

**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA**

Order Instituting Rulemaking Regarding
Transportation Electrification Policy and
Infrastructure.

Rulemaking 23-12-008

**VEHICLE-GRID INTEGRATION FORUM WORKSHOP REPORT
FILED BY SOUTHERN CALIFORNIA EDISON COMPANY (U 338-E),
SAN DIEGO GAS & ELECTRIC COMPANY (U 902 E), AND
PACIFIC GAS AND ELECTRIC COMPANY (U 39 E)**

REBECCA MEIERS-DE PASTINO

Southern California Edison Company
2244 Walnut Grove Avenue
Rosemead, California 91770
Telephone: (626) 302-6016
E-mail: rebecca.meiers.depastino@sce.com

Attorney for
SOUTHERN CALIFORNIA EDISON
COMPANY

BENJAMIN C. ELLIS

Pacific Gas and Electric Company
300 Lakeside Drive, Suite 210
Oakland, California 94612
Telephone: (415) 819-6810
Facsimile: (415) 973-5520
E-Mail: ben.ellis@pge.com

Attorney for
PACIFIC GAS AND ELECTRIC
COMPANY

WALTER C. WAIDELICH

San Diego Gas & Electric Company
8330 Century Park Court, CP32D
San Diego, California 92123
Telephone: (858) 331-0806
Facsimile: (619) 699-5027
Email: wwaideli@sdge.com

Attorney for:
SAN DIEGO GAS & ELECTRIC
COMPANY

May 26, 2026

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Pursuant to Decision (D.) 22-11-040, Ordering Paragraph (OP) 11, issued November 21, 2022, and the *Email Ruling Delaying the Timing of the Vehicle-Grid Integration (VGI) Forums Ordered in D.22-11-040* (Ruling),¹ issued November 13, 2023, Southern California Edison Company (SCE), San Diego Gas & Electric Company (SDG&E), and Pacific Gas and Electric Company (PG&E) (collectively, the “Joint IOUs”)² hereby file the VGI Forum Workshop Report (Report), dated May 25, 2026.

D.22-11-040 and the Ruling require that the Joint IOUs shall file the Report and distribute the Report to the service lists for other relevant Commission proceedings.³ The Report is attached.

Respectfully submitted on behalf of the Joint IOUs,

/s/ Benjamin C. Ellis

Benjamin C. Ellis
Pacific Gas and Electric Company
300 Lakeside Drive
Oakland, California 94612
Telephone: (415) 819-6810
Facsimile: (415) 973-5520
E-Mail: ben.ellis@pge.com

Attorney for
PACIFIC GAS and ELECTRIC COMPANY

Dated: May 26, 2026

¹ See generally Rulemaking (R.) 18-12-006, *Email Ruling Delaying the Timing of the Vehicle-Grid Integration (VGI) Forums Ordered in D.22-11-040* (Ruling) (Nov. 13, 2023) (delayed the VGI Forum until Quarter 1, 2024).

² Pursuant to Commission Rule 1.8(d), counsel for PG&E confirms that SDG&E and SCE have authorized PG&E to file these comments on behalf of the Joint IOUs.

³ Decision (D.) 22-11-040, pp. 231-32 (Nov. 21, 2022); see also Ruling at p. 7.

VEHICLE GRID INTEGRATION FORUM REPORT

VEHICLE GRID INTEGRATION FORUM REPORT

Prepared in response to Decision (D.) 22-11-040 by San Diego Gas and Electric, Southern California Edison, and Pacific Gas and Electric Company

May 25, 2026

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Executive Summary

In November 2022, the Commission issued Decision (D.) 22-11-040, which ordered the large-Investor-Owned-Utilities (IOUs),¹ in conjunction with California Public Utilities Commission (CPUC) Energy Division staff, to host an annual vehicle-grid-integration (VGI) forum (VGI Forum) with the objective of convening stakeholders to engage in discussion around the established VGI strategic focus areas of 1) rates and demand flexibility programs; 2) technology enablement and 3) planning.² The IOUs hosted the third annual VGI Forum on March 25, 2026, from 9:30 a.m. to 4:30 p.m. at the California Public Utilities Commission in San Francisco, California.³ Attendees included the IOUs, CPUC Energy Division staff and other regulatory and industry stakeholders. The VGI Forum agenda comprised of six sessions:⁴

- Session 1 - VGI and Ratepayer Impacts
- Session 2 - V2G Industry Trends
- Session 3 - VGI Use Cases – Part 1: Dynamic Rates
- Session 4 - VGI Use Cases – Part 2: Programs/Pilots
- Session 5 - Policies to Address Barriers, Q&A, and Closing
- Session 6 - VGI Reporting (Optional)

Session 1 addressed whether VGI can provide meaningful ratepayer benefits, and the conditions required to achieve this outcome. Panelists emphasized that realizing such benefits requires coordination between bulk-system and distribution-system objectives. Unmanaged or insufficiently coordinated charging may create secondary peaks and increase system costs. Presenters further discussed study results from PG&E's *Electrification Impact Study, Part 2* and Public Advocates Office's *Distribution Grid Electrification Model* which indicated that electrification scenarios incorporating greater demand flexibility and vehicle-to-grid (V2G) participation may reduce long-term distribution investment needs relative to baseline scenarios. However, stakeholders noted that such modeled benefits are dependent on key assumptions regarding customer participation, load response reliability, aggregation scale, and the extent to which VGI can defer or avoid specific distribution upgrades in practice. The discussion noted that deployment of load management programs at scale, potentially through the use of LCFS funds in the near term, would both help address current distribution system challenges and provide data to inform the reliability of EV Virtual Power Plant programs to determine the value to grid planning. Stakeholders also observed that any beneficial bill impacts may be modest relative to other cost drivers impacting rates as well as highlighting the timing mismatch and risk associated with infrastructure investments which are required today in advance of the realization of uncertain, future affordability benefits.

Session 2 addressed current V2G industry trends and the state of bidirectional charging technology across residential and commercial applications. The discussion examined original equipment manufacturer (OEM) and service-provider efforts to advance V2G deployment, including the availability

¹ The California large IOUs refer to Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), and San Diego Gas & Electric Company (SDG&E).

² Decision (D.) 22-11-040, p. 172.

³ Pursuant to D.22-11-040, Appendix A, p. 2, the third annual VGI Forum was scheduled for Q4 2025; however, D.25-12-005, p. 11, revised the schedule to require that, beginning in 2026, the annual VGI Forum occur in the first quarter (Q1).

⁴ Full agenda available in Attachment A.

and readiness of bidirectional vehicles and chargers, AC and DC technical considerations, and the role of control, communication, and interoperability capabilities. Presenters emphasized the importance of a streamlined customer experience that simplifies enrollment and clearly communicates the value proposition to encourage VGI participation. Stakeholders also discussed the current value proposition for customer participation, emphasizing that broader market adoption will likely depend on continued reductions in hardware and installation costs, clearer and more durable compensation structures, and policy and program frameworks that can support commercialization beyond early-adopter use cases.

Session 3 examined how the Commission's dynamic rate and demand response frameworks may shape stakeholder interest in VGI and whether VGI-specific considerations warrant further consideration. The discussion focused on VGI's potential role within dynamic pricing structures and broader demand flexibility frameworks, including how to assess the costs and benefits of dynamic rates for all ratepayers, how to identify and forecast VGI-related costs and benefits associated with such rates, and how to mitigate potential cross-subsidies and equity concerns. Presenters also highlighted key dynamic rate efforts to date, including customer participation figures. Stakeholders further observed that dynamic rates may be more effective in capturing broad system value and that tradeoffs exist as rates target more localized distribution-level value, and reliability and dispatchability of a resource may be more challenging.

Session 4 provided an overview of current VGI-related programs and pilot offerings and examined the lessons generated through those efforts. Discussion focused on case studies from PG&E's Vehicle-to-Everything (V2X) Pilots and SCE's Charge Smart SoCal program and experiences related to customer participation barriers, including device and installation costs, limitations in customer understanding of dynamic rates and incentives, interoperability and communication challenges. Stakeholders also discussed whether existing program structures are sufficient to inform future incentive design, compensation approaches, and scalable deployment pathways, or whether additional data, use cases, and design modifications will be necessary.

Session 5 synthesized key themes from across the forum and focused on policy barriers that may limit broader realization of VGI participation and value. The discussion highlighted issues related to the short-term nature of current managed charging pilots, high interconnection fees and processes for bidirectional charging, limited compensation pathways for exports, the practical utility of submetering and flexible service connections, and the role of non-ratepayer funding mechanisms in supporting deployment. Stakeholders also discussed potential policy directions to address these barriers and to provide greater regulatory clarity for future VGI implementation.

Session 6 addressed VGI reporting requirements for the Annual Transportation Electrification Programs and Initiatives Compliance Report, as directed in Decision (D.) 25-12-005 and was an optional session. The discussion focused on how reporting may be structured to provide decision-useful information regarding program participation, grid impacts and performance, program financials, and technology and use-case development, with the objective of supporting regulatory oversight and more consistent tracking of VGI progress over time. There was support to focus future VGI reporting on data elements directly related to assessing the costs and benefits of VGI programs.

Background

In November 2022, the Commission issued Decision (D.) 22-11-040, which ordered the large-Investor-Owned-Utilities (IOUs), in conjunction with California Public Utilities Commission (CPUC) Energy Division staff, to host an annual vehicle-grid-integration (VGI) forum (VGI Forum) with the objective of convening stakeholders to engage in discussion around the established VGI strategic focus areas of 1) rates and demand flexibility programs; 2) technology enablement and 3) planning⁵. D. 22-11-040 also ordered the large IOUs to file a workshop report within 60 days of the VGI Forum, to capture the discussion and lessons identified for the record of relevant proceedings⁶.

On February 11th, 2026, PG&E served the notice of the 2026 VGI Forum to the service lists of relevant rulemaking proceedings.⁷ The VGI Forum was held on March 25, 2026⁸ from 9:30 am to 4:30 pm at the California Public Utilities Commission (CPUC) in San Francisco. Remote attendance option was also available. Attendees included representatives from the IOUs, CPUC's Energy Division staff and other regulatory and industry stakeholders.

The agenda for the VGI Forum (provided in Attachment A) comprised of six sessions:

- Session 1 - VGI and Ratepayer Impacts
- Session 2 - V2G Industry Trends
- Session 3 - VGI Use Cases – Part 1: Dynamic Rates
- Session 4 - VGI Use Cases – Part 2: Programs/Pilots
- Session 5 - Policies to Address Barriers, Q&A, and Closing
- Session 6 - VGI Reporting (Optional)

All presenter slides can be found in Attachment B.

