads to **-0.2 to -4.5¢/kWh** downward pressure by 2040 but also warns rates may not fall at all due to other costs such as wildfire hardening (a key driver of late).
- In the EIS and DGEM studies, **much of the rate saving modelled is from electricity sales growth.**

**Takeaway 2:** Whilst flexibility is helpful, the largest source of future costs may still be from distribution expenditures

- A large portion of future ratepayer impacts are **distribution-driven**. SCE's EIS scenarios emphasized non-coincident circuit peaks and local constraints as key drivers of cost
- DGEM notes that EV charging behavior is a primary driver of distribution costs. However, feeder-level optimization can also reduce costs ~42% vs unmanaged shapes
- **Managed charging reduces peak demand, but current studies show they might not eliminate grid costs**

# ED Reflections on VGI Bill Impacts (pt 2)

**Takeaway 3:** Technical potential does not equal economic or achievable participation

- The study scenarios model various potential participation rates. But predicting customer behavior is hard.
- Ratepayer participation depends on automation costs, customer understanding, and elasticity of behavior.

**Takeaway 4:** Without a better alternative, non-coincident demand charges may still be needed

- Many T&D costs are functionalized as non-peak, meaning that they are *allocated to customer classes on the basis of Non-Coincident Demand*.
- If "Non-Peak costs are not recovered Non-Coincident Demand Charges, then an alternative **Revenue-Neutral Mechanism\*** needs to be designed.
  - *\* Revenue-Neutral means that all allocated costs will be recovered for customer who take service on the rate.*

**Break — we will resume at 11:15 am PT**

# Session #2: V2G Industry Trends

**ELI DARBY, PG&E**

PRODUCT OWNER, EXPERT

**SRI KANAPARTHI, TELLUS GREEN POWER**

SENIOR VICE PRESIDENT OF TECHNOLOGY

**DAVID NICOLAS, TESLA**

STAFF PRODUCT MANAGER

**FRANCES BELL, BIDIRECTIONAL ENERGY**

FOUNDER AND CHIEF EXECUTIVE OFFICER

**MATHIAS BELL, WEAVERGRID**

VICE PRESIDENT OF POLICY AND MARKETING



**TELLUS POWER GREEN**

# **Fleet Electrification – V2G Industry Trends**

Srikanth Kanaparthi (Sri) – SVP Technology

[www.telluspowergreen.com](http://www.telluspowergreen.com)





# Tellus Power – Corporate

- 2012 – Established Worldwide
- Headquartered in Irvine, USA
- Installations in 23+ countries
- Inhouse R&D, State of Art Facilities
- UL, CE Energy Star Approved
- BABA Compliance – CA Facility
- 500K+ – AC Stations Delivered
- 50K+ – DC Stations Delivered



 North America

 Europe

 South America

 Middle East

 Asia Pacific



# DC Charger Family



30kW to 380kW  
DC Charger



Distributed Charging System (300-1200kW)



Integrated Battery Charging  
(BSS) DC Charger



Mega Watt Charging Solution



# V2G DC Charger Family



20kW V2G  
DCFC



30kW to 60kW V2G DCFC



Integrated Battery Charging (BSS)  
V2G DC Charger



# Case Study – Zum– V2G

## Project Details

- Total EV Chargers : 74 (30kW and 60kW)
- Total EV Buses : 74 (Type A BYD)
- Total Project Capacity : 2.7 MW
- Energy Returned to the Grid : 2+ GWh per year – Equivalent to powering 400 Homes per year
- Eliminate up to 25,000 Metric Tons of greenhouse gas emissions per year
- Project Lifetime : 10 years
- 2 Years Consistently Operational with over 98% Uptime
- Utility : PG&E (Rule-29, VGI Program)
- Ongoing Installation for 250+ DCFC V2G Chargers
- Charge to discharge ratio 2 : 1





## Technical Details

1. Interoperability : ISO 15118-20
2. Certification : UL 1741 SB
3. IEEE 1547 and Sunspec 2030.5
4. Server Communication: OCPP 1.6 / 2.1
5. 96% Efficiency
6. Operation: Remote Sleep / Wakeup ( 100% unmanned )

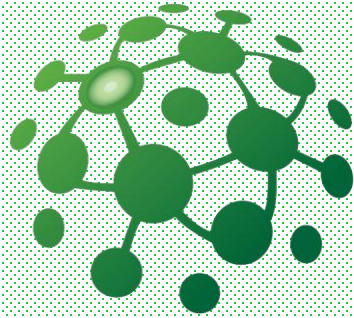


# Other Projects Ongoing

## Summary:

- Customers using products: Highland, Zum, The Mobility House, Nuvve, ABM, NV Energy etc
- Multiple Charge Pilots completed, ongoing, and planned
- 100+ Projects successfully completed
- 2026 outlook of 100+ more sites
- OCPP 2.1 Support
- Interoperability with BYD, Bluebird, Micro bird, XOS, Lion, Navistar/International, Thomas-Built, and more.
- Approved with Utilities: PG&E, ComED, Portland Electric, Duke Energy, NV Energy and others





Thank you

**Tellus Power Green**

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[www.telluspowergreen.com](http://www.telluspowergreen.com)



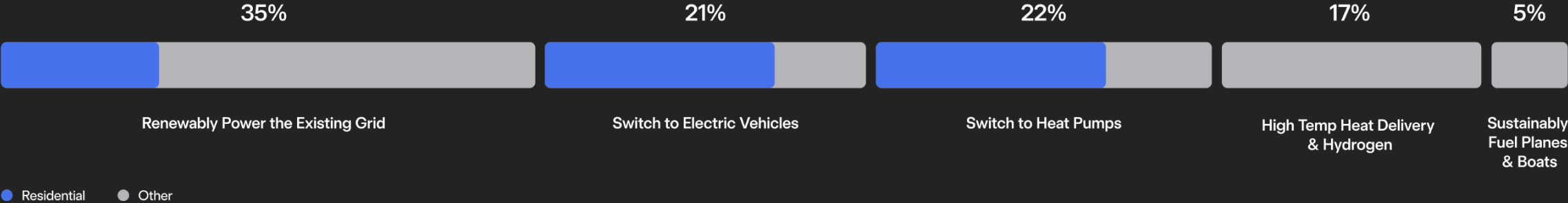
# Powershare

Bi-directional EV Charging



# Home and EV Electricity Demand Will 5X

## Drivers of Reduction in Fossil Fuel Use



## Powershare is a critical part of the solution for meeting this new demand



Avoids transmission losses & network upgrades



VPPs support the grid locally and drive value for owners



Protects against outages and weak grids

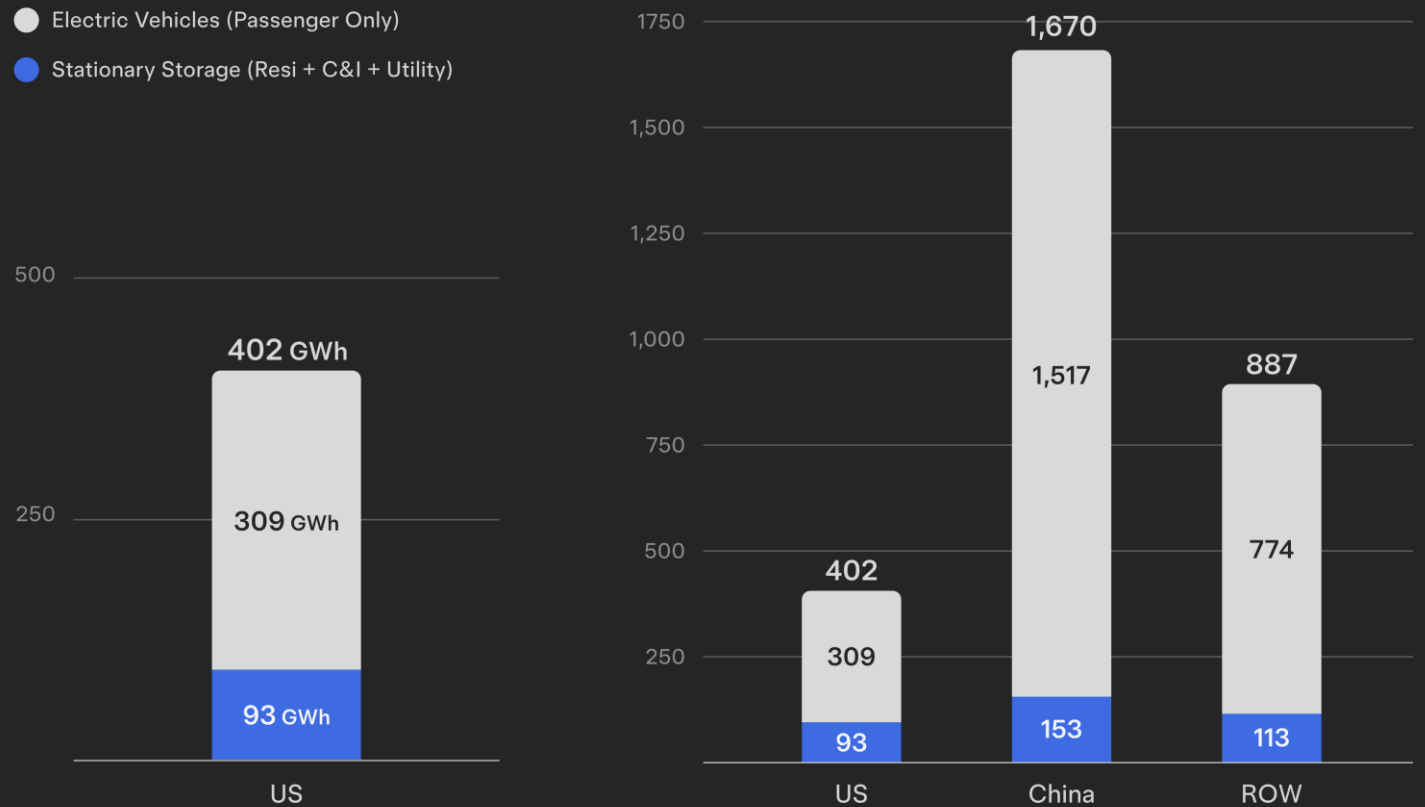


Maximizes the use of intermittent renewables

# EVs at Scale, Helping the Grid

- Stationary storage not being deployed fast enough to match renewable generation additions to grid
- Leverage vehicle bi-directionality to accelerate storage capacity on grid
- Complement to stationary storage deployment

All Time EV vs. Storage GWh on the Grid



As of February 2025\*

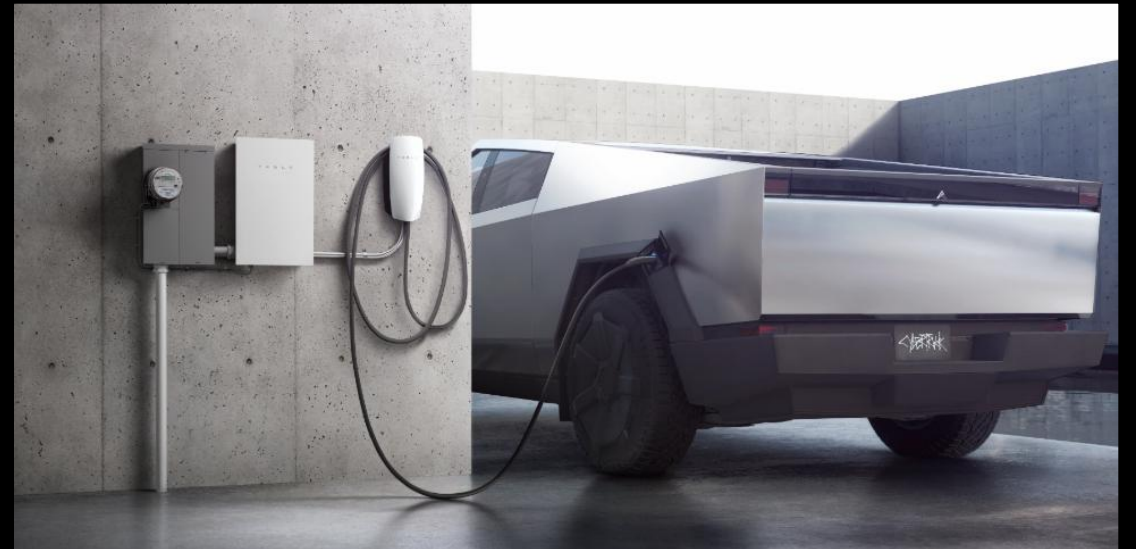
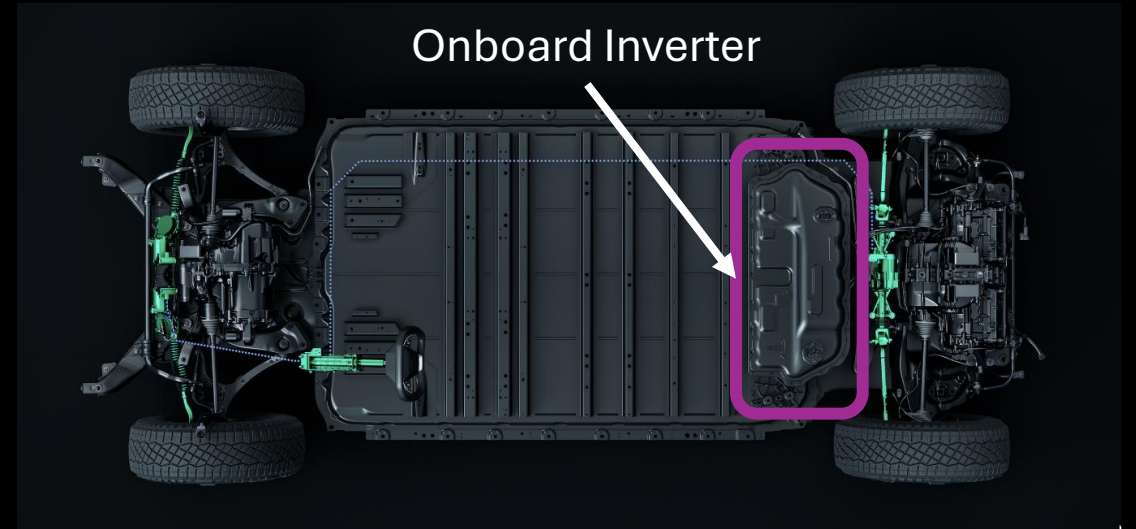
# Tesla Powershare

## Definitions

- Vehicle to Home (V2H) → vehicle can only discharge when disconnected from the grid
- Vehicle to Grid (V2G) → vehicle can discharge when connected to grid

## What is Powershare?

- Onboard vehicle technology that supports bi-directional AC power flow
- Enables the following functionality **today**
  - Charging electric appliances and loads (Vehicle to Load)
  - Charging other EVs (Vehicle to Vehicle)
  - Home backup (Vehicle to Home)
- **Coming soon**
  - Grid Support (Vehicle to Grid)



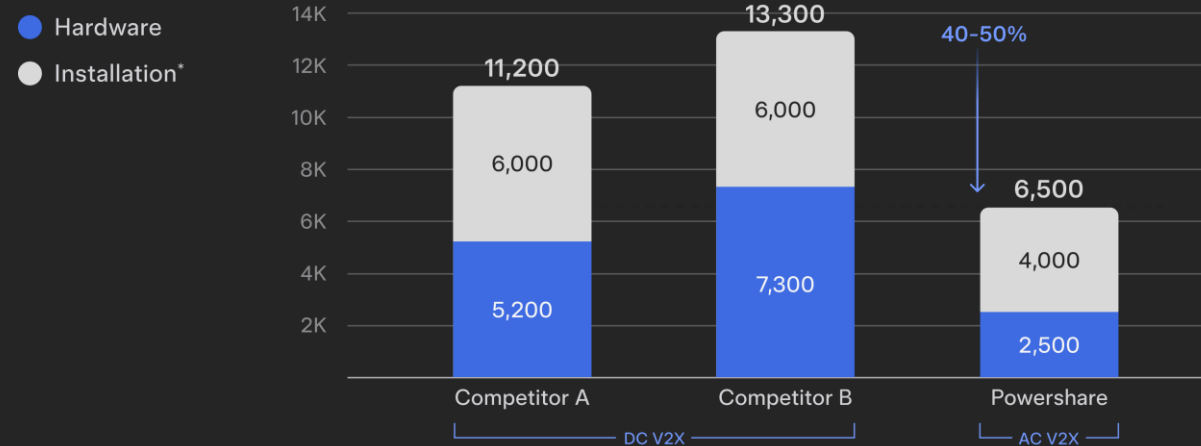
# Lowest Cost, Most Affordable

- AC architecture reduces total cost of V2X by 40%-50% vs competitors
- Leverages existing onboard vehicle inverter
- Fewer boxes to install
- Accelerates speed of storage deployment, benefitting utilities

## Tesla Powershare Install



## Competitor Install



# Powershare at Scale

## Home Backup

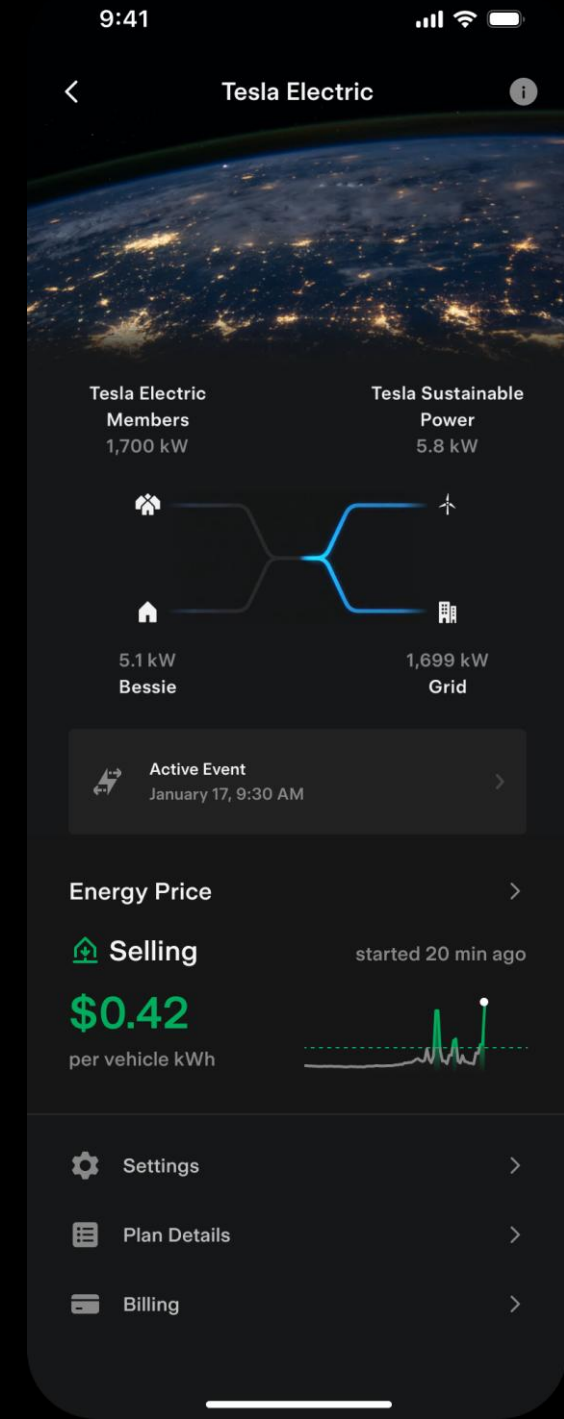
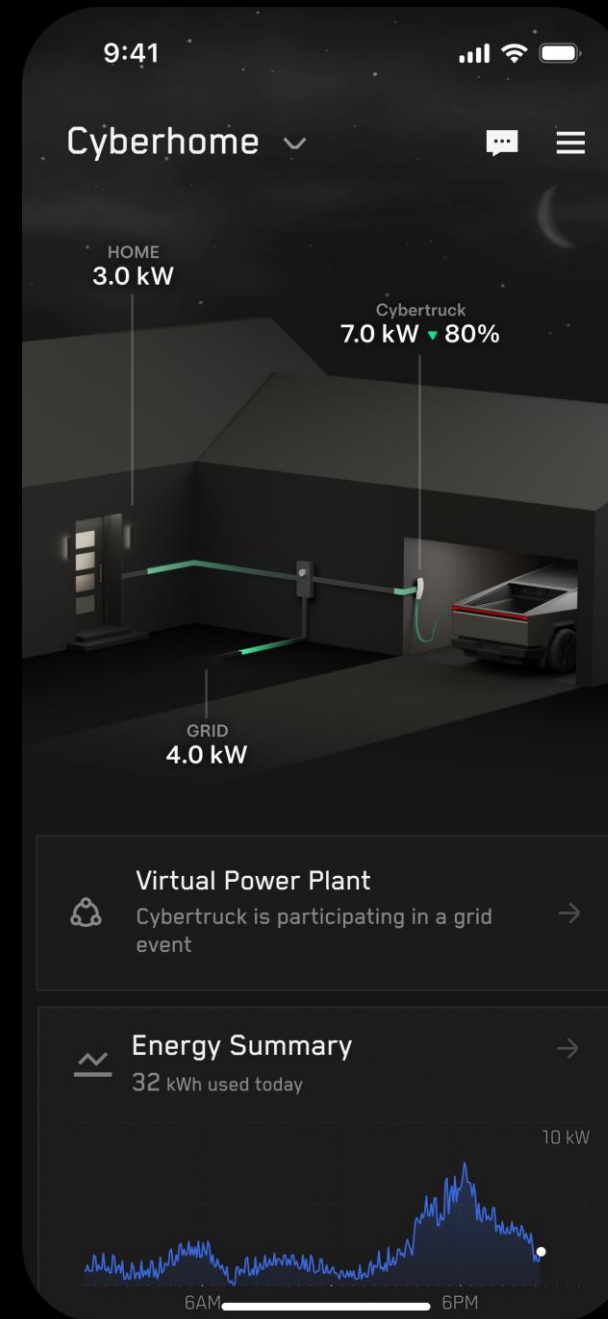
- ~5000 homes are now being backed up by Cybertruck

## Grid Support

- Industry first AC V2G compliance path with UL 1741 SB CRD, certification expected in April
- Supported programs this summer:
  - **Tesla Electric Drive Plan (ERCOT)** – customers earn 90% of real-time electricity price revenues above 30c/kWh
  - **Emergency Load Reduction Program (CA)** – day-ahead and real-time emergency demand response capacity

## Tesla's ability to scale

- Tesla installed our 1,000,000<sup>th</sup> Powerwall last year
- >100 VPP programs supported
- Largest US EV manufacturer



FROM IDLE BATTERY TO ACTIVE INCOME

**What is the fastest and cheapest way to get capacity?**

FROM IDLE BATTERY TO ACTIVE INCOME

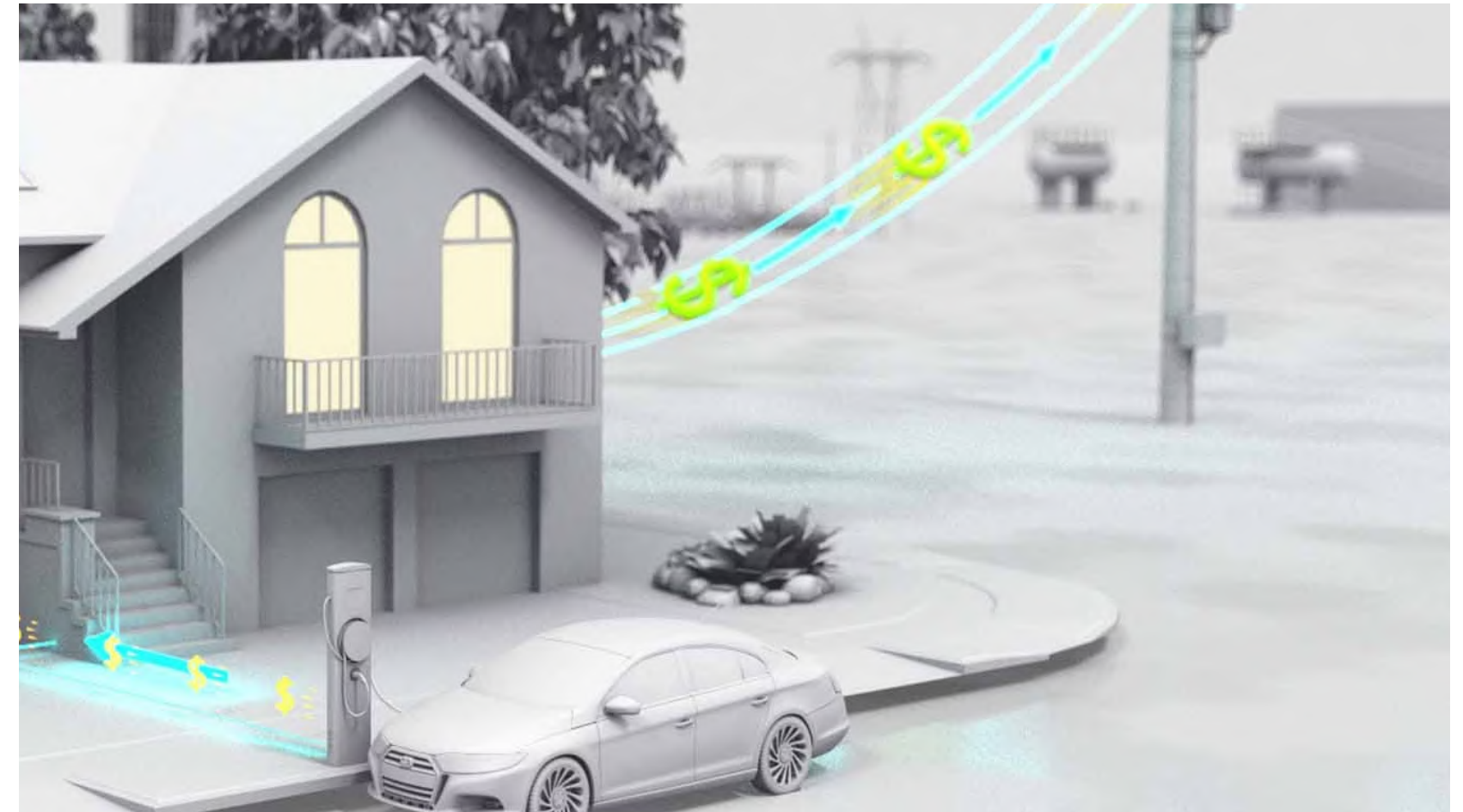
We **facilitate** customers' bidirectional charger installation and enable them to **earn** money by selling energy to the grid.