Session 1 – VGI and Ratepayer Impact

The objective of Session 1 was to discuss VGI as a tool for delivering ratepayer benefits. Panelists provided perspectives on qualitative and quantitative approaches to assessing those rate impacts.

Challenges with VGI Ratepayer Benefits

Michaela Levine representing Energy and Environmental Economics, Inc. (E3) presented multiple challenges facing VGI today in terms of its ability to create ratepayer benefits. The first challenge acknowledges the difference between the bulk system needs and value as compared to the distribution system needs and value. Ms. Levine highlighted the example of passive managed charging responding to current retail time-of-use (TOU) rates and how that can lead to creations of new peaks, relative to passive unmanaged charging, given the concentration of EV load at TOU transition periods. The creation of new peaks under passive managed charging results in increased costs resulting from the new peaks and can unintentionally erode ratepayer benefits from transportation electrification. While active

⁵ D.22-11-040, p. 172.

⁶ D.22-11-040, OP 11.

⁷ See Rulemaking (R.) 23-12-008; see also R.22-07-005; R.22-11-013; R.21-06-017; R.24-01-018.

⁸ Email Ruling issued November 9, 2023 delayed the timing of the VGI Forum ordered in D.22-11-040 from end of 2023 to end of Q1 of 2024.

managed charging can help mitigate the issue of rebound peaks, Ms. Levine highlighted that focusing VGI solely on either bulk system value or distribution system value is insufficient. Instead, there is an opportunity to optimize across both systems to maximize rate payer benefits. Active managed charging that only focuses on the bulk system can lead to distribution overloads, similar to passive unmanaged charging. Conversely, active managed charging that only focuses on distribution system leaves value on the table, as it is not able to capture the benefit of low bulk system prices.

A fine balance and optimization of the bulk and distribution system (“grid-aware”) value is necessary to maximize value from VGI as well as to ensure the differing needs and characteristics of the bulk and distribution system are accounted for and that VGI does not solve for one at the expense of the other and unintentionally increase grid costs. The second challenge relates to VGI program design and the balance between three program goals which can be at tensions with one another: 1) maintaining ratepayer benefits, 2) incentivizing participation, and 3) procuring sufficient capacity. The cost of procuring enough VGI capacity and incentivizing participation must be lower than the value that VGI provides in order for ratepayer benefits to be realized. To illustrate this example, Ms. Levine presented an analysis of PG&E’s V2G pilot and compared the cost of customer incentives to the potential grid value realized by the pilot.

Finally, Ms. Levine highlighted several key areas of uncertainty to ensuring VGI can provide value as a grid asset, primarily that VGI aggregations have sufficient enrollment and scale in order to deliver predictable load response given the primary use of electric vehicles is for mobility and not for VGI.

Electrification Impact Study Part 2

Bill Peter representing PG&E presented on the Electrification Impact Study (EIS) Part 2 which PG&E developed as part of the CPUC’s High Distributed Energy Resources (High DER) Grid Planning Proceeding. The purpose of the Study was to estimate the long-term distribution grid costs of achieving the State’s electrification goals.

The Study modeled four scenarios and presented results of approximately \$23-32 billion dollars of distribution system investment by 2040. Notably, the Base Case scenario resulted in a cost of \$25.5 billion dollars and the Enhanced Demand Flexibility scenario—which includes active management, Vehicle-to-Grid applications, as well as greater levels of participation in load management—yielded a \$1.8 billion dollar reduction relative to the Base Case scenario.

Mr. Peter highlighted that across all scenarios, the rate of investment needed was relatively consistent through 2040, with no individual year showing a materially sharp increase in investment. The Study also showed that the majority of costs were attributable to the secondary system, as opposed to the primary system. The Study also conducted preliminary analysis on the rate impact of the modeled distribution system investments over time and showed that in the near-term there would be a marginal increase in rate pressure, but as the load materialized, significant downward rate pressure could be achieved in the long-term.

Distribution Grid Electrification Model

Richard Khoe representing the Public Advocates Office discussed the Distribution Grid Electrification Model (DGEM) study and highlighted key assumptions and considerations to realizing downward rate

impact in practice. The Study modeled the impacts of electrification on the distribution system across nine different scenarios and showed costs ranging from \$20-37 billion dollars through 2040.

Mr. Khoe highlighted several observations from the analysis such as how optimizing for the bulk versus distribution grid needs will affect the ultimate value, there were modeled circuits that would be overloaded across all scenarios and the importance of targeting managed charging to circuits where the upgrade could realistically be deferred or avoided. He also noted the potential for downward rate pressure from managed charging.

Mr. Khoe further highlighted a key assumption in the DGEM study which assumes that the load from managed charging is perfectly firm and reliable and that it does translate to an avoided or deferred grid upgrade. However, he cautioned that this assumption has high uncertainty in practice, citing the Commission's past efforts under the Distribution Investment Deferral Framework (DIDF), which similarly sought to leverage distributed energy resources to defer distribution investments. While the DIDF effort generated learnings and insights, DIDF ultimately did not deliver the anticipated level of distribution deferrals based on a variety of reasons. The decision to build or upgrade infrastructure versus implementing a deferral project is a complex decision and thus, it should not be simply and directly assumed that managed charging will directly translate to deferred or avoided distribution upgrades.

Finally, Mr. Khoe noted a timing mismatch between when investments in infrastructure are made and when the projected ratepayer benefits are realized, highlighting the assumed risk of making investments today that rely on the realization of uncertain future benefits.

Bill Impacts of VGI

Clint Chan representing the CPUC's Energy Division discussed key takeaways on the current state of the ability of VGI to provide positive ratepayer benefits. Mr. Chan acknowledged the potential for VGI to deliver benefits as outlined in PG&E's EIS Part 2 as well as Public Advocates Office's DGEM study. However, Mr. Chan equally acknowledged that assumptions used in the studies and real-world implementation are ultimately critical factors to whether modeled benefits come to fruition. Mr. Chan highlighted four key takeaways.

- Takeaway 1: Beneficial rate impacts from VGI may be modest relative to other cost drivers, such as wildfire hardening. Furthermore, much of the modeled rate savings is dependent on electricity sales growth.
- Takeaway 2: Load flexibility cannot eliminate the need for future distribution grid investment. While load flexibility is certainly helpful in mitigating costs, the aggregate load growth from EVs will still require distribution grid investment and represent a large portion of future costs.
- Takeaway 3: Technical potential from studies may not equate to achievable potential. Customer behavior and participation is a key variable that creates uncertainty in reaching technical potential.
- Takeaway 4: Non-coincident demand charges may still be needed to capture non-peak costs absent a better alternative.

Stakeholders discussed the overarching priority of accelerating energization to meet customer needs, noting that this objective is a fundamental obligation of the utility and that downward rate pressure from electrification follows as more demand materializes. Panelists also noted that confidence in load

response is closely tied to aggregation size, with larger aggregations generally providing greater certainty, while distribution deferral use cases often involve smaller aggregations and therefore greater uncertainty regarding performance. Panelists further highlighted the timing mismatch between when infrastructure investments are made in the near term and when potential benefits may materialize over the longer term, if at all. Stakeholders discussed the role of Avoided Cost Calculator (ACC) values, noting both their current usefulness and their limitations with respect to quantifying VGI export value. Participants described the ACC as the best available tool at present for quantifying certain near-term, system-level values, such as for resource adequacy, but also noted uncertainty regarding how well it captures distribution capacity value and observed that it was originally developed with solar in mind rather than V2G which is a distinct resource. Stakeholders also discussed the challenge of modeling vehicles that can move across locations, noting that this mobility introduces complexity that current modeling approaches do not fully capture and suggesting that rates may not be the most effective tool for influencing location-specific outcomes, for which programs may be better suited.

Session 2 – V2G Industry Trends

The objective of Session 2 was to convene stakeholders from equipment OEMs and EV service providers representing the residential and commercial space to discuss progress in implementing bidirectional charging.

Commercial V2G Applications

Sri Kanaparthi representing Tellus Green Power presented a case study of a deployment of bidirectional chargers for school buses in partnership with Zum. The project consisted of a deployment of 74 bidirectional chargers ranging from 30kW to 60kW accompanied by 74 Type A electric school buses manufactured by BYD.

The project totaled 2.7 MW of installed capacity and was capable of exporting over two gigawatt-hours (GWh) of energy per year. Mr. Kanaparthi highlighted a key project success in delivering frequent export events in response to grid needs while maintaining an operational uptime of over 98% over the course of two years.

Residential V2G Applications

David Nicolas representing Tesla shared the progress of Tesla's implementation of AC V2G, citing the benefits of the inverter being integrated in the vehicle resulting in 40-50% installation cost reduction relative to DC V2G. Mr. Nicolas discussed Tesla's Powershare program, which now supports vehicle-to-home and vehicle-to-vehicle uses, with V2G functionality coming soon. Mr. Nicolas highlighted the scale of the Powershare program, with approximately five thousand homes being capable of being backed up by a Cybertruck. Furthermore, Tesla intends to participate in VGI programs in the Texas and California jurisdiction this summer.

Frances Bell representing Bidirectional Energy, discussed the ability of V2G to provide grid capacity on short timescales, emphasizing its potential to address pressing grid needs. Ms. Bell described Bidirectional Energy's role in facilitating V2G installations for customers through partnerships with hardware vendors and installers. Furthermore, Bidirectional Energy acts as a software platform that optimizes V2G participation in IOU VGI offerings. She highlighted the opportunity for V2G-enabled

revenue streams to unlock greater customer participation, drawing parallels to the adoption trajectory of rooftop solar. Ms. Bell also shared the Oakland Demonstration Home project, which is among the first residential V2G deployments as part of a greater planned deployment of 120 residential V2G systems funded through the California Energy Commission's REDWDS grant. Finally, she emphasized that achieving scale will require improvements to deployment workflows to enable a repeatable and efficient approach to feasibility evaluation and utility interconnection.

Mathias Bell representing WeaveGrid highlighted the coordination required among electric vehicle (EV) customers, utilities, and utility systems to enable effective VGI. Mr. Bell identified five key enablers necessary to scale V2X applications: the availability of V2X-capable vehicles, V2X-capable EV chargers, clear and workable interconnection rules, sustainable compensation models, and sustained customer participation. He also presented several examples of EV load shape data, illustrating how vehicle charging behavior can be responsive to utility price and operational signals when appropriate coordination and enabling infrastructure are in place.