# We are the bridge between EV consumers and the grid



## FOR EV DRIVERS

- We make it **simple** to turn your car into power.
- Earn money, save on your bill, and keep your home running during outages.



## FOR UTILITIES AND MARKETS

- Access **fast, flexible** power when it's needed most.
- Reduce peak strain and boost grid resilience without building new plants.



# Oakland Demonstration Home

One of the first residential V2G sites pursued in PG&E territory

Real-world test of the full stack: vehicle, charger, home electrical system, utility process, and software controls

Used to validate not just technology, but deployment workflow

Exposed where residential V2G is still friction-heavy today

Helped identify what can now be standardized for future sites

A practical test of what it takes to move from pilot concept to repeatable deployment



# Programs We Are Running Today

## V2G MARKET PARTICIPATION

*California*

**Partners:** Wallbox, Treehouse

**Goals:**

- Install 120 V2G EV chargers
- Capture utility bill savings
- Participate in grid programs to earn revenue
- Engage in hourly flex price program

## UTILITY V2G PROGRAM

*Connecticut*

**Partners:** Eversource, United Illuminating (Avangrid), Wallbox, Treehouse

**Goals:**

- Design and test residential utility V2G program design
- Install 60 V2G EV chargers
- Validate incentive design for residential V2G

## MULTI-FAMILY

*California*

**Partners:** Emporia, VW Group, Honda, USGBC-CA, Southern California Edison (SCE)

**Goals:**

- Demonstrate grid support with four V2G chargers on a single multi-family site
- Install 100 V2G EV chargers

# From first-of-a-kind to repeatable deployment

## STANDARDIZING RESIDENTIAL V2G DEPLOYMENT ACROSS PROGRAMS

### First-of-a-kind challenge:

### Repeatable approach:

Custom customer coordination



✓ Standardized customer journey

Site feasibility assessed case by case



✓ Screening criteria applied upfront

Interconnection handled as a custom process



✓ Documented utility submission pathway

Each project carried timeline risk



✓ More predictable stage gates and dependencies

Residential V2G is no longer hypothetical, but scale depends on execution

The technology is advancing, but deployment still requires strong **cross-functional coordination**

Customer experience, installer readiness, interconnection, and controls all matter

Early residential projects are **building the playbook** for broader adoption

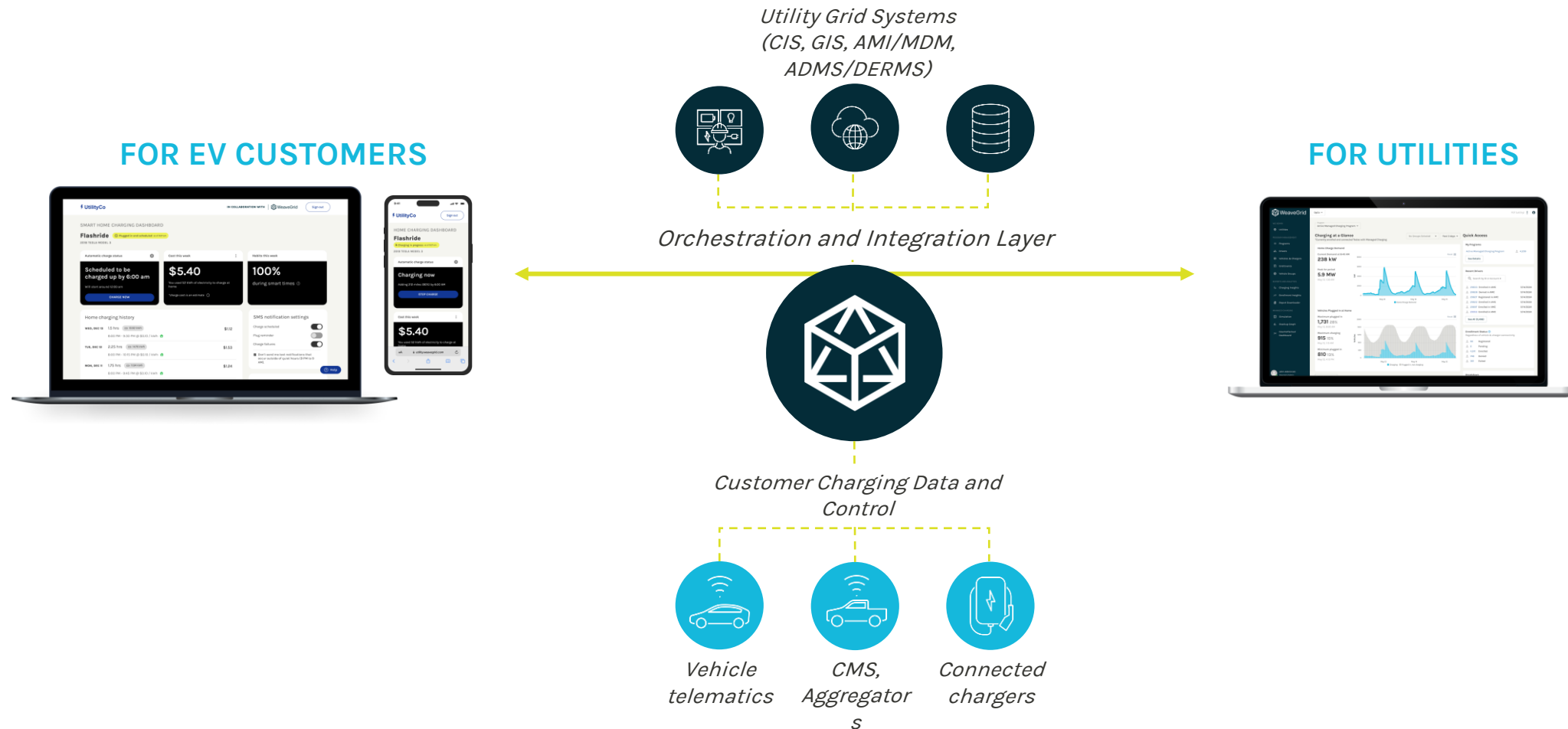
Bidirectional Energy is focused on making residential **V2G operationally repeatable**



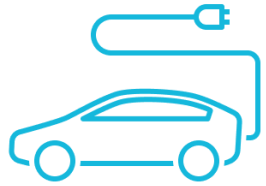
# 2026 Vehicle-Grid Integration Forum

March 25, 2026

# Turning EVs into grid resources requires coordination

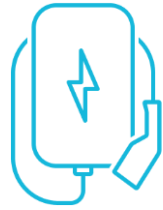


# Key enablers of scalable V2X



## CAPABLE VEHICLE

- Bidirectional-capable vehicle with software available for optimization
- Clear battery warranty and OEM participation terms



## CAPABLE EV CHARGER

- Bidirectional-capable charger with software available for optimization
- Interoperability and certification pathways



## INTER-CONNECTION

- Timely, standardized approval processes
- Clear installer and utility requirements



## PROGRAM DESIGN

- Valuable grid use cases
- Compensation aligned to customer and system value
- Coordination across utilities, auto and EVSE OEMs, aggregators



## PARTICIPATING CUSTOMERS

- Simple enrollment and participation experience
- Clear value proposition and low friction



## V2X

Grid and price signals can improve V2X performance, but only when simple participation pathways are in place

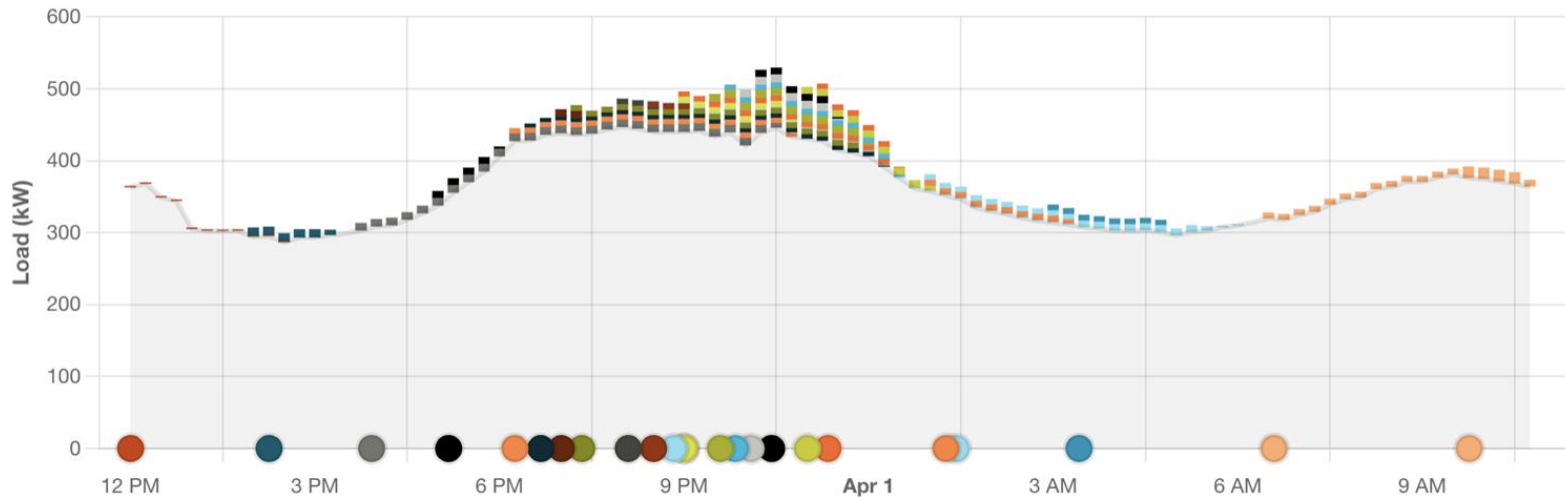
### Charging and Dispatching

Charging occurs during low dynamic rate periods while mirroring driver expectations of TOU rates

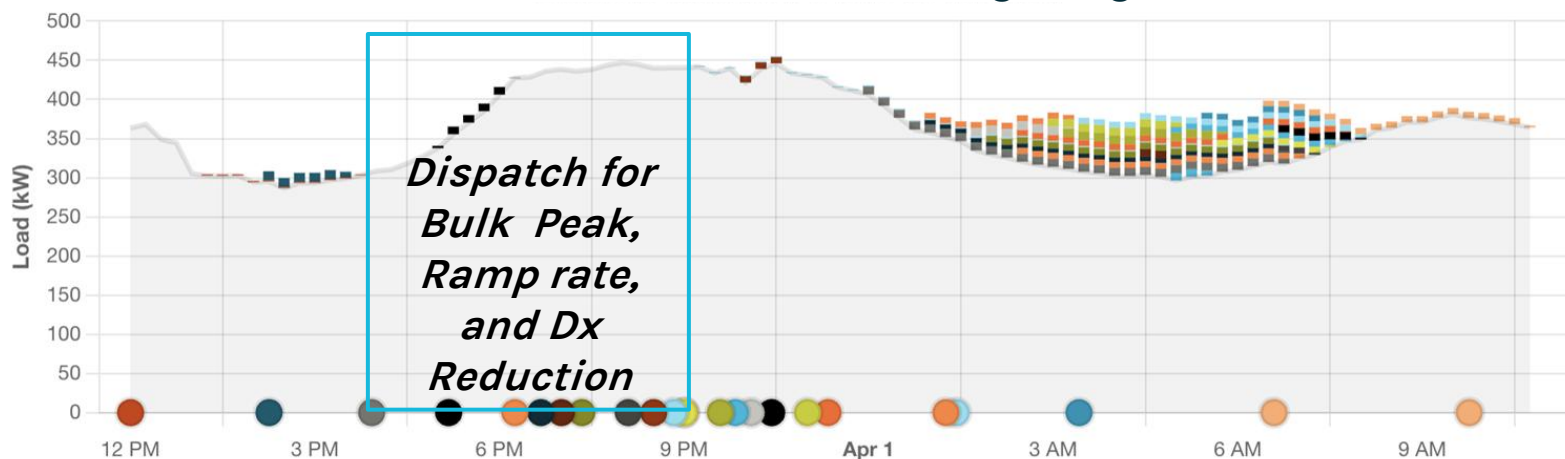


# Adding V2X can expand the grid value of EV load orchestration

Without Managed Charging Scenario



Orchestration Scenario (with grid signals)



**Coincident charging load + non-EV load reduction with V2X**

# Thank you!

Mathias Bell, VP of Market  
Development & Partnerships

[mathias.bell@weavegrid.com](mailto:mathias.bell@weavegrid.com)

**Lunch — we will resume at 1:00 pm PT**

# Session #3: VGI Use Cases – Part 1: Dynamic Rates

**NICK FIORE, SDG&E**

CLEAN TRANSPORTATION INNOVATION MANAGER

**ACHINTYA MADDURI, CPUC ENERGY DIVISION**

SENIOR REGULATORY ANALYST, RETAIL RATES

**REUBEN BEHLIHOMJI, SCE**

PRINCIPAL MANAGER OF RATE DESIGN

**ORIANA TIELL, PG&E**

PRODUCT MANAGER, PRINCIPAL



California Public  
Utilities Commission

# Regulatory Roadmap for Dynamic Hourly Rates

**Achintya Madduri, PhD**

Senior Analyst | Retail Rates | Energy Division | California Public Utilities Commission



# Potential of Widespread Demand Flexibility



...leading to a reduction in peak loads, energy prices, and required infrastructure...



Lower peak load means less infrastructure cost..

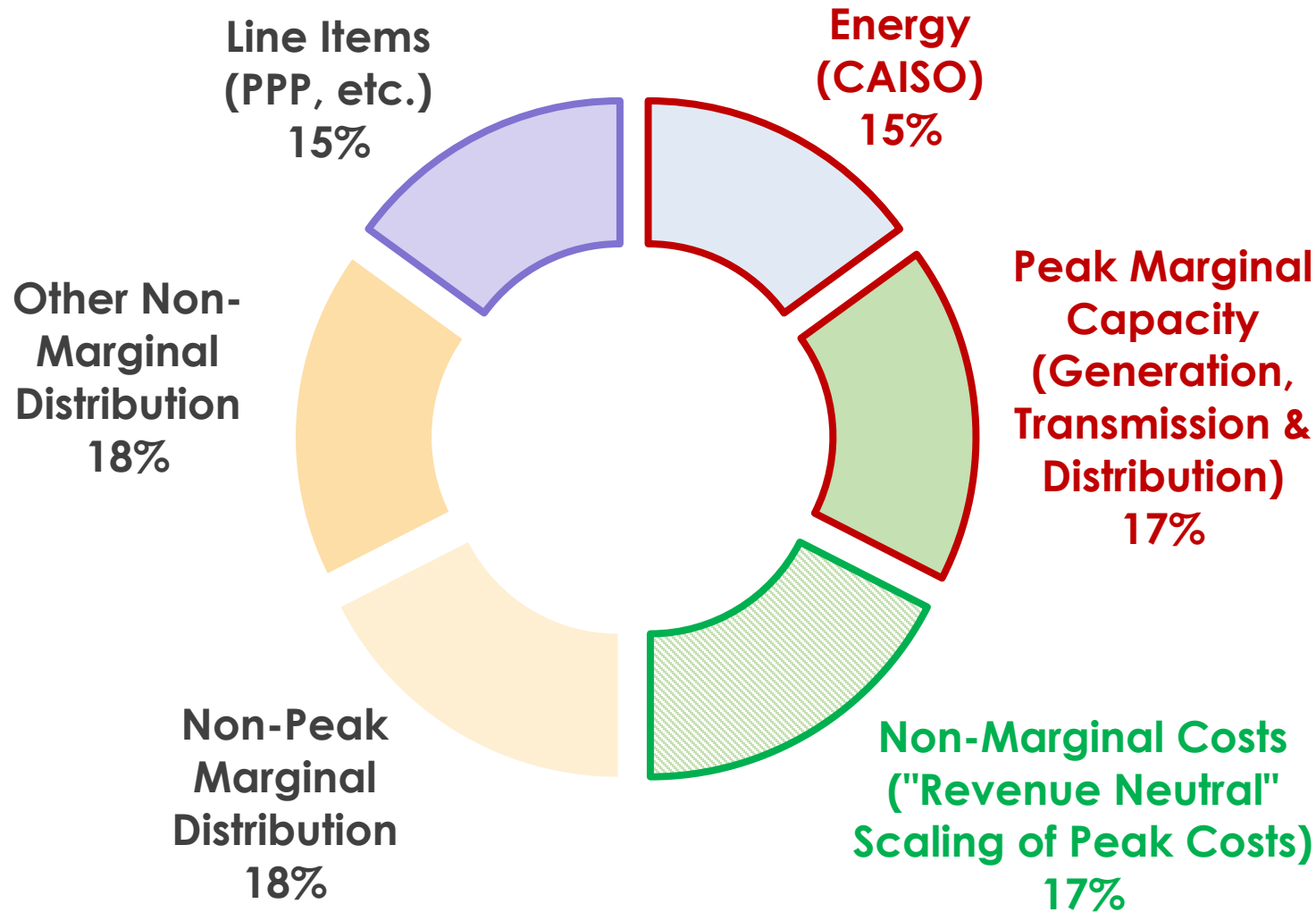
...and customers buy more electricity when it is cheaper



# Demand Flexibility OIR (R.22-07-005)

- Developed guidelines for dynamic rate applications that will be filed to comply with the CEC Load Management Standards (LMS) for dynamic hourly rates
  - **What: Optional “marginal cost-based” dynamic hourly rates**
  - **Who: All IOUs & CCAs → All Customer Classes**
  - **When: Rates or Programs available on opt-in basis by Jan 1, 2027**
  - **Guidance provided multiple options/recommendations to reduce complexity of RTP rates relative to current authorized Pilots.**
    - **Provides flexibility to IOUs to propose rate designs that balance the value potential of dynamic pricing and ensuring fairness to non-participants**

# How much of the rate should be dynamic – per CPUC Guidance (Illustrative Only)



Category	%	Avg Rate (cents/kWh)
Total Marginal Costs (in import & export price)	32%	13
Scaled Non-Marginal Costs (only in Import price)	18%	7
Remaining Distribution Costs	35%	14
Line Items (Flat Surcharge on Imports)	15%	6
<b>Total</b>	<b>100%</b>	<b>40</b>

# Regulatory Timeline for Dynamic Retail Rates in CA

Date	Milestone
<b>March 2024- Dec 2027</b>	<b>Expanded Pilots authorized in SCE and PG&amp;E (D.24-01-032)</b> <ul style="list-style-type: none"> <li>Pilots include eligibility for VGI (including submetering)</li> <li>Enrollment target of 150 MW by 2027 -&gt; <u>over 200MW enrolled</u></li> </ul>
<b>Oct 2024 – Dec 2027</b>	<b>PG&amp;E V2X Pilot (SB 676) Phase 2 launched</b> <ul style="list-style-type: none"> <li>EV pilot that provides export compensation for bidirectional EV charging on a CalFUSE rate for residential and commercial fleets</li> </ul>
<b>Jan 2025</b>	<b>SDG&amp;E Dynamic Export Rate Pilot Program</b> <ul style="list-style-type: none"> <li>Generation-only Hourly Export Rate Rider Program that includes CAISO Day Ahead price and Generation Capacity Price Adder</li> </ul>
<b>2025</b>	<b>Large IOUs and CCAs to submit applications for opt-in dynamic hourly rates in response to CEC LMS</b>
<b>2027</b>	<b>CEC Load Management Standards require that large IOUs and CCA offer dynamic hourly rates or programs for all customer classes</b>

# Demand Flex Rate Applications

- **PG&E – Testimony in PG&E’s GRC Phase 2 Application (A.24-09-014)**
  - Supplemental Testimony to be filed in June
- **SCE – Consolidated RTP Application (A.24-03-019)**
  - Large C&I (Large Power Dynamic Rate)
  - All other customers (Standard Dynamic Rate)
- **SDG&E – A.26-02-001**

# VGI Forum - Dynamic Rates

Reuben Behlihomji

SCE - Pricing Design and Research

# Pathways to Dynamic Rates

- **CEC Load Management Standards**

- Docket: 23-LMS-01 for Load Management Standards Implementation [California Energy Commission : Docket Log](#)
- Ensuring LMS compliance with seamless customer access to dynamic rates, including VGI customers.
- Compliance maintains program integrity while supporting customer growth in dynamic rates as a complement to other VGI and demand response initiatives

- **Phase 2 of SCE's 2025 GRC (A.24-03-019)**

- SCE filed a motion to adopt the VGRP settlement in its 2025 GRC Phase 2, pending CPUC approval – [A Proposed Decision received on March 20<sup>th</sup> denies the Settlement Agreement](#)
- The VGRP Settlement presents an export compensation structure that enables EV integration as a distributed energy resource.
- The flexible structure allows VGRP to serve both residential and non-residential customers, offering tailored rate options including Time-of-Use (TOU) and dynamic pricing structures.

# Pathways to Dynamic Rates

- **SCE's Dynamic Rate Applications**

- A.24-06-014 Large Power Dynamic Pricing Rate
- A.24-12-008 Standard Marginal Cost-Based Dynamic Pricing Rates
- The proceeding is active and both Applications were consolidated under A.24-06-014. SCE's proposal includes an export compensation structure for VGI customers.
- Our focus is customer outcomes: clear rate designs, manageable bill impacts, and tools that enable equitable and accessible rate options that work in concert with other demand flexibility programs.

- **Demand Flexibility Rulemaking(s)**

- We continue our focus on implementation insights from existing pilots, including SCE's Flexible Pricing Rate Pilot ([SCE Flexible Pricing Rate Pilot](#)). VGI customers can participate on the Pilot
- The CPUC's DFOIR-Track B Decision (D.25-08-049) guides the regulatory framework for dynamic rates, defining their design, and consistency with CEC requirements.
- The CPUC's Demand Response Rulemaking (R.25-09-004) will address systems and processes needed to implement dynamic rates.

# Principles that guide our Pathway approach

- Dynamic rates are technology agnostic, and will actively complement programs that enable a broader suite of customer participation in the State's energy transition.
- Rates act as a bridge between policy outcomes and operational practicalities by providing customers with a meaningful pathway to make investments in technology and modify customer behavior such that system costs are optimized in the long run.
- **The Value Stack:**
  - Crawl-Walk-Run
  - Dynamic Rates will likely target VGI dispatch to the highest-value grid needs as embedded in the dynamic prices even if at the system level for an initial roll-out (e.g. coincidence and non-coincidence load optimization, ramping support, soak up excess renewable supply, optimize for distribution grid constraints).
  - If VGI also participates in demand response or other markets/programs, define rules for value stacking and attribution so the same kW is not paid for twice.

# Principles that guide our Pathway approach

- **Simplicity:** Dynamic rates should be machine-readable and stable in structure so aggregators/vehicles can reliably respond without requiring daily customer decisions.
- **Day-Ahead hourly visibility:** Aligns time scaled to ensure billing intervals and pricing intervals are aligned with the propensity of expected response.
- **Pay as you go:** Load shifts in response to more refined dynamic rates (as opposed to block TOU rates) will accrue shared benefits to customers and the grid, which in turn should reduce rate payer risks in the long run.
- **Technology Considerations:** Dynamic rates need robust technology, systems, and processes to ensure rate accessibility can provide meaningful customer participation. Additionally transparent yet secure communication and data exchange are imperative for adoption at scale.
- **Equity:** Consider on-ramps for low-income and disadvantaged communities, managed outreach, technology access, learn from the potential distributional impacts if dynamic rates evolve with locational granularity.
- **A persistence for learning:** A pathway for iterative and positively reinforcing loops are paramount for success as the Commission seeks broader adoption of dynamic rates.