Stakeholders discussed the key blockers that face V2G today and panelists highlighted the need for streamlining the customer experience to make participating in V2G an easy decision to make. Panelists noted that the decision to participate in V2G today can be a complex financial decision that only early adopters may enjoy engaging in. However, to reach the majority the decision making needs to be simplified. This entails continuing to reduce hardware and installation or "soft" costs as well as conveying clear and easily understandable incentive structures that minimize the payback period for a customer's investment. Furthermore, stakeholders emphasized the need for policy and program frameworks to keep pace with proven technical capability of V2G. Stakeholders also discussed ideal compensation mechanisms noting there is not necessarily one ideal mechanism as it is dependent on the grid use case trying to be solved. The discussion on compensation mechanisms also echoed previous points regarding the importance of maintaining simplicity for customer participation and the need to ensure that stacking different compensation mechanisms does not become overly burdensome for customers to understand. Compensation mechanisms ultimately should strive to be tailored to specific market needs while remaining simple and transparent for customers.

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

The objective of Session 3 was to examine how the CPUC's dynamic rate and demand response frameworks shape stakeholder interest in VGI and whether VGI-specific considerations should be raised. Discussion focused on VGI's potential role within the CPUC's CalFUSE and broader demand response frameworks, including how to assess the cost-benefit of dynamic rates for all ratepayers, how to identify and forecast VGI costs and benefits tied to dynamic rates, and how to mitigate potential cross-subsidies and inequity across ratepayers.

Regulatory Roadmap for Dynamic Hourly Rates

Achintya Madduri representing the CPUC's Energy Division provided an explanation of the high-level intent and purpose of dynamic rates to support grid needs in an economically efficient manner by sending customers price signals that encourage customers to adjust their behavior. Mr. Madduri also provided details on the components of a dynamic rate as well as provided extensive regulatory background on the various dynamic rate-related proceedings and efforts by the State and large IOUs.

Dynamic Rates - SCE

Reuben Behlihomji representing SCE provided an overview of the various regulatory avenues SCE is engaged in to implement dynamic rates. These avenues included the CEC's Load Management Standards, the Commission's Demand Flexibility Rulemaking, SCE's 2025 General Rate Case Phase 2 and SCE's Dynamic Rate Application (A. 24-06-014).

Mr. Behlihomji also outlined SCE's principles for how it thinks about VGI through dynamic rates and explained that SCE approaches VGI and dynamic rates through a set of principles intended to support customer participation while maintaining a clear regulatory framework. He noted that SCE views rates as a technology-agnostic tool that allows customers to evaluate their own risk-value proposition rather than prescribing a specific technology pathway.

Mr. Behlihomji also emphasized the importance of avoiding double compensation across rates and programs, such that customers are compensated appropriately without receiving overlapping payments for the same underlying value. In addition, SCE highlighted the need for simplicity for customers, for example, dynamic rates being machine-readable to simplify participation and reduce the need for customers to make daily decisions.

Finally, he underscored the importance of providing day-ahead, and where feasible week-ahead, visibility into pricing so that customers and service providers can plan and automate their response. SCE also emphasized the need for policy flexibility at both the CPUC and CEC to support a portfolio-based approach that enables demand flexibility and compensation pathways for VGI – This permits an inclusive approach and considers the wide range of energy acumen and risk tolerance that may be inherent in each customer's consumption preferences.

Hourly Flex Pricing – PG&E

Oriana Tiell representing PG&E provided an overview of PG&E's Hourly Flex Pricing (HFP) pilots. Ms. Tiell explained that HFP features an hourly day-ahead price accompanied by a seven-day forecast. HFP is open to all customer classes and is not exclusive to EVs. Participants remain on their Otherwise Applicable Tariff (OAT) and receive monthly HFP performance reports. After 12 months, customers who perform better on HFP relative to their OAT receive a credit, while customers who perform worse face no penalty, making the offering effectively risk free. To measure performance and mitigate price volatility, PG&E uses a baseline subscription based on a customer's prior usage load shape, with the difference between actual usage and the subscription billed at the HFP rate. Ms. Tiell noted that, although customer interest in HFP has been strong, enrollment from V2X customers has remained limited to date.

Stakeholders discussed the role of dynamic rates in sending price signals intended to help optimize overall grid costs by having higher prices during times of grid constraint and conversely lower prices when there are fewer constraints. Stakeholders also emphasized that dynamic rates are not a singular tool for addressing all grid needs. Participants noted that as you target further down the distribution system, the price signals need to become more granular and tradeoffs can arise between the effectiveness of those prices and the ability to achieve dispatchable performance, suggesting that additional tools will also be necessary. Stakeholders further observed that dynamic rates are generally

better suited to capturing systemwide value, including generation, resource adequacy, and certain aspects of transmission, than they are to capturing distribution-level value, particularly as you target further down the distribution system. Stakeholders also noted that customers place a high value on predictability, which can be in tension with more dynamic price structures, and that technology providers and OEMs will need a sufficient value proposition to justify continued investment in customer-facing products and services.

Session 4 – VGI Use Cases – Part 2: Programs/Pilots

The objective of Session 4 provides an overview of current demand response and CalFUSE-related VGI pilot and program offerings. Building on lessons learned, the session examines participation barriers such as device upgrades and secondary costs, implementation challenges, and whether current offerings produce sufficient data to support VGI valuation and inform future incentive structures. Topics include interactions between VGI pilots and demand response programs; barriers tied to understanding dynamic rates, device and installation costs, and incentive availability; the availability and effectiveness of tools that help customers understand the value proposition of participating in pilots under dynamic rates; expected ratepayer and individual customer bill savings; whether existing pilot designs are adequate for valuation or require additional data, use cases, or design changes; and issues related to communication standards, device access, and associated costs.

Nick Fiore representing SDG&E and moderator for the panel provided opening remarks with a placemat summary of the IOU's VGI activities. This can be found in Attachment B.

CEC Actions Supporting VGI

Peter Chen representing the CEC's Energy, Research and Development Division provided a summary of the multiple different workstreams that the CEC has to support VGI: Funding Programs, Regulatory Authority, Modeling and Analysis and Technology Standardization. Mr. Chen provided a more detailed status update on the Responsive, Easy Charging Products with Dynamic Signals (REDWDS) and Electric Program Investment Charge (EPIC) programs. Preliminary data from REDWDS shows over 20,000 participating residential customers successfully shifting EV charging load out of on-peak periods. Furthermore, REDWDS participants are reporting savings from utilizing a dynamic rate however, there is a significant variance in the amount of savings ranging from \$0.53/customer-month to \$19/customer-month which the CEC intends to conduct further research to understand the rationale between the large variance. Mr. Chen highlighted key challenges learned from REDWDS.

- **Dynamic Rate Access:** A high proportion of customers fail to complete enrollment due to dual participation restriction rules (e.g. existing participation in a demand response program).
- **Submetering:** Although it was envisioned to help mitigate dual participation issues, there is still no viable pathway for residential customers to implement EV submetering four years into implementation.
- **Interoperability:** Observed use of proprietary APIs to execute managed charging.
- **Interconnections:** There is a lack of clear and consistent process for interconnecting bidirectional chargers.

Mr. Chen then highlighted a few notable EPIC projects that are demonstrating key VGI use cases such as reducing distribution circuit peaks through managed charging. Utilizing VGI to support resource adequacy requirements and open standard based systems to support AC bidirectional capabilities.

V2X Pilots – PG&E

Rudi Halbright representing PG&E provided an overview of PG&E's V2X pilots and noted that enrollment in PG&E's V2X pilots has lagged, with the residential pilot not expected to meet its enrollment target and the commercial pilot also trailing expectations, though it may come closer to its target. Mr. Halbright explained that the pilots have encountered several barriers, including a pullback in investment in V2X-capable vehicles by EV OEMs and equipment costs that remain significantly higher than available pilot incentives can offset. Mr. Halbright noted that the anticipated decline in V2X equipment costs that is a characteristic of new technology has not yet materialized. In addition, Mr. Halbright stated that Hourly Flex Pricing has not yet proven to be a reliable compensation mechanism because the complexity of dynamic rates makes it difficult for customers to forecast potential savings, if any. Although the Emergency Load Reduction Program (ELRP) compensates exports, dual participation challenges related to ELRP's baseline methodology can unintentionally reduce compensation relative to expectations. Taken together, the nascency of bidirectional technology, persistent cost challenges, and an uncertain customer value proposition have contributed to the pilots' low enrollment to date.

Charge Smart SoCal Program - SCE

Randy Robinson representing SCE explained that SCE views the core objectives of VGI as delivering customer value to support affordability, establishing repeatable and scalable demand flexibility, and using VGI to help optimize grid investments by deferring near-term upgrades where feasible. Mr. Robinson highlighted SCE's Charge Smart program, which is intended to mitigate EV charging peaks that can occur after the conclusion of On-peak TOU periods, sometimes referred to as secondary peaks. Mr. Robinson explained that Charge Smart has demonstrated not only the expected reduction in charging during peak periods, but also a more significant reduction in peak demand immediately after the peak period ends at 9:00 p.m., with load spread more evenly throughout the night and into the following morning and resulting in a lower net peak. Mr. Robinson also shared several lessons learned from SCE's experience, including that customers are strongly motivated by clear, upfront value and that sustaining participation requires consistent and ongoing benefits. He further noted that programs led or endorsed by utilities and automotive OEMs tend to achieve the highest enrollment and participation, underscoring the importance of trusted channels, and that vendor capabilities remain inconsistent and should be validated through pilots before broader scaling.

Session 5 – VGI Policies to Address Barriers

Zach Woogen representing the Vehicle Grid Integration Council (VGIC) provided a comprehensive overview of the policy landscape facing VGI in California, with a specific focus on barriers arising within existing CPUC regulatory frameworks. The presentation underscored the growing urgency of VGI as transportation electrification accelerates and as electric vehicles increasingly represent both a significant new load and a flexible grid resource. Mr. Woogen identified several cross-cutting policy challenges that continue to limit VGI deployment and scale.

- **Managed charging** – Lack of persistent programs and dynamic rates results in uncertainty, with many pilots authorized only through 2027 with limited clarity on post-pilot pathways. Mr. Woogen also noted that planning assumptions related to VGI uptake were created for the Integrated Resource Planning (IRP) but were not run as part of the modeling. Modeling VGI, regardless of whether it is selected in the results, provides value to the VGI policy discussion. Finally, existing submetering protocols remain constrained to EVSE-based metering and are undermined by a lack of compelling EV-specific rates, reducing the practical usefulness of submetering for VGI.
- **Grid-Isolated Bidirectional Charging** – The current approval framework, under which systems operating only when electrically isolated from the grid do not require Rule 21 interconnection, may not scale as deployment expands as it appears utilities still conduct lab or witness testing prior to confirming regulatory treatment on a case-by-case basis, introducing uncertainty and delays. Finally, upfront cost support for such systems remains limited, with incentives largely confined to narrow pilot programs and a small set of eligible vehicles and equipment.
- **Grid-Parallel Bidirectional Charging** – Mr. Woogen highlighted the high cost and complexity of interconnection, including the \$800 application fee and metering requirements for legacy net energy metering customers, which can trigger costly net generation output meters. Despite compliance with applicable standards such as UL 1741 SB and the use of inverters already deployed in rooftop solar installations, early projects have experienced prolonged interconnection timelines. Planning gaps persist, as grid-parallel bidirectional charging has been modeled only in limited studies, and compensation mechanisms for net exports remain highly uncertain.
- **Customer Credits for Exports** – Mr. Woogen emphasized that while multiple compensation pathways have been explored, including static export credits, pilot dynamic export credits, ELRP participation, and capacity valuation under DSGS or CAISO constructs, the CPUC has not issued clear guidance on how bidirectional charging exports should be fairly compensated based on marginal costs. As a result, pilot dynamic export rates remain largely unused, post-pilot pathways are unclear, and non-pilot applications have been deferred or rejected.
- **Flexible Service Connection** – The use of flexible service connections is a critical but underutilized VGI enabler, especially in use cases where customers elect to utilize it beyond just a bridging solution. Mr. Woogen noted that while much of the systems and processes for flexible service connection is in place, customers lack incentives to adopt non-bridging flexible service solutions. Additionally, Integration Capacity Analysis (ICA) maps remain of limited usefulness due to data quality and update frequency issues, constraining their effectiveness as planning and customer decision-making tools.

Session 6 - VGI Reporting

Brian Chen and Blake Heidenreich representing the IOUs engaged stakeholders in a conversation regarding VGI reporting as part of the transportation electrification reporting consolidation effort as directed in D. 25-12-005. The objective is to ensure VGI reporting focuses on information that meaningfully tracks progress toward clear VGI outcomes and supports regulatory oversight. The proposed framework organizes reporting into four core categories: 1) Program Participation, 2) Grid Impact and Performance, 3) Program Financials, and 4) Technology and Use Case. These categories were

designed to balance customer, system, and market development insights. Collectively, these categories are intended to provide a streamlined, decision-useful view of VGI activity, performance, and maturity while enabling stakeholders to assess whether VGI initiatives are delivering intended grid, customer, and equity benefits and to identify barriers requiring further policy or program attention.

Attachment A: Agenda for Forum

2026 VGI Forum Agenda

9:30am Welcome & Introduction (30 min)

- Introduction & Safety Message
- Opening Remarks

10:00am Session #1: VGI and Ratepayer Impacts (60 min)

Objective: Discuss VGI as a tool for ratepayer benefits. Discuss qualitative and quantitative frameworks to assessing ratepayer impacts including inputs, assumptions and other key considerations for determining value.

Key Topics

- 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.
- Deferred or avoided distribution upgrade costs - Impact of avoiding export of EVs on grids

11:00am Break (15min)

11:15am Session #2: V2G Industry Trends (45 min)

Objective: Hear from industry stakeholders about their latest update on V2G technology, challenges, costs, and limitations.

Key Topics

- OEM value proposition for investing in V2G.
- Availability and readiness of bidirectional vehicles and chargers.
- AC versus DC V2G technical considerations and limitations.
- Control, communication, and interoperability constraints.

12:00pm Lunch (60 min)

1:00pm Session #3: VGI Use Cases – Part 1: Dynamic Rates (60 min)

Objective: Examine how the CPUC’s dynamic rate and demand response frameworks impact stakeholder interest in VGI and what, if any, VGI-specific considerations need to be raised.

Key Topics

- VGI’s potential role within the CPUC’s Calfuse and Demand Response frameworks and how to assess:
 - Cost-benefit of dynamic rates for all ratepayers.
 - Identification and forecasting of VGI costs and benefits related to dynamic rates.
- Mitigating potential cross-subsidies and inequity across all ratepayers.

2:00pm Session #4: VGI Use Cases – Part 2: Programs/Pilots (60 min)

Objective: Overview of current DR and Calfuse-related VGI pilot and programmatic offerings. Discussion will draw on lessons learned and examine participation barriers such

as upgrade and secondary costs, implementation challenges and whether current offerings generate sufficient data to support VGI valuation and inform future incentive structures.

Key Topics

- Lessons learned from implementation of Calfuse and DR-related pilots.
 - Interaction between VGI pilots and demand response programs.
 - Customer participation barriers, including understanding dynamic rates, device and installation costs, and availability of incentives
 - Availability and effectiveness of tools to help customers understand the value proposition of participating in pilots under dynamic rates.
 - Ratepayer and individual customer bill savings
- Assessment of whether existing pilot designs are sufficient to inform VGI valuation or whether additional data, use cases, or design changes are needed.
- Communication standards, device access, and associated costs.

3:00pm Break (15 min)

3:15 pm Session #5: Policies to Address Barriers, Q&A, and Closing (45 min)

Objective: Summarize and consolidate insights from across the Forum sessions to identify the most significant barriers to realizing VGI value. Stakeholder discussion on policy recommendations to address barriers and Q&A.

4:00pm Session #6: VGI Reporting – (Optional to Participate) (45min)

Objective: Discuss VGI reporting requirements for the Annual Transportation Electrification Programs and Initiatives Compliance Report.

Attachment B: Presenter Slides

Vehicle-Grid Integration (VGI) Forum

Shiva Ourang

Utility Engineer | Transportation Electrification

Energy Division | CPUC

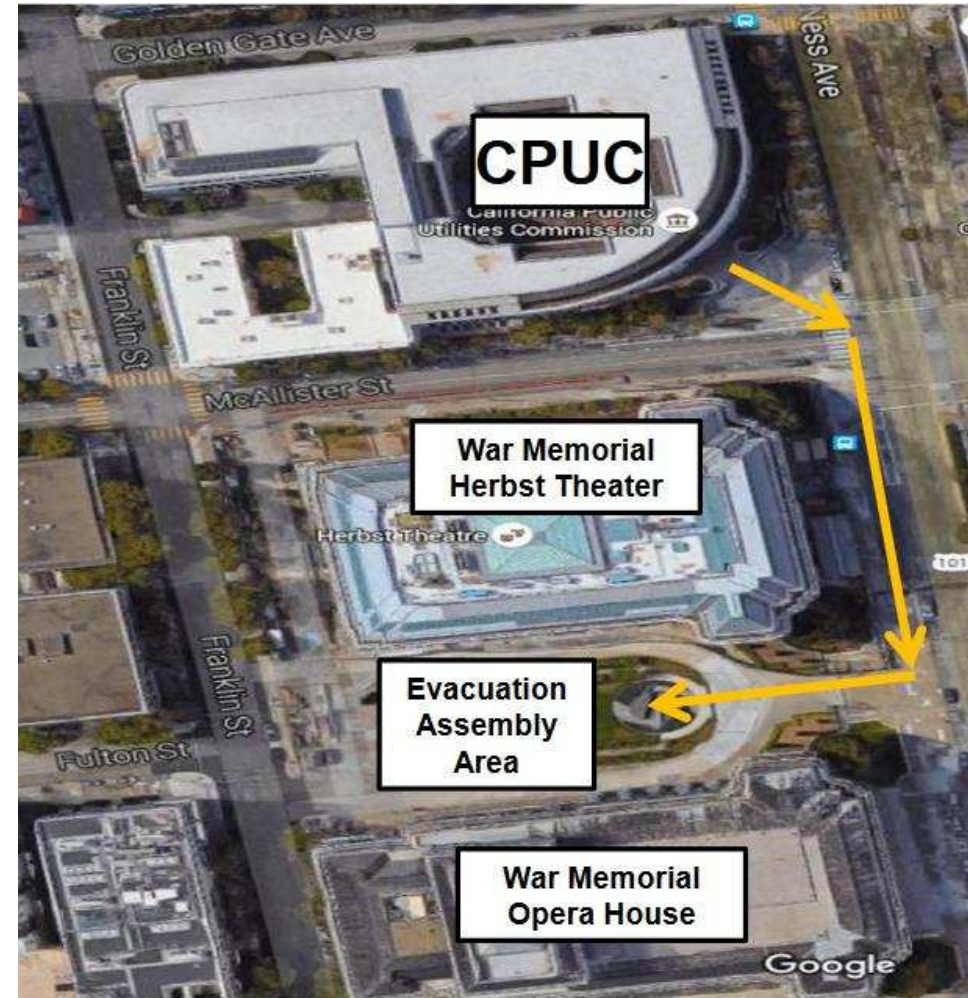
March 25, 2026



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.