# VGI Forum: Hourly Flex Pricing Pilots

3/25/2026

Oriana Tiell [oriana.tiell@pge.com](mailto:oriana.tiell@pge.com)

VGI Pilots and Analysis



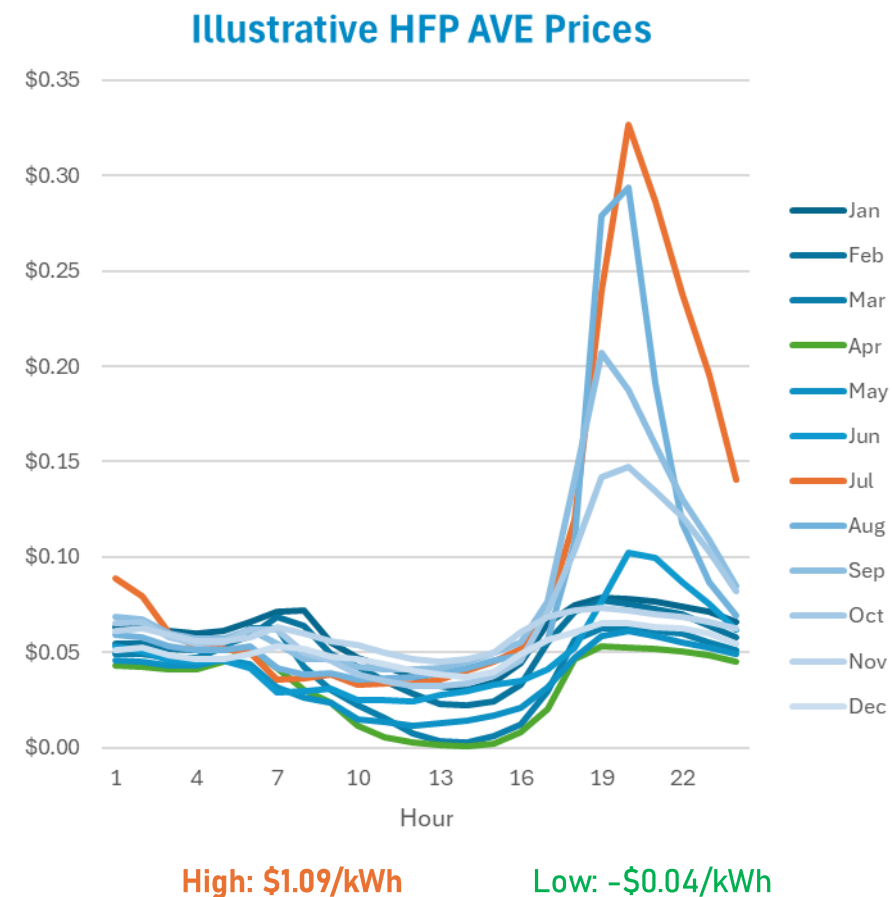
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# Hourly Flex Pricing At Glance

Hourly Flex Pricing (HFP) pilot rates vary every hour every day.

- Risk-free opt-in HFP pilot rates launched in Q4 2024
- Hourly prices are available day ahead, including 7-day forecast, accessible via third-party API
- Hourly prices are the same or lower than comparable rate plans for most of the year
- HFP participants:
  - Continue to receive and pay their PG&E energy statements
  - Receive monthly HFP performance report generated through the third-party shadow billing platform
  - After 12 months, customers who perform better on HFP will receive a credit on their PG&E energy statement
- Measurement and Evaluation (M&E) timeline:
  - Mid-term report Aug 2026
  - Final report Mar 2028



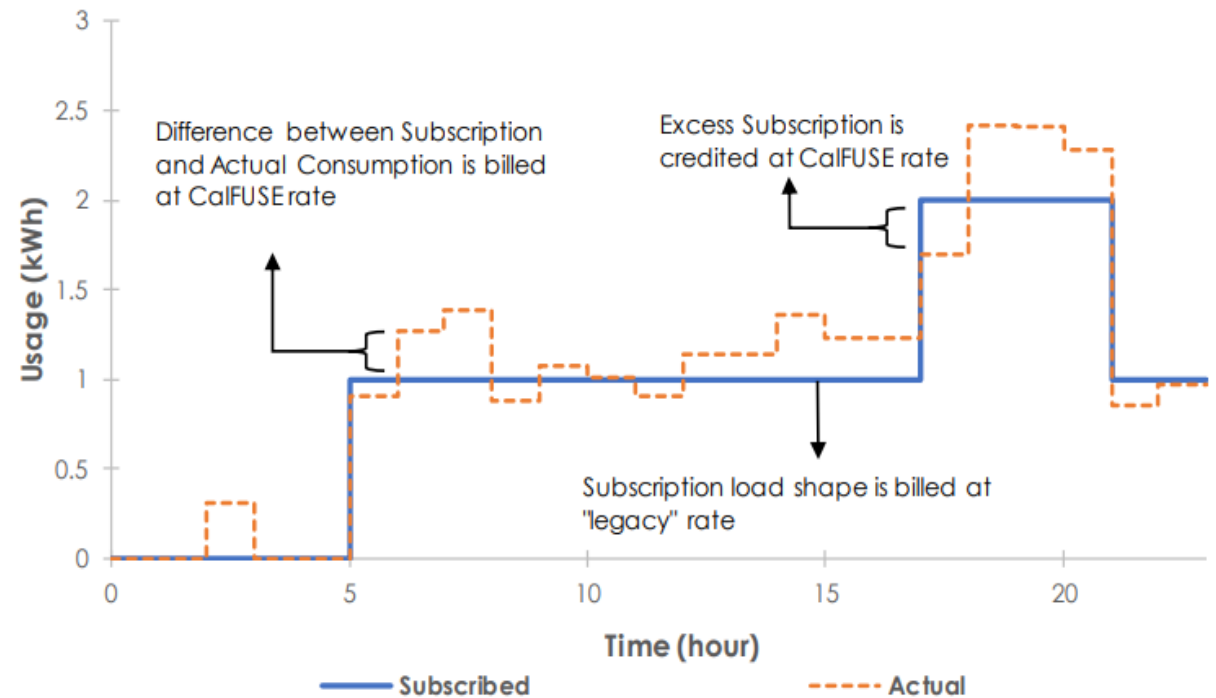
Learn more at <http://pge.com/hfprates>



# HFP Rate Design

HFP Rate design consists of marginal cost components for generation and distribution, along with a subscription element.






- **HFP Generation** component consists of day-ahead Marginal Energy Cost (MEC) and Marginal Generation Capacity Cost (MGCC).
- **HFP Distribution** component consists of Marginal Distribution Costs (MDC) and prices vary based on load at the circuit.
- **HFP Subscription** is based on the customer's average daily usage in the same month year prior, separated by weekday/weekend, and scaled to match actual monthly usage.
- HFP is symmetrical (i.e., same cost for imports and exports).





# HFP Pilot Rates by Customer Segment

While HFP pilot rates have attracted strong interest across customer classes, enrollment outcomes indicate that HFP presents distinct challenge for residential V2X customers.

Customers	Electric Vehicle Customers (via VGI Pilots)	Agricultural Customers	Residential & Commercial Customers
Target Use Cases	 V2G RES Chargers V2G COM EV Chargers V1G (BEV) Charging Sites	 Water Pumps/Sanitation, Electric Tractors 	 Smart EV charging (V1G), BTM Batteries, heat pumps, COM HVAC management 
Timeline	Oct 2024 – TBD	Nov 2024 – Dec 2027	Nov 2024 – Dec 2027
Customer Incentives	Up to \$3.3k for Interconnection Application for bidirectional EV customers	\$160/kW towards automation technology for customer	
Participating CCA and ASP Incentives	CCA: \$20/kW of enrolled load annually	CCA: \$20/kW of enrolled load annually	CCA: \$20/kW of enrolled load annually ASP: \$42/kW for managed load annually
Enrollment***	V2G RES: 0 sites/ 0 customers V2G COM: 2 sites/2 customers / 2 MW V1G: 158 sites / 2 customers/ 154 MW	1,323 sites 102 MW	RES: 359 sites / 3.6 MW (90% EV) COM: 469 sites/ 57.2 MW

\*Community Choice Aggregator (CCA)

\*\*Automated Service Provider (ASP)

\*\*\*Source: PG&E's internal reporting tools effective 3/23/2026

# Session #6 : VGI Use Cases – Part 2: Programs/Pilots

**NICK FIORE, SDG&E**

CLEAN TRANSPORTATION INNOVATION MANAGER

**PETER CHEN, CEC**

SUPERVISOR, ENERGY RESEARCH & DEVELOPMENT DIVISION

**RUDI HALBRIGHT, PG&E**

PRODUCT MANAGER, EXPERT

**RANDY ROBINSON JR., SCE**

SR. PROJECT MANAGER, DEMAND RESPONSE SYSTEMS AND PILOTS

# The IOU's VGI Activities

Administered by other party  
Sunsetting Within 1 year

Available Now or Within 1 year  
No Longer Available

## PG&E


## SCE

## SDG&E



**Rates**

EV TOU Rates		
Hourly Flex Pricing	Expanded Dynamic Rate Pilot	Dynamic Export Comp Rate Pilot



**Managed Charging (V1G)**

REDWDS			
EV Charge Manager (EPIC)	Flexibility Improvement Distributed Energy Resource (SIDER)	Orchestrated Charging and Advanced Resiliency for Distribution (ORCHARD)	CCA Managed Charging Pilot (EPIC)
evPulse	ChargeSmart: Residential EV Deferred Distribution Upgrade Project	BTM Optimization of Load Technology Study (BOLTs)	



**V2X**

V2X Pilots (Comm, Res, Microgrid)	ChargeSmart: Residential EV Deferred Distribution Upgrade Project	Bidirectional Energy CEC Grant	Toyota V2X Pilot
AC V2G VPP (EPIC)	VGRP (PD denied Settlement Agreement)		V2X CRC Resilience Pilot (EPIC)
Emergency Load Reduction Program (ELRP)			
REDWDS			



**Other**

Flex Connect Pilot	Flexible Service Connection Pilot	Community Outreach & Education
Advisory Services (TEAS)		
Customer Insights Research		



# **2026 VGI Forum**

## **Panel 3: VGI Use Cases – Programs/Pilots**

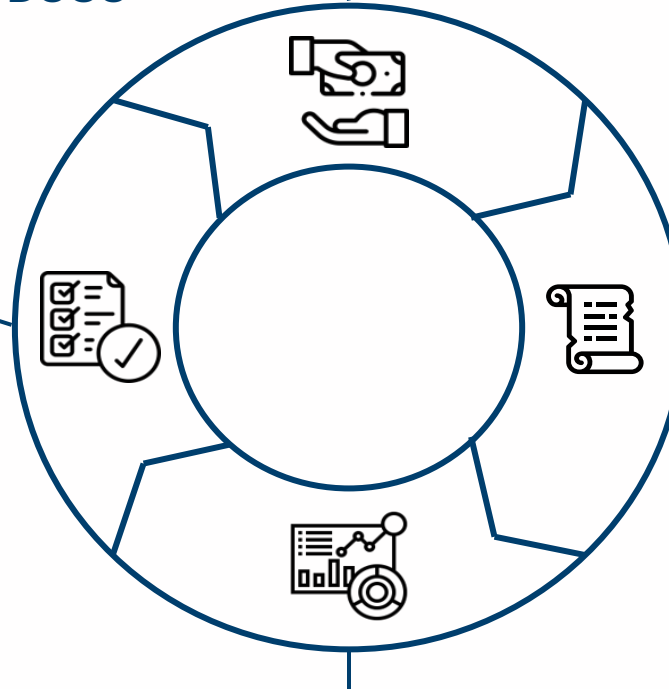
*Peter Chen, Supervisor  
Transportation Unit, Energy Research and Development Division*



# CEC actions are supporting VGI

## Funding Programs

- REDWDS
- EPIC
- DSGS



## Regulatory Authority

- SB 59 Bidi-Capable Vehicles
- SB 49 Flexible Demand Appliance Standards
- Load Management Standards

## Modeling and Analysis

- AB 2127 Assessment
- IEPR Forecast
- Demand Flex Potential Modeling
- [Bidirectional Charging White Paper](#)

## Technology Standardization

- Interoperability and Conformance Testing (Charge Yard)
- V2G Equipment List



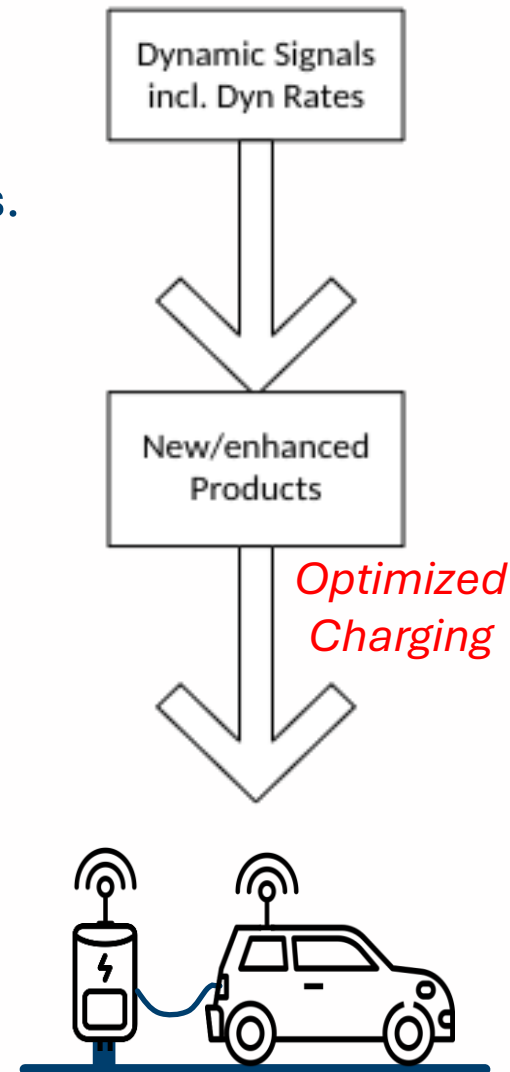
# REDWDS

## Responsive, Easy Charging Products with Dynamic Signals

**Purpose:** deploy vehicle-grid integration (VGI) at scale, leveraging dynamic signals

- Deploys smart and bidirectional chargers for light-, medium-, and heavy-duty EVs.
- Dynamic rates save drivers money, improve grid reliability, and reduce emissions.