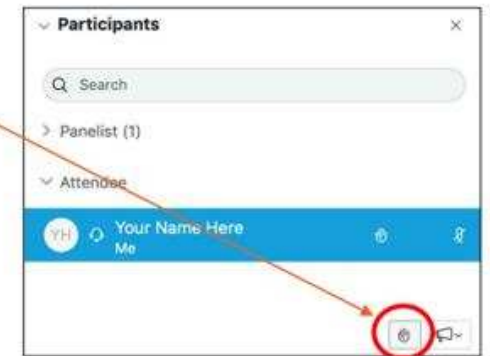
WebEx Tips

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



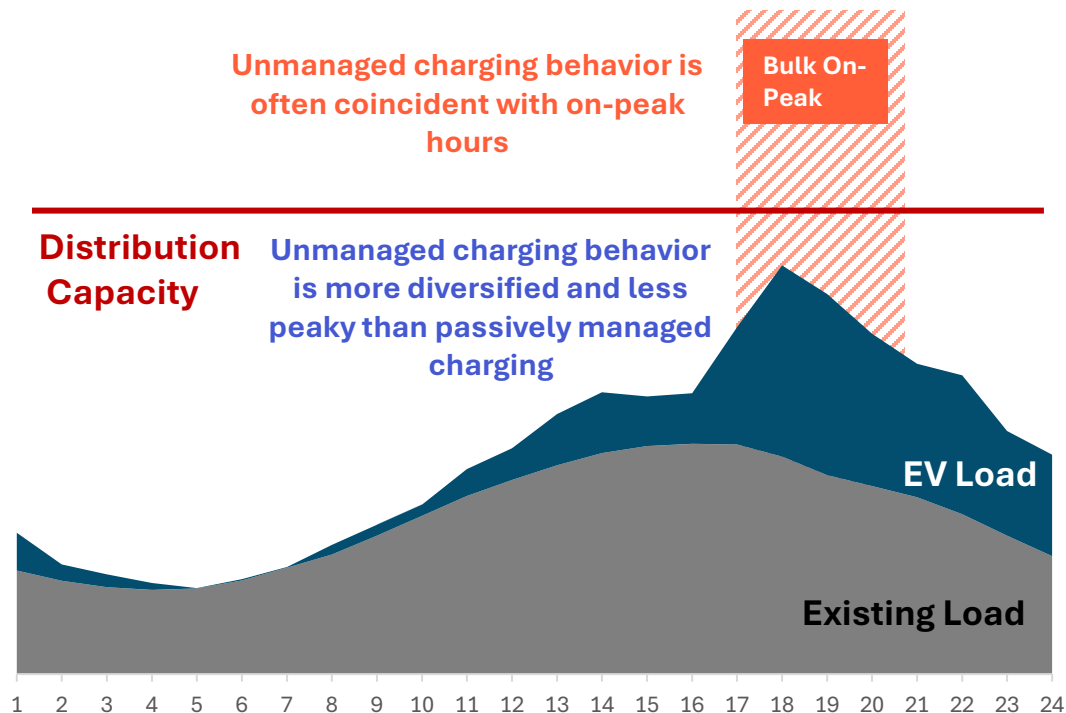
Energy+Environmental Economics

Michaela Levine, Senior Managing Consultant
Eric Cutter, Partner

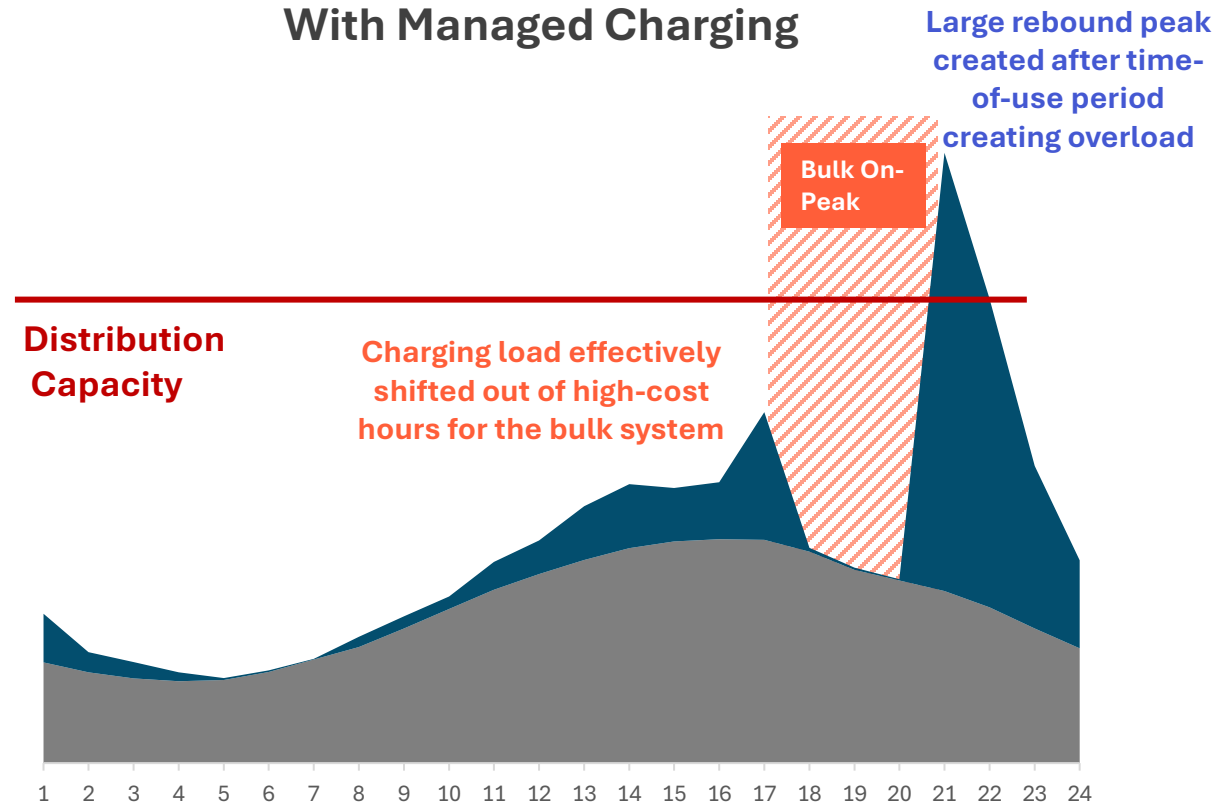
Passive management with retail rates can create local distribution challenges, increasing costs

Example Peak Day Distribution System Load

With Unmanaged Charging



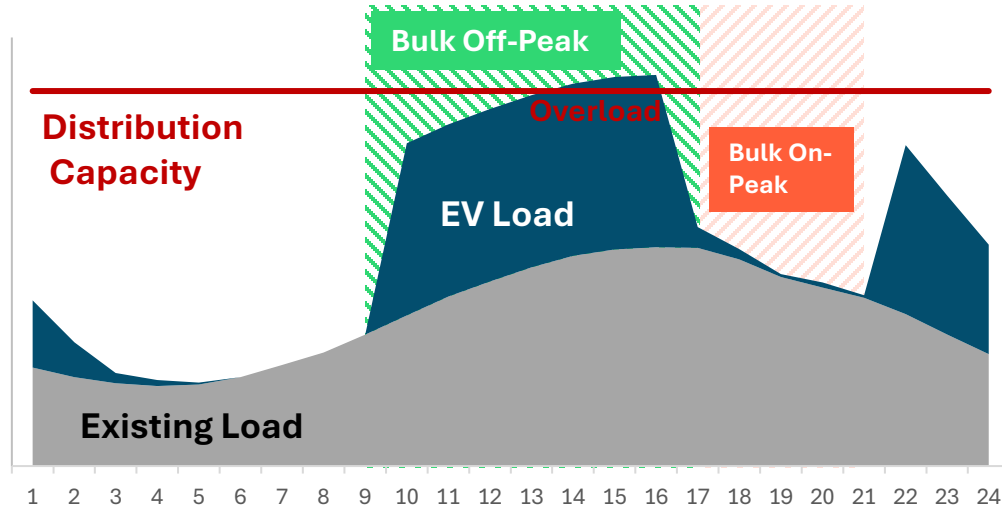
With Managed Charging



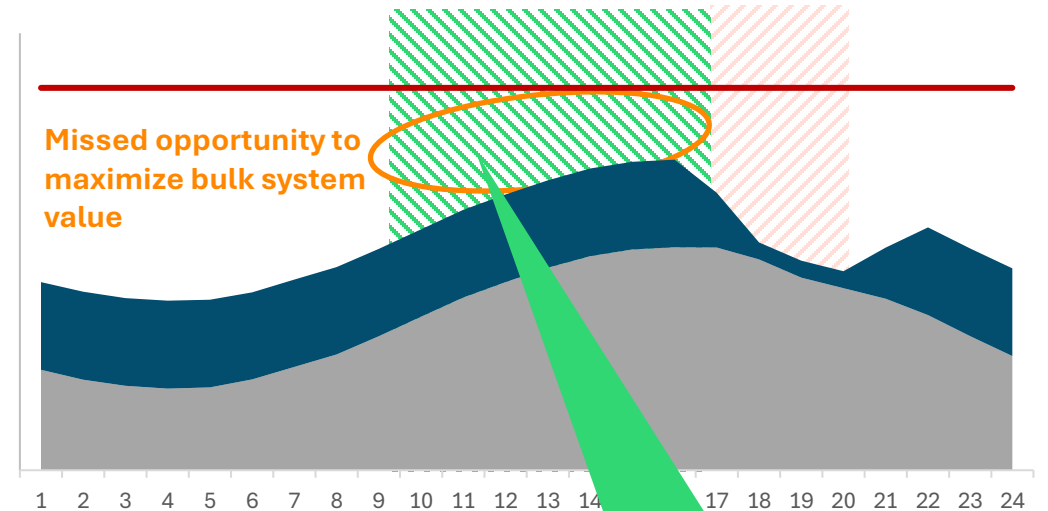
In recent studies, E3 and Integral Analytics have seen TOU rates increase peaks on >20% of distribution feeders

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

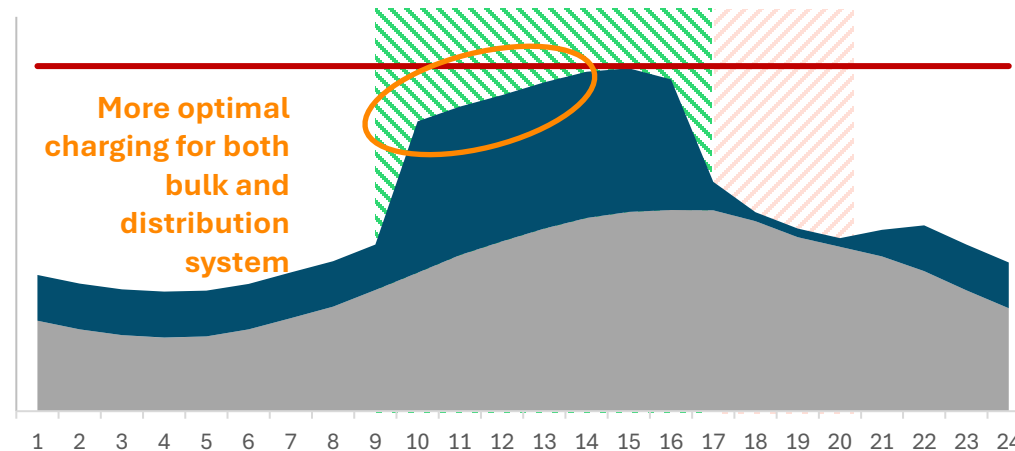
Managed Charging to Maximize Bulk System Value



Managed Charging to Flatten Peak

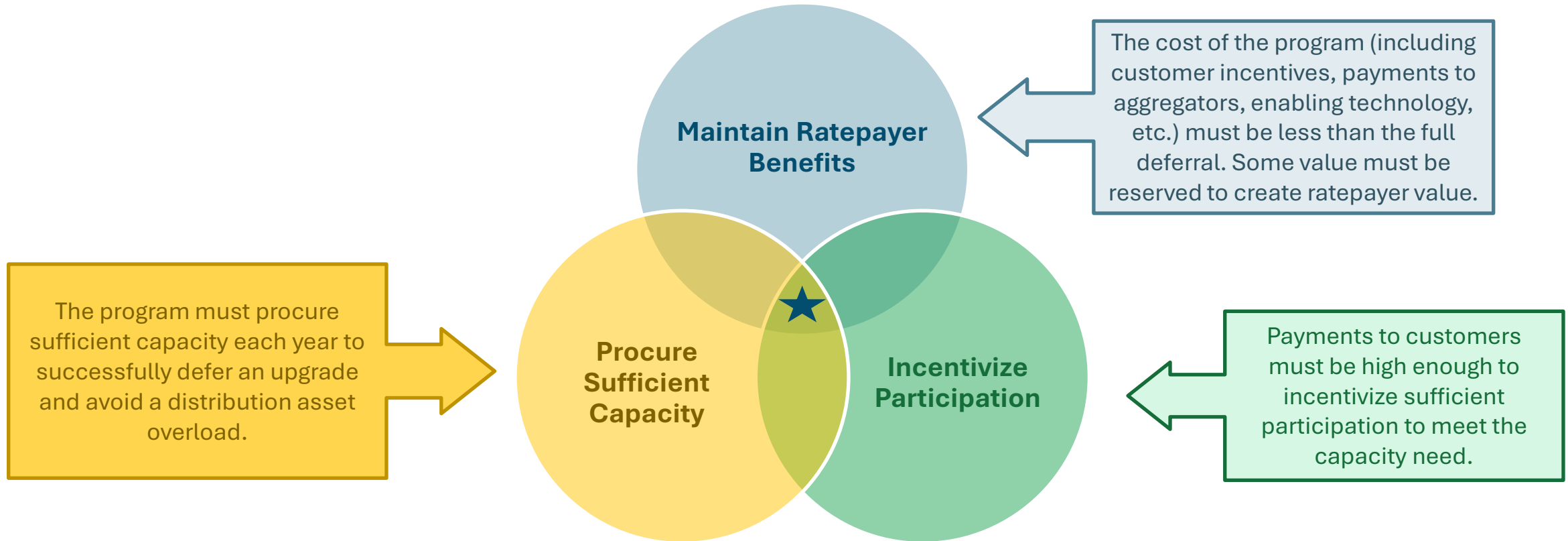


Distribution Aware Solution



Missed opportunity to maximize bulk system value

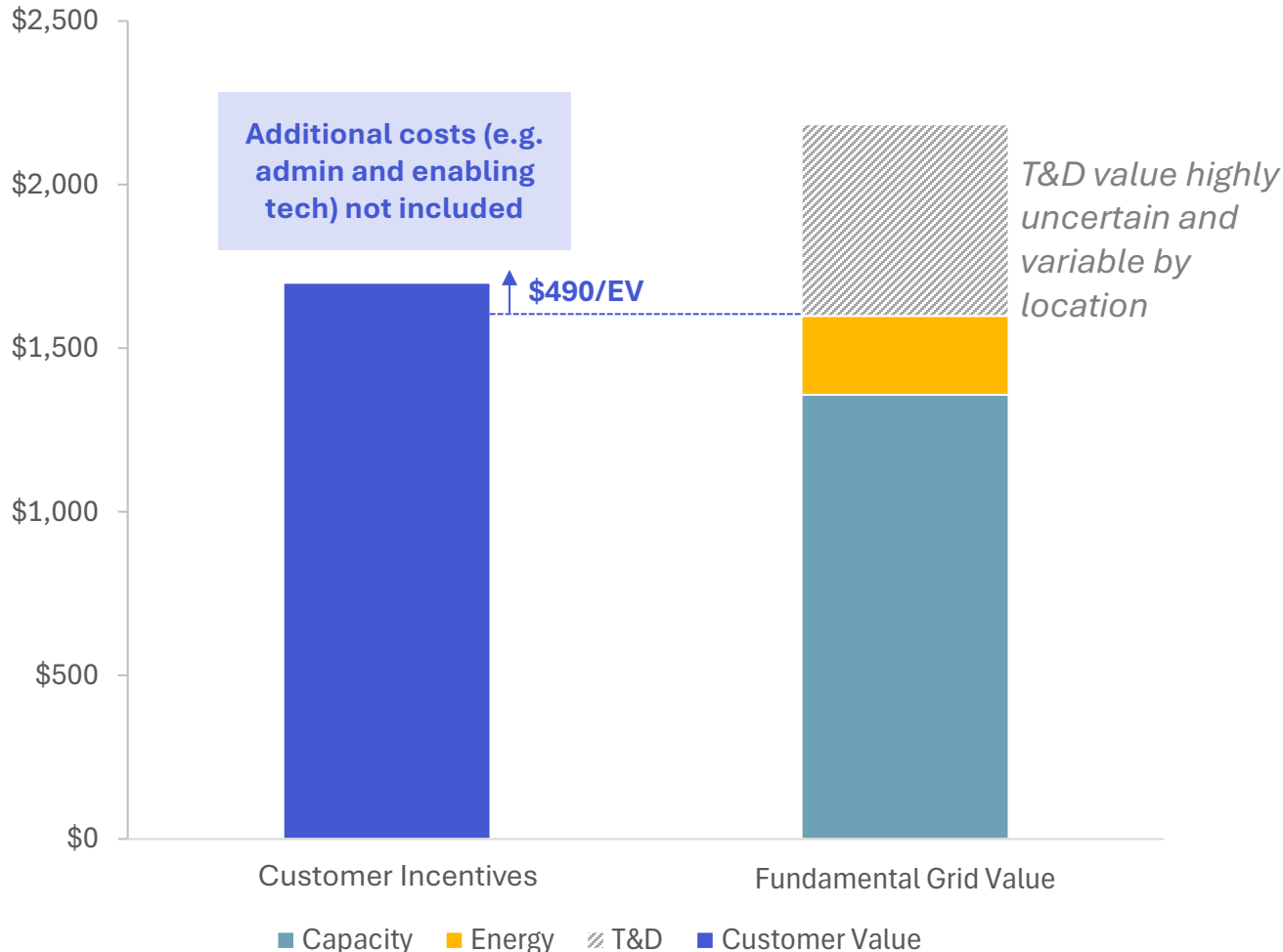
To achieve distribution deferral and realize its value, a VGI program must balance 3 goals



The balance of these goals ultimately informs compensation

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

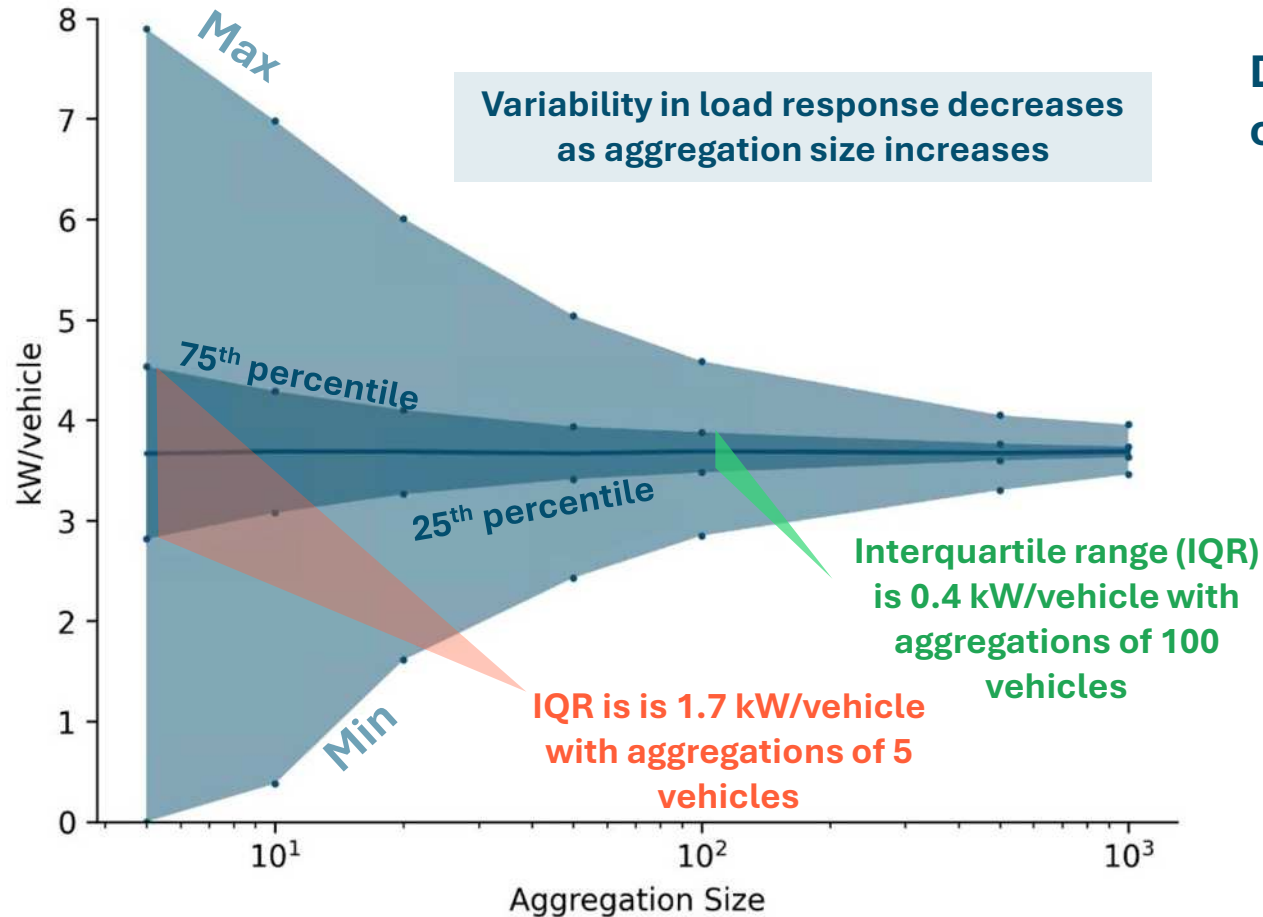
V2G Grid Value vs Customer Bill Savings on PG&E's Hourly Flex Pricing Program, \$/vehicle



- + E3's analysis of PG&E's V2G pilot¹ 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

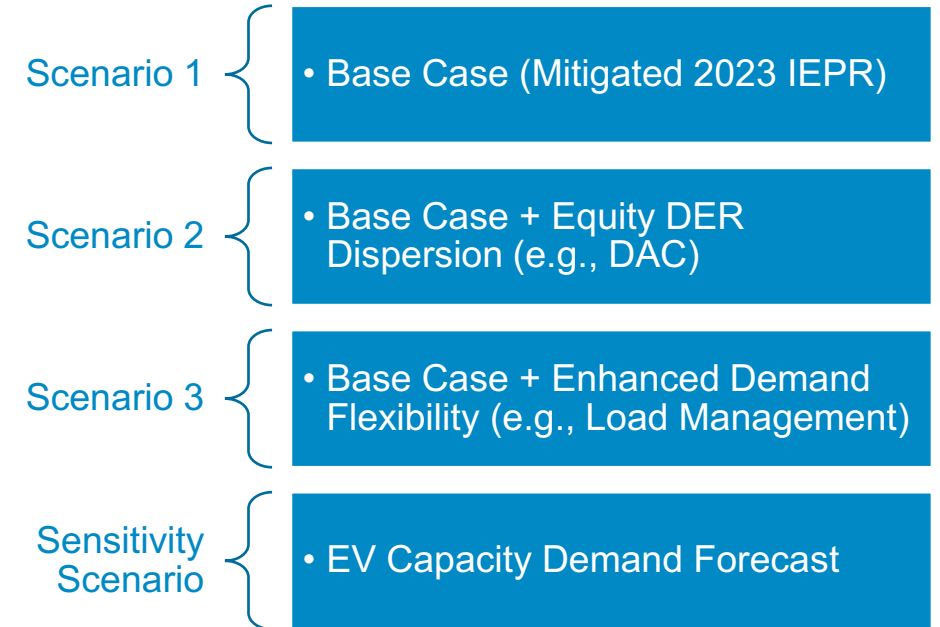




PG&E Electrification Impact Study (EIS) Overview

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 grid¹ 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”)