	Phase I	Phase II (if fully funded)
Number of Projects	10	9
L2 chargers	272	14,000
Small DC chargers (<50kW)	400	19,000
Fast DC chargers	133	1,200
SW & telematics deployments	27k	401k
Est. Total load capacity (MW)	261.7	3,621
Est. Total load shift capacity (MWh)	80.2	1,038



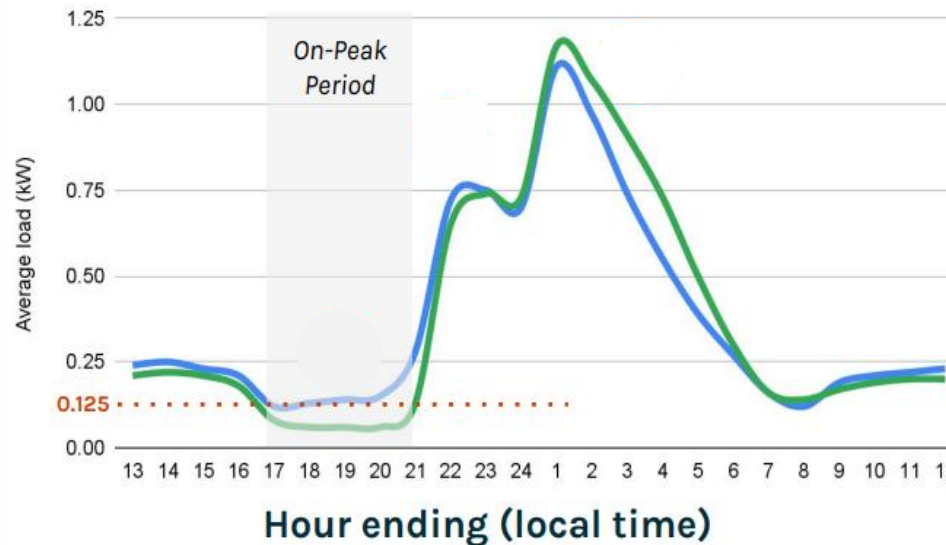


# REDWDS

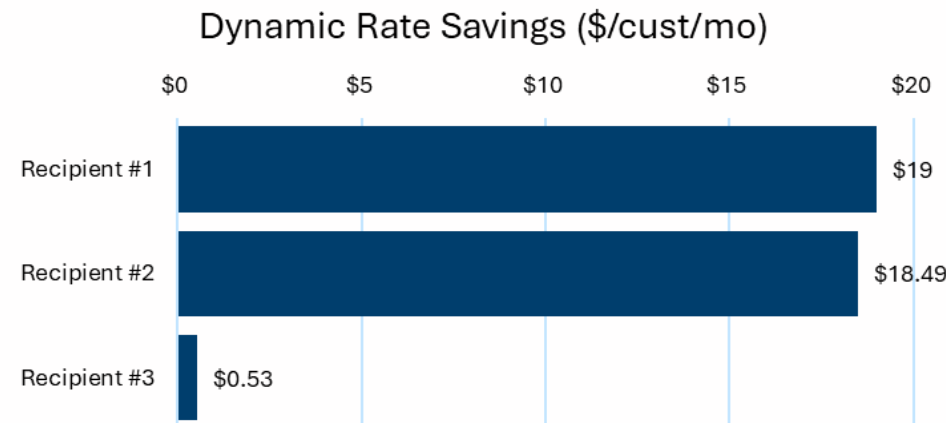
## Preliminary data

- Over 20,000 residential customers enrolled
- Scaled managed charging supports the grid by moving charging out of the system peak
- Dynamic rates allow managed charging customers achieve range of savings compared to TOU rates\*

Pre-enrollment (blue) and program (green) charging profiles



Dynamic rate savings in a typical month





# REDWDS

## Things to work on

**Dynamic rate access:** availability and dual participation rules are problematic

- *High proportion of failure to enroll*

**Submetering:** no viable path for residential; one recipient could only participate by becoming their own Meter Data Management Agent

- *It has been 4 years since the EV submetering decision*

**Interoperability:** for residential managed charging, some recipients prefer using proprietary APIs instead of OCPP to control chargers

- *REDWDS requires CSMS and charger OCA certification*

**Interconnection:** lack of clear processes confuse stakeholders attempting to deploy bidirectional chargers

- *1st PTO for a REDWDS recipient was issued this month*



# CEC EPIC Projects

Supporting research and demonstrations to advance VGI

## Project

## Innovation

## Progress / Barriers to Address

**WeaveGrid:**  
EPC-24-023

Demonstrate orchestrated managed charging that balances EV load across groups of customers to reduce peak load on feeders.

- **Managed Charging Performance:** Collecting data from ~1,800 enrolled EVs in Charge Smart pilot; load balancing consistently reduces timer peaks compared to TOU counterfactual.
- **VGI Valuation:** Will test response to grid aware signal; model least cost distribution upgrades needed across representative feeders; enroll 20 bidirectional charging customers.

**San Diego Community Power:**  
EPC-25-017

Study exploring the value of managed charging for balancing bulk system and distribution system needs.

- **VGI Valuation:** Will analyze how managed charging, including optimization of secondary peaks, may help load serving entities meet new slice of day resource adequacy requirements.
- **Program Coordination:** Will provide insight into how managed charging can be optimized in situations where CCAs provide customers with unbundled service.

**Rivian:**  
EPC-25-012

Develop a low-cost, interoperable AC bidirectional charger and islanding device to enable residential V2X.

- **Interoperability:** Will develop an open standards-based system that works with non-Rivian AC bidirectional capable EVs.
- **Customer Participation & Value:** Will conduct voice of the customer research to investigate interest in residential V2X use cases and inform product and program design.



# What to expect next from CEC

## Near-term actions

- Additional REDWDS deployments and data
- Additional EPIC project learnings
- Capital Charge Yard launch
- V2G Equipment List update for V2G AC
- Third AB2127 report publication
- EPIC 5 Investment Plan

# VGI Forum: VGI Pilot Use Cases

3/25/2026

Rudi Halbright [rudi.halbright@pge.com](mailto:rudi.halbright@pge.com)

VGI Pilots and Analysis



Together, Building  
a Better California



# Overview of V2X Pilots

PG&E's VGI pilots will help test V2X solutions and determine cost-effective pathways to scale deployment.



## Pilot 1: V2X - Residential

- 1,000 residential customers
- \$7.5M
- split-phase bidirectional EVSEs

Residential

### Timeline

- Phase I: In progress, launched April 2023
- Phase II: In progress, launched September 2024
- Phase III (Evaluation): estimated start Q1 2028

## Pilot 2: V2X - Commercial

- 200 commercial chargers/vehicles
- \$2.7M
- bidirectional EVSEs

Commercial

### Timeline

- Phase I: In progress, launched April 2023
- Phase II: In progress, launched September 30, 2024
- Phase III (Evaluation): estimated start Q1 2028

## Pilot 3: V2X - Microgrid

- 200 EVs (residential or commercial) in select microgrids
- \$1.5M

Microgrid

### Timeline

- Demonstration of Phase I: started Q1 2025
- Phase II: In progress, launched September 30, 2024
- Phase III (Evaluation): estimated start 2028



## V2X Pilot Objectives:



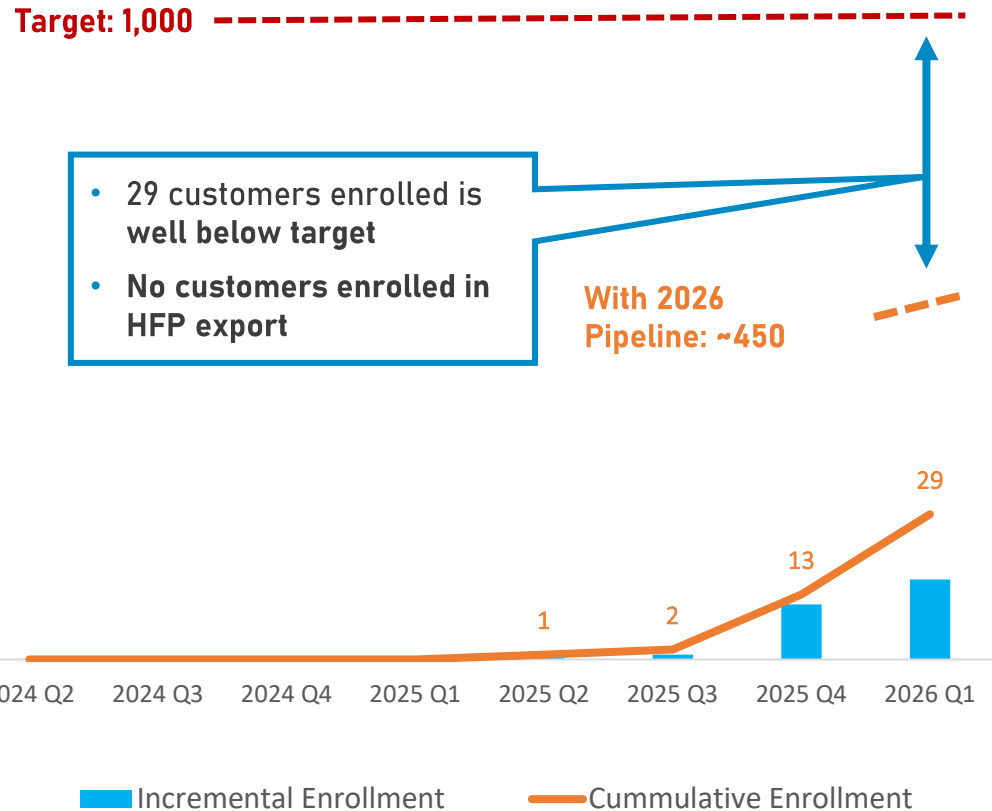
1. Demonstrate the value of V2X/bidirectional EVs for customers and the electricity grid.
2. Reduce the total cost of EV ownership by understanding potential revenue streams for the services provided and identify potential barriers that inhibit access to these revenue streams.
3. Implement a VGI Dynamic Rate to compensate participants based on the actual value of energy exports
4. Prove out the following value streams in Residential and Commercial Pilots:
  - backup power
  - customer bill management
  - system real-time energy
  - system renewable integration (Residential)
  - grid upgrade deferral (Commercial)
5. Use the Microgrid Pilot to demonstrate:
  - customer adoption of V2G technology for community resiliency
  - value to the microgrid (GHG reduction, resiliency)
  - operational integration of EVs to charge/discharge in a microgrid environment



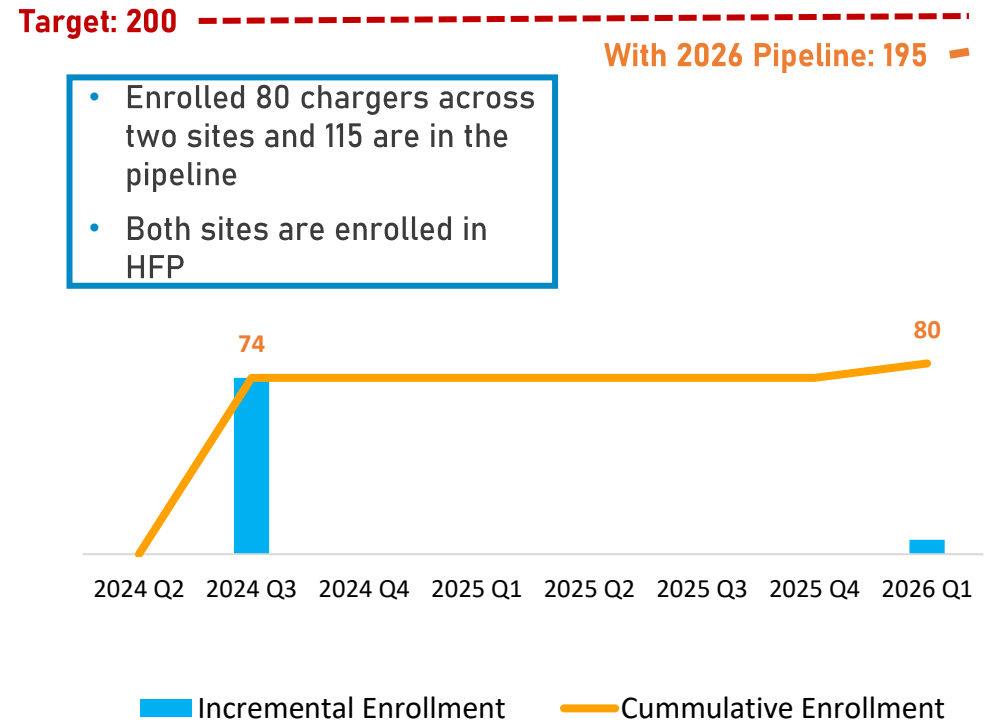
# V2X Pilots Enrollment Update

Since the April 2024 launch, residential V2X enrollment has lagged, recent improvements are promising but insufficient to meet pilot target. Commercial enrollment is closer to the target.