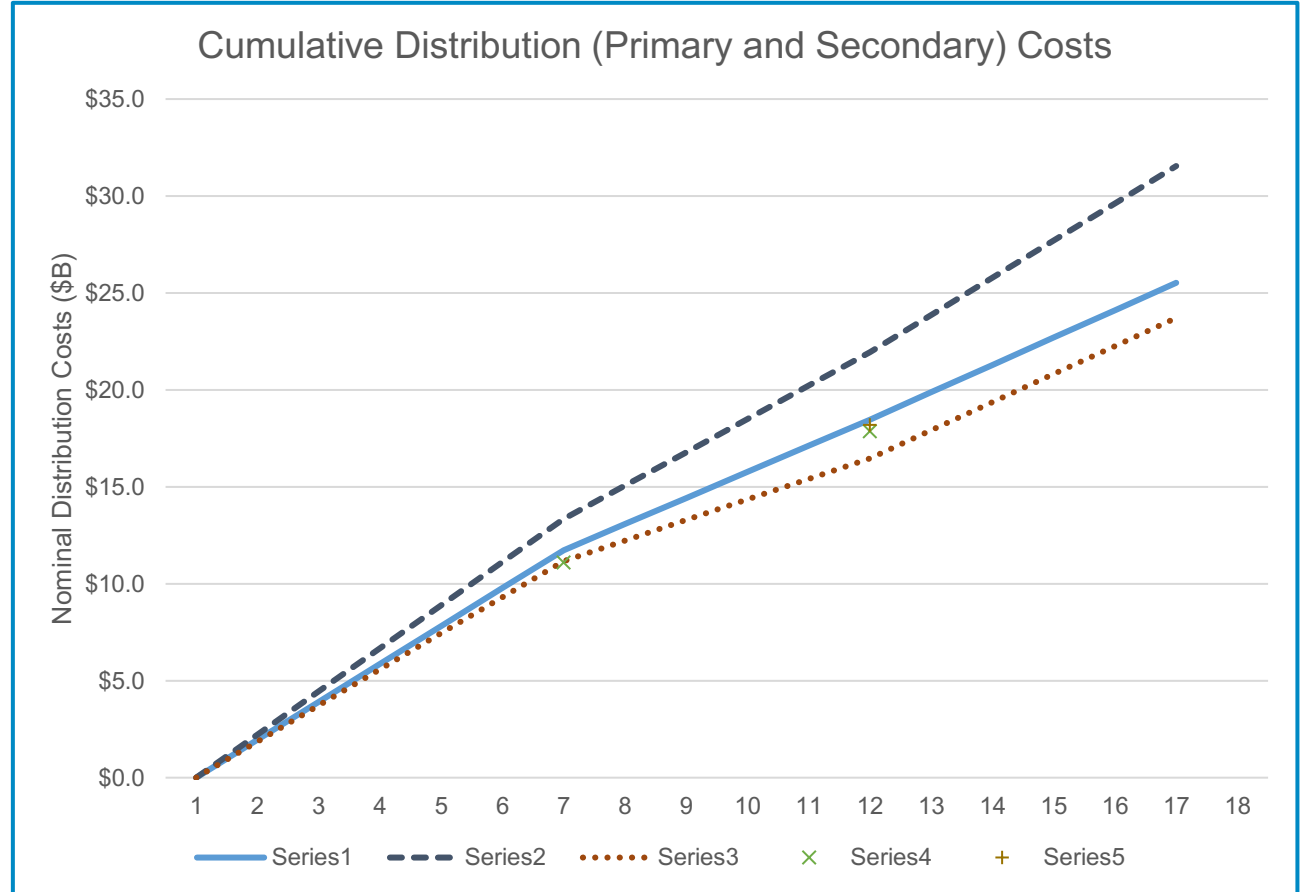
Electrification Distribution Infrastructure Costs

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

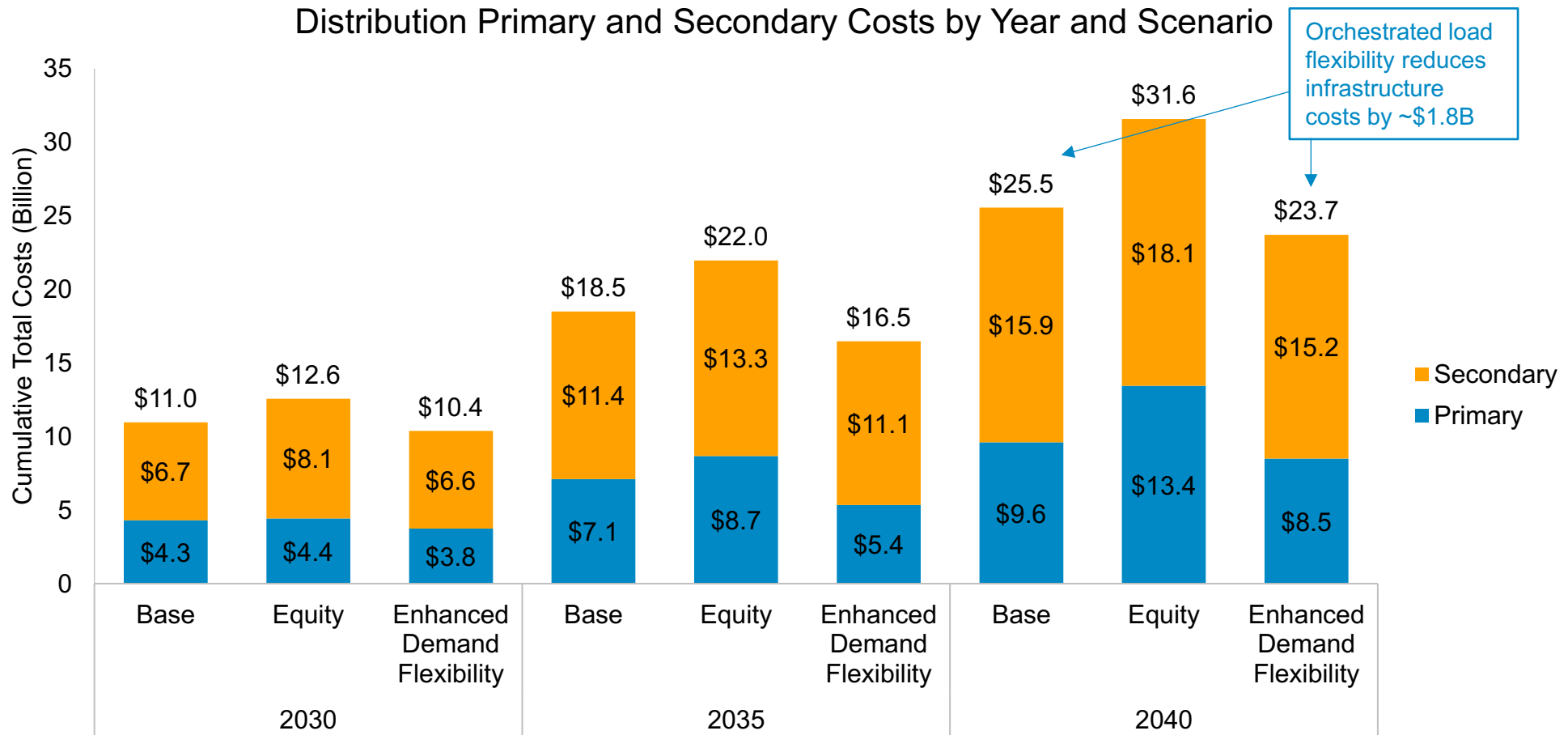


Linear Interpolation of costs used between study years.



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.



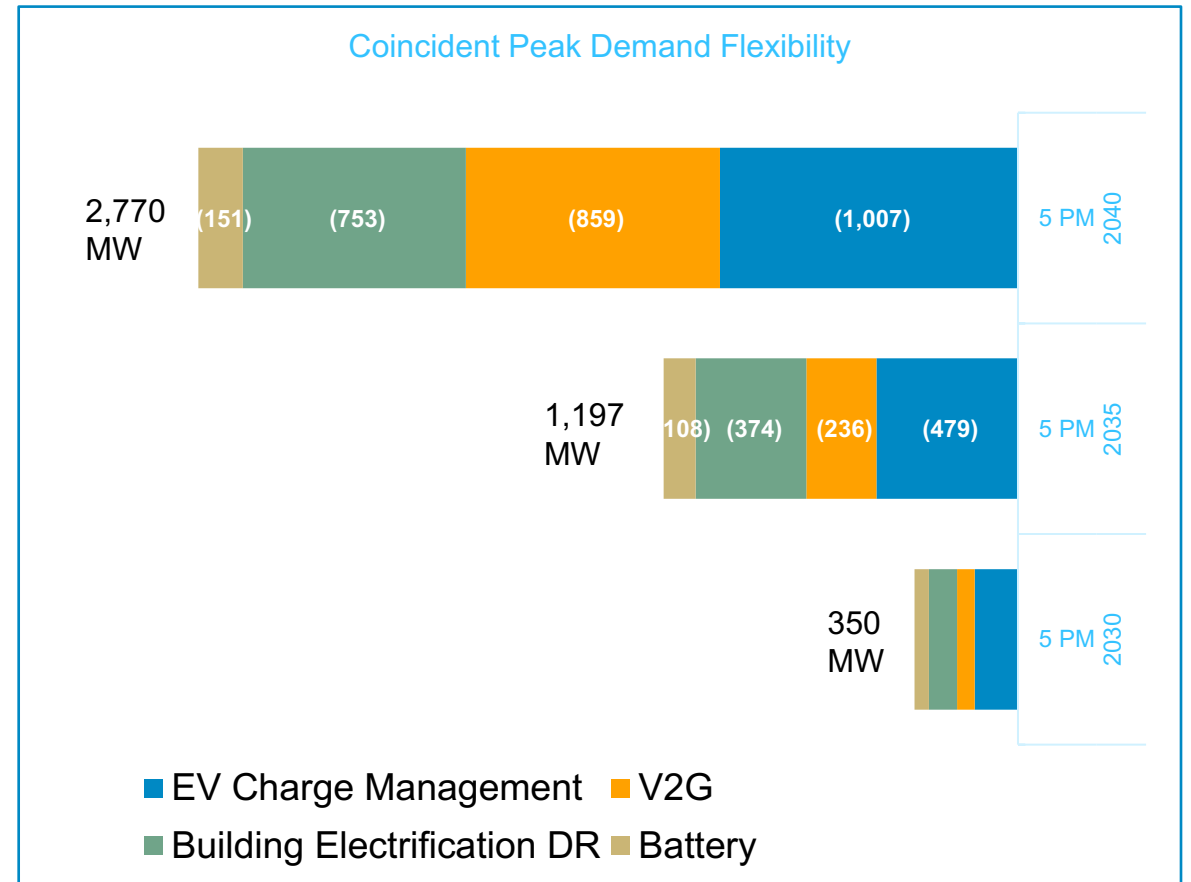
The EV Capacity Sensitivity Scenario (not shown) only modeled secondary costs, with total secondary costs of \$7.3B, \$12.5B, and \$17.5B through 2030, 2035, and 2040, respectively.