## Residential V2X Pilot Adoption



## Commercial V2X Pilot Adoption



# Barriers to Participation

- EV OEMs are cutting models from US Market that would support V2X
  - Honda dropped 0 Series EVs and Acura RSX
  - Ford dropped F-150 Lightning EV
  - Hyundai dropping Ioniq 6, Kia models are in question
- Incremental cost of V2X capable chargers over V1G chargers is significantly more than pilot incentives cover
- HFP as the Pilot Compensation Mechanisms is unproven and not guaranteed to successfully incentivize desired behavior; it is difficult for customers to predict what, if any, savings opportunity is available; optimizing HFP is more complex than anticipated and few are prepared to do so
- ELRP provides clear compensation for exports, but the opportunity is muddled by the impact of participation in V2X Pilot exports on ELRP Baseline



# Pilot Design Challenges

- HFP is complicated and opportunities it offers uncertain
  - The potential to use V2G to shift energy peak production to times of peak demand is compelling, but may not be rewarded in cases where customers are commercial/industrial without local renewable generation and w/o corresponding evening demand
  - HFP is itself in pilot stage and computation methods have been modified/refined over the course of the pilot, this limits the ability to show accurate trends in pricing data and to draw conclusions about participation over time
- Learnings about HFP w/export depend on customer's willingness and ability to optimize for HFP
- Nascency of bidirectional technology presents significant challenges and barriers; combining those challenges with HFP confounds results; it is difficult and, in some cases, impossible to determine to what degree lack of participation is due to difficulties in attaining required hardware, and to what degree it's due to uncertainties or limitation in what is available through HFP

# Thank you!



Rudi Halbright  
Expert Product Manager, PG&E  
[rudi.halbright@pge.com](mailto:rudi.halbright@pge.com)

For more information about PG&E's V2X Pilots: [www.pge.com/vgi](http://www.pge.com/vgi)

## VGI Lessons Learned

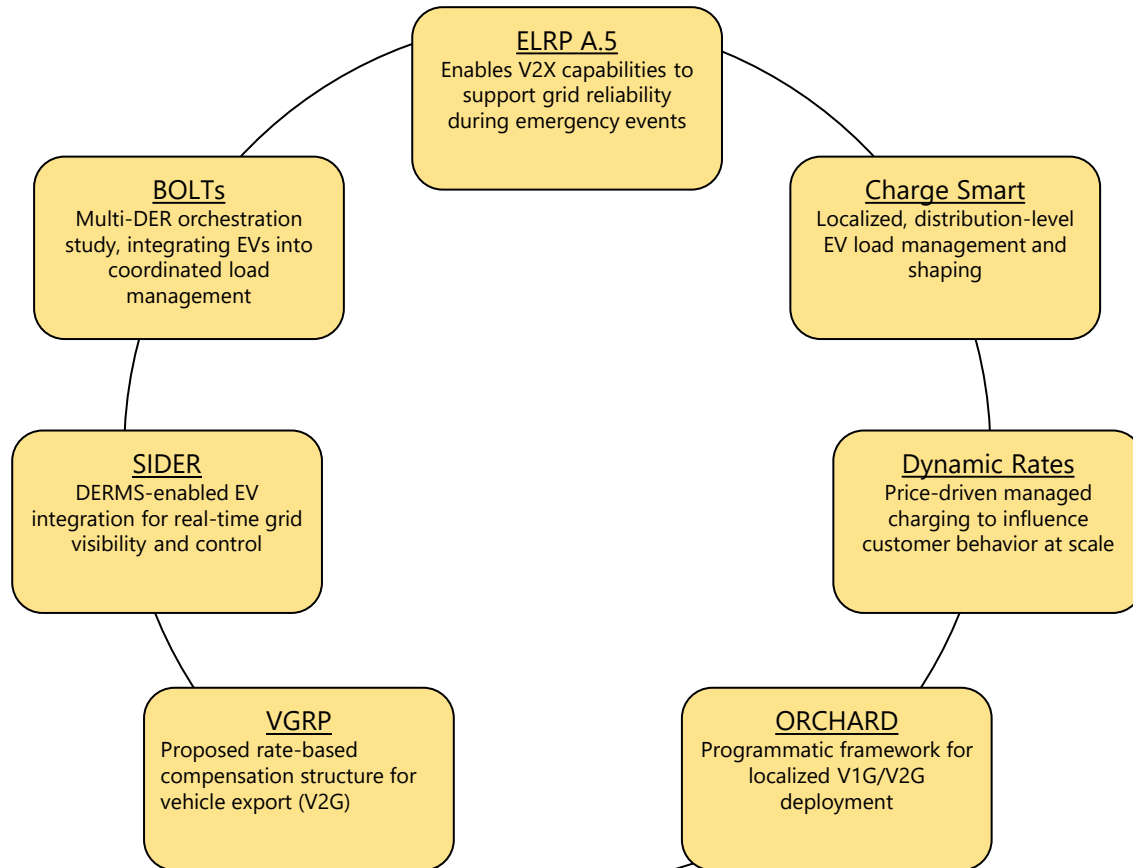


Energy for What's Ahead



# SCE's VGI Portfolio is Aligned to a Clear Set of Strategic Outcomes

## EFFORTS / PROJECTS



## Core Objectives

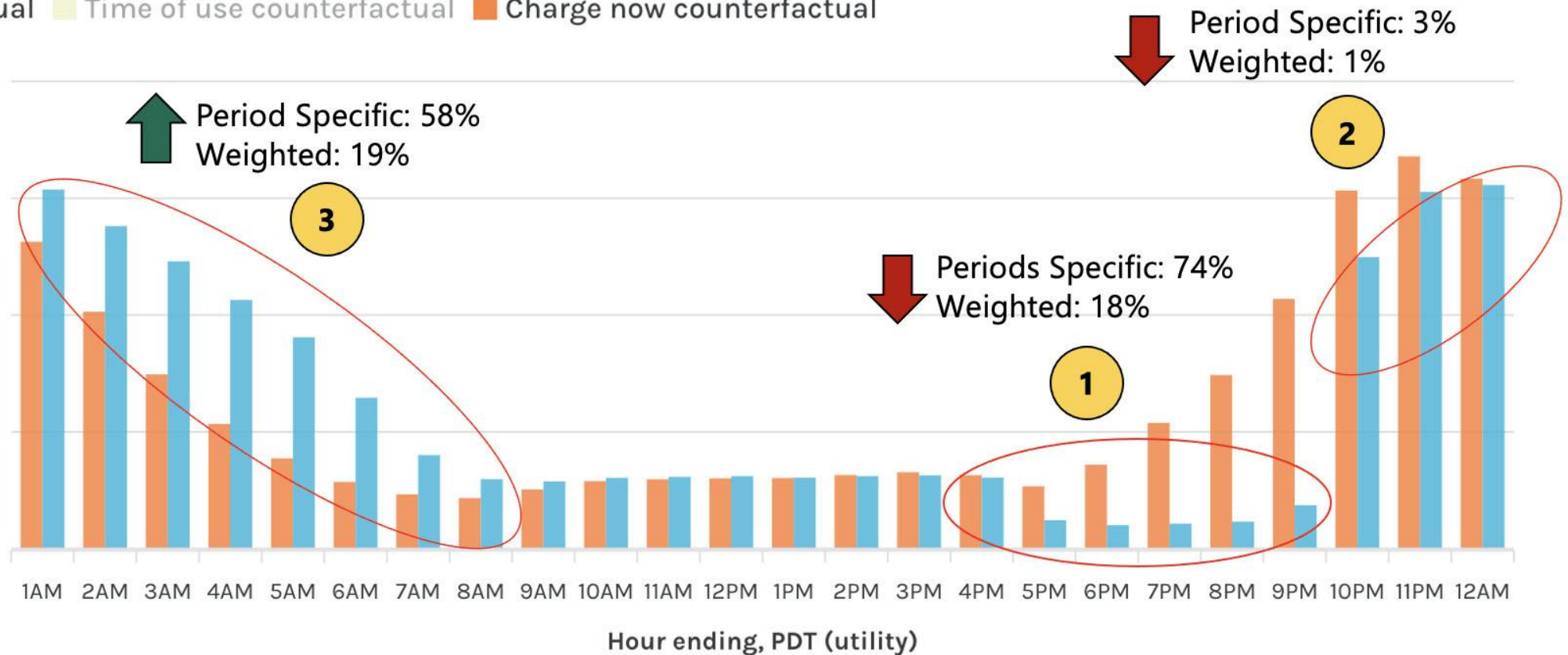
- 1 Optimize Grid Investments**  
Defer near-term infrastructure upgrades while minimizing long-term capital needs through flexible load orchestration
- 2 Deliver Customer Value**  
Enable tangible customer savings and unlock new revenue streams through participation in grid services
- 3 Scale Demand Flexibility**  
Establish repeatable, technology-enabled program models that support scalable deployment across devices, vendors, and geographies

# ChargeSmart SoCal, AKA Revddup, Helps to Mitigate Post TOU Peaks Through Managed EV Charging

#	Topic	Description
1	<b>Background</b>	Charge Smart – SoCal is a managed EV charging demonstration led by SCE and WeaveGrid, funded in part by the California Energy Commission. The project focuses on residential EV drivers in Southeast Los Angeles County (Gateway Cities) and aims to show how targeted managed charging can defer costly grid upgrades while meeting customer charging needs.
2	<b>Why Charge Smart - SoCal</b>	Rapid EV adoption has the potential to stress local distribution infrastructure not originally built for widespread EV charging. Traditional solutions (transformer/circuit upgrades) are expensive and slow to implement. Managed charging provides a cost-effective, scalable solution to align EV load with grid capacity while protecting customer choice.
3	<b>Value Proposition</b>	Customers: Incentives (\$50 sign-up + \$50 annually up to 3 years), charging cost savings (up to \$600 over time), flexible participation (override anytime). SCE & Grid: Avoided or deferred distribution upgrades, improved load management, and enhanced reliability in LIC/DAC communities. Others (Regulators / Policy): Demonstrates scalable, equitable decarbonization strategy supporting California’s clean energy goals.
4	<b>How Charge Smart Works</b>	Customers enroll through an easy-to-use app and connect their EV. Customers set preferences (departure time, minimum charge). Charging is automatically shifted to off-peak hours. Charging spread across shoulder hours to prevent secondary peaking. Customers retain control through opt-out (“Charge Now” option). SCE collects data on grid impacts, customer experience, and cost savings.
5	<b>Program Specifics</b>	Launch: Initiated in 2024 as part of the REVDDUP demonstration with WeaveGrid. Focus Area: Gateway Cities region (Compton, Long Beach, La Mirada, Whittier), with emphasis on LIC/DAC participation. Scale: Targeting 3,000 enrollments (1,000 currently enrolled). Technology: EV-only managed charging). Timeline: 2025 - 2028

# ChargeSmart is Delivering as Designed: Consistent Load Shift from On-Peak to Off-Peak

■ Actual 
 ■ Time of use counterfactual 
 ■ Charge now counterfactual



# Lessons Learned - VGI Is Maximized With Low Friction, Trusted Channels and Grid-Aligned Designs

<b>Use Cases</b>	<ul style="list-style-type: none"><li>• Residential EVs are proving to be a highly effective resource for mitigating secondary peaks, particularly in post-TOU periods where unmanaged load rebound occurs.</li></ul>
<b>Customer Experience</b>	<ul style="list-style-type: none"><li>• Customers are strongly motivated by clear, upfront value; however, sustained engagement requires consistent reinforcement of ongoing benefits, which are less intuitive and harder for customers to recognize.</li></ul>
<b>Marketing, Education &amp; Outreach</b>	<ul style="list-style-type: none"><li>• Programs led and endorsed by utilities and OEMs drive the highest participation, reflecting the importance of trusted channels in customer decision-making.</li></ul>
<b>Vendor Management &amp; Ecosystem Readiness</b>	<ul style="list-style-type: none"><li>• Vendor capabilities remain inconsistent in practice, highlighting the need for stronger validation, standardization, and performance accountability across the ecosystem.</li></ul>
<b>Incentive Design &amp; Customer Value</b>	<ul style="list-style-type: none"><li>• Upfront incentives are the primary driver of enrollment, but long-term program success depends on clearly articulating and delivering sustained value beyond initial sign-up.</li></ul>

## Appendix Slides

# VGI Framework

## Vehicle Grid Integration (VGI)

- VGI refers to the seamless integration of electric vehicles (EVs) with the power grid, enabling bidirectional energy flow and optimizing the use of renewable energy sources.

### V1G

- V1G involves varying the time or rate at which an electric vehicle is charged.

### Smart Charging (V1G)

- Smart charging involves the use of advanced technologies and algorithms to intelligently manage the charging of electric vehicles, considering factors such as grid demand, electricity prices, and renewable energy availability to minimize costs and maximize efficiency.

## Vehicle-to-Everything (V2X)

- V2X is the overarching term for transferring the electricity stored in electric vehicle (EV) batteries to the grid, buildings, houses, and other energy-consuming destinations.

### Vehicle-to-Grid (V2G) Isolated

- V2G Isolated refers to the arrangement where an EV and customer site is operating in isolation to the grid.

### Vehicle-to-Grid (V2G) Parallel

- V2G Parallel refers to the arrangement where an EV and customer site is operating in parallel to the grid.

### V2H

- Vehicle-to-Home allows electric vehicles to serve as a backup power source for homes during outages or peak demand periods by utilizing their stored energy to power household appliances.

### V2B

- Vehicle-to-Building transfers power from parked EVs to the building's power management system during peak load times or power outages.

### V2G

- Vehicle-to-Grid technology enables bidirectional energy flow between electric vehicles and the grid, allowing EVs to not only draw power from the grid but also to discharge energy back into the grid when needed, providing grid services and supporting grid stability.

Vision

In-Operation

Pilots

V2L, V2V, V2F: Vehicle-to-Load (2L), Vehicle-to-Vehicle (V2V), Vehicle-to-Farm (V2F)

**Break — we will resume at 3:15 pm PT**

# VGI Policies to Address Barriers

**ZACH WOOGEN, VEHICLE-GRID-INTEGRATION COUNCIL**  
EXECUTIVE DIRECTOR



# Summary of CPUC-Related Policy Challenges

March 25, 2026

# VGIC MEMBERS / 2026

## LEADERSHIP CIRCLE



## GENERAL MEMBERS



## ASSOCIATE MEMBERS



# Why VGI Now?



Accelerate Transportation Electrification



Increase Affordability of Electricity



Support the Evolving Power Sector



Improve Community Resilience



Foster Economic Activity



# Senate Bill 676 (Bradford, 2019) Envisioned **VGI at Center Stage**

- Public Utilities Code Section 740.16:

“It is, therefore, the policy of the state and the intent of the Legislature to **maximize net ratepayer and grid benefits** from transportation electrification and **reduce costs or mitigate cost increases for all ratepayers** due to increased usage of electric vehicles **by accelerating electric vehicle grid integration** and by ensuring that any investments in transportation electrification do not foreclose the electric vehicle grid integration potential of these investments”

- “... the commission shall establish strategies and quantifiable metrics to **maximize the use of feasible and cost-effective electric vehicle grid integration** by January 1, 2030”
- “...the commission shall reference the electric vehicle grid integration strategies established pursuant to subdivision (c) in relevant ongoing and subsequent proceedings that address issues of transportation electrification in any part and **shall identify how programs and investments that the commission may approve will advance the achievement of the strategies**
- “...the commission **shall consider how, or if, electric vehicle integration can mitigate any generation, transmission, or distribution costs, or increase the economic, social, or environmental benefits** associated with transportation electrification, and **shall not foreclose future utilization of electric vehicle grid integration strategies**

# What is Vehicle-Grid Integration (VGI)?

VGI encompasses the suite of ways EVs can provide services to the grid and increase the value proposition of EVs:

## Managed Charging

- Passive or active load shift

## Grid-Isolated Bidirectional Charging

- Islanded configuration to power a home, building, or microgrid

## Grid-Parallel Bidirectional Charging

- Utility-interconnected to minimize customer bills and/or provide grid services

## Flexible Service Connection

- Minimizing time and costs for infrastructure deployment using load management solutions and/or distributed energy resources (DER)

## DER-Paired Charging

- Co-located or integrated with customer generators and/or stationary energy storage

# Policy Challenges – Managed Charging

## Program and rate uncertainty:

	PG&E	SCE	SDG&E
ELRP	Authorized through 2027		
Distribution System Optimization	Proposed (LCFS-Funded)	Approved (LCFS-Funded)	-
Pilot Dynamic Rate	Authorized through 2027	Authorized through 2027	-
Post-Pilot Dynamic Rate	Proposed		

*\*Does not include IOUs' EPIC-funded R&D activities*

### Planning:

- Inputs and assumptions for VGI in previous and current IRP cycles
  - Actual modeling results (e.g., high, medium, or low VGI enrollment) were not shared

### Submetering:

- Submetering protocol limited to EVSE-based metering
- Limited compelling EV-specific rates (impacts the usefulness of both EVSE- and EV-based submetering)

# Policy Challenges – Grid-Isolated Bidirectional Charging

**Today’s approval framework may not scale:**

- Systems operating in bidirectional charging mode *only* when isolated from the grid do not need to move through Rule 21
  - Utilities appear to be conducting lab and/or witness testing for systems before confirming this treatment

**Upfront cost support:**

	PG&E	SCE	SDG&E
Upfront Incentives / Equipment Rebates	<p><b>Residential:</b> Ford and GM Systems Only (V2X Pilots)</p> <p><b>Non-Residential:</b> RIDE, Micro Bird, Blue Bird, Nissan (V2X Pilots)</p>	Rejected (LCFS-Funded)	Proposal Withdrawn (LCFS-Funded)

*\*Does not include IOUs’ EPIC-funded R&D activities*

# Policy Challenges – Grid-Parallel Bidirectional Charging

## Interconnection costs:

- \$800 interconnection application fee presents a major barrier, especially for small residential customers
- Legacy NEM customers installing grid-parallel bidirectional charging systems must take service under NEM-Multiple Tariff (NEM-MT), triggering the installation of a costly Net Generation Output Meter (NGOM)

## Interconnection efficiency:

- Early sites, including those meeting the Rule 21-required UL 1741 SB standard and those using the *very same* inverters used in rooftop solar systems, have been impacted by interconnection delays

## Upfront cost support:

	PG&E	SCE	SDG&E
Upfront Cost Support	<b>Residential:</b> Ford and GM Systems Only (V2X Pilots) <b>Non-Residential:</b> RIDE, Micro Bird, Blue Bird, Nissan (V2X Pilots)	Rejected (LCFS-Funded)	-

*\*Does not include IOUs' EPIC-funded R&D activities*

## Planning:

- Inputs and assumptions for VGI in previous and current IRP cycles
  - Actual modeling results (e.g., high, medium, or low VGI enrollment) were not shared
- EIS Part 2: Only PG&E modeled grid-parallel bidirectional charging

**Compensation mechanism uncertainty:** (see next slide)

## Policy Challenges – Grid-Parallel Bidirectional Charging (continued)

- The following pathways have been explored:

	PG&E	SCE	SDG&E
Static Export Credit	-	Rejected (pending PD)	-
Pilot Dynamic Export Credit	Authorized through 2027 (no customers enrolled)	-	Authorized through 2026 (no customers enrolled)
CPUC Post-Pilot Dynamic Rate Guidance	Does not direct utilities to credit exports		
Utilities' Non-Pilot Dynamic Export Credit Applications	<ul style="list-style-type: none"> <li>Deferred (DAH RTP)</li> <li>Proposed (GRC II)</li> </ul>	-	-
ELRP	Authorized through 2027		
DSGS	Latest CEC proposal limits participation to resources and aggregators that participated 2025		
BTM RA Capacity Valuation	Rejected		
CAISO Modified PDR Model	Pending		

*\*Does not include IOUs' EPIC-funded R&D activities*

- Presently, the CPUC has issued no guidance regarding how bidirectional charging customers will be fairly (i.e., based *only* on marginal costs) credited for supporting the grid through net exports**

# Policy Challenges – Flexible Service Connection

## **No incentive to scale *elective*, non-bridging flexible service connection:**

- Customers should be able to *choose* a flexible service connection program/tariff as a non-bridging strategy
- Customers should be offered an upfront incentive to offset the hardware and/or software costs incurred to implement FSC as a non-bridging strategy (e.g., NY LMTIP)

## **Limited usefulness of Integration Capacity Analysis maps**

- Most of the framework to enable non-bridging flexible service connection is in place (e.g., standard flex connect offering, internal utility teams and capabilities)
- However, the ICA maps remain of limited usefulness, needing improvements to data quality/accuracy and update frequency

# Thank you!

Vehicle Grid Integration Council (VGIC) is a national 501(c)(6) membership-based trade association committed to advancing the role of electric vehicles and vehicle-grid integration through policy development, education, outreach, and research.



**VGIC** VEHICLE  
GRID  
INTEGRATION  
COUNCIL

[vgicouncil.org](http://vgicouncil.org)

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# Open Q&A

# Closing Remarks

# VGI Data Reporting

## Regulatory Background

D. 25-12-005 consolidated various IOU, TE-related reporting into a consolidated Annual TE Programs and Initiatives Compliance Report ("TE Report"), including the Annual and Semi-Annual VGI Strategies report.

Energy Division and IOUs directed to finalize TE Report data template by May 30<sup>th</sup>, 2026 with first TE Report due September 30, 2026. D. 25-12-005 directs IOUs & ED to utilize the VGI Forum to work with stakeholders to determine which VGI reporting questions remain relevant.

## Objective

- Solicit Stakeholder feedback on what VGI reporting provides most value to track progress.
  - What is our desired end-state for VGI and what data tells us whether we are on or off-track?
- Solicit Stakeholder feedback on proposed Narrative Reporting Questions

# Categories of VGI Reporting

Program Participation

Grid Impact/Performance

Program Financial

Technology & Use Case

# Program Participation

*Purpose: Visibility into current VGI offerings and assessing customer participation progress, trends and challenges.*

## Key Question

- What VGI pilot/programs, rates or incentive programs were active during the reporting year?
- What customer segments are served under each VGI offering? (e.g., residential, commercial, fleet)?
- What was the overall level of participation and how did participation change relative to the prior reporting period?
- To what extent did participation align with program design expectations or forecasts, and what factors most influenced outcomes?
- What participation barriers materially constrained enrollment or retention during the reporting year?

## Example Data Elements

*(not intended to be comprehensive)*

- # Applications Submitted
- # EVs Participating/Enrolled
- Amount of energy (MWh) and/or capacity (MW) expected
- DAC / Underserved Community Status percentage
- Event/Session opt-outs

# Grid Impact/Performance

*Purpose: Assessing effectiveness & reliability of VGI offerings in load management and ensure VGI creates affordability benefits.*

## Key Questions

- What are the load profiles of participants?
- Is the load (curtailment or export) showing up at the right times?
- Are VGI offerings delivering the actual quantity of load shift that is expected?
- What is the quantity of load being exported?

## Example Data Elements

(not intended to be comprehensive)

- Aggregate Load Data Delivered (MWh, MW)
- Participant Compliance Rate
  - % of charging that occurs during scheduled times
- Expected Load Shift vs Actual Load Shift
- Time Periods VGI Occurs (e.g. peak, off-peak)

# Program Financial

*Purpose: Assessing financial stewardship of funding. Inclusive of customer participation/performance incentives.*

## Key Questions

- How much are we spending across the portfolio of VGI offerings?
- When are ratepayer funds being used versus non-ratepayer funds?
- What are customer incentive levels?

## Example Data Elements

(not intended to be comprehensive)

- Program Administrative Cost
  - Third-party Vendor Costs
  - Measurement and Evaluation
  - Marketing, Outreach and Education
- Authorized Budget vs Actual Spend
- Funding Sources: EPIC, LCFS, Balancing Acct
- Incentives Paid to Customer
  - DAC vs non-DAC allocation

# Technology & Use Case

*Purpose: Assessing maturity of VGI technologies and use cases. Understanding what barriers stakeholders should focus effort on.*

## Key Questions

- Which VGI use cases are showing the most traction? Which ones are lagging?
- What Interconnection reforms are complete, in progress and still needed for V2G?
- Are existing compensation mechanisms for export sufficient?
- How do the IOU's use ALM today and how will it evolve in the future?
- What's the state of availability for equipment necessary to implement VGI use cases?

## Example Data Elements

(not intended to be comprehensive)

- V1G, V2G, V2X, etc enrollments
- EV & EVSE Make/Model
- # IOU ALM sites
- # of bidirectional EVSE installed and interconnected (in-parallel / grid following)
- # of bidirectional EVSE installed and interconnected (isolated only - resiliency)