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.



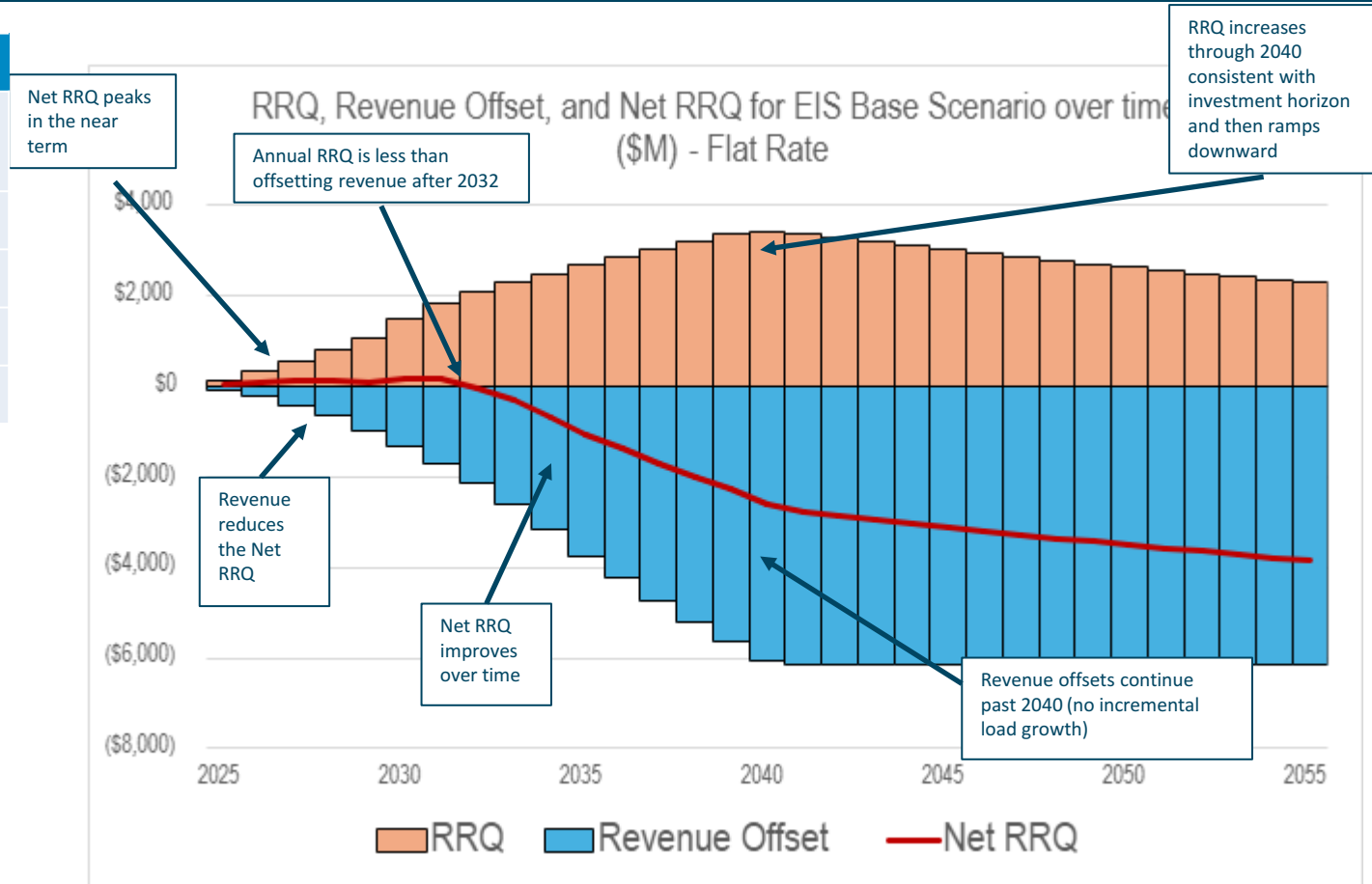


Preliminary Analysis shows significant downward pressure on Distribution Rates over time

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




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

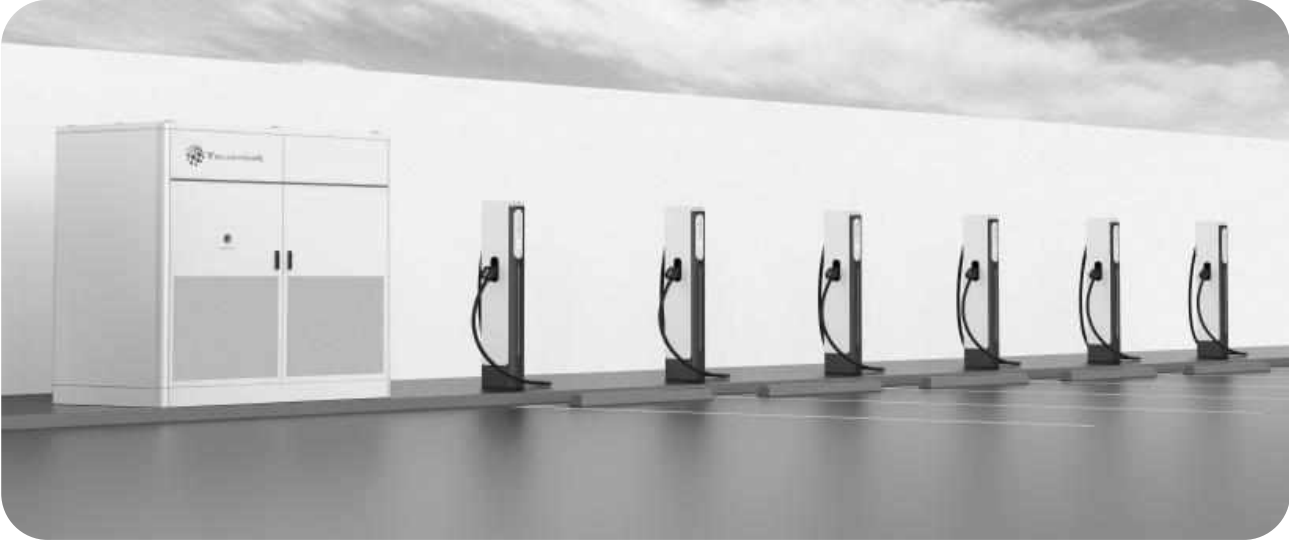
 Asia Pacific



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



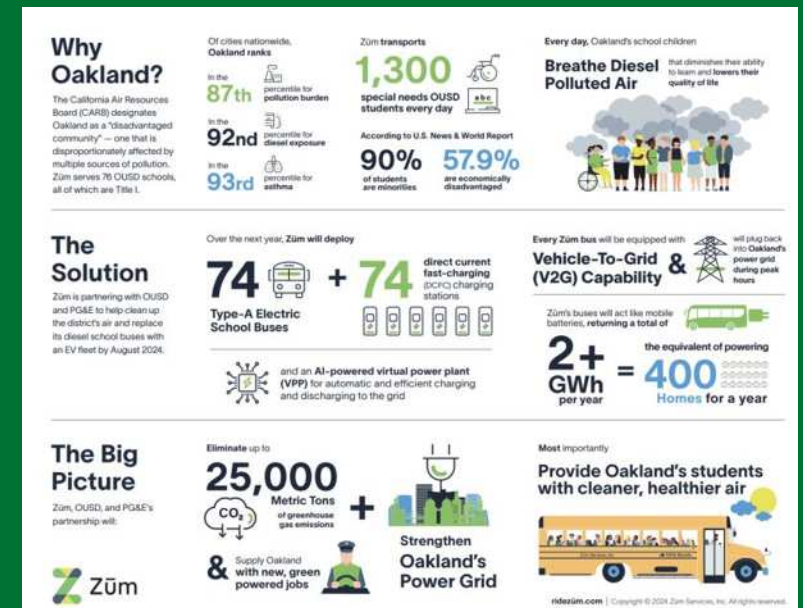
Integrated Battery Charging (BSS) V2G DC Charger



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)

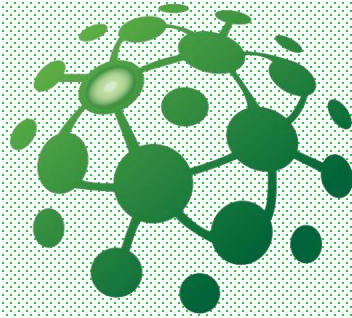


Other Projects Ongoing

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

23541 Ridge Route Dr, Suite B,
Laguna Hills, CA 92653

www.telluspowersgreen.com



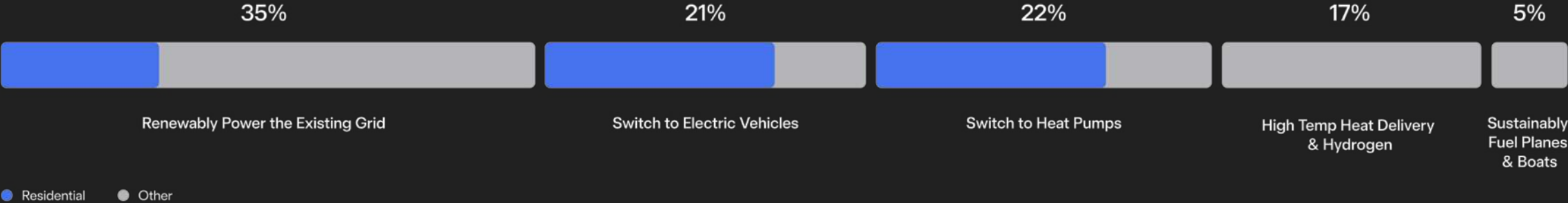
Powershare

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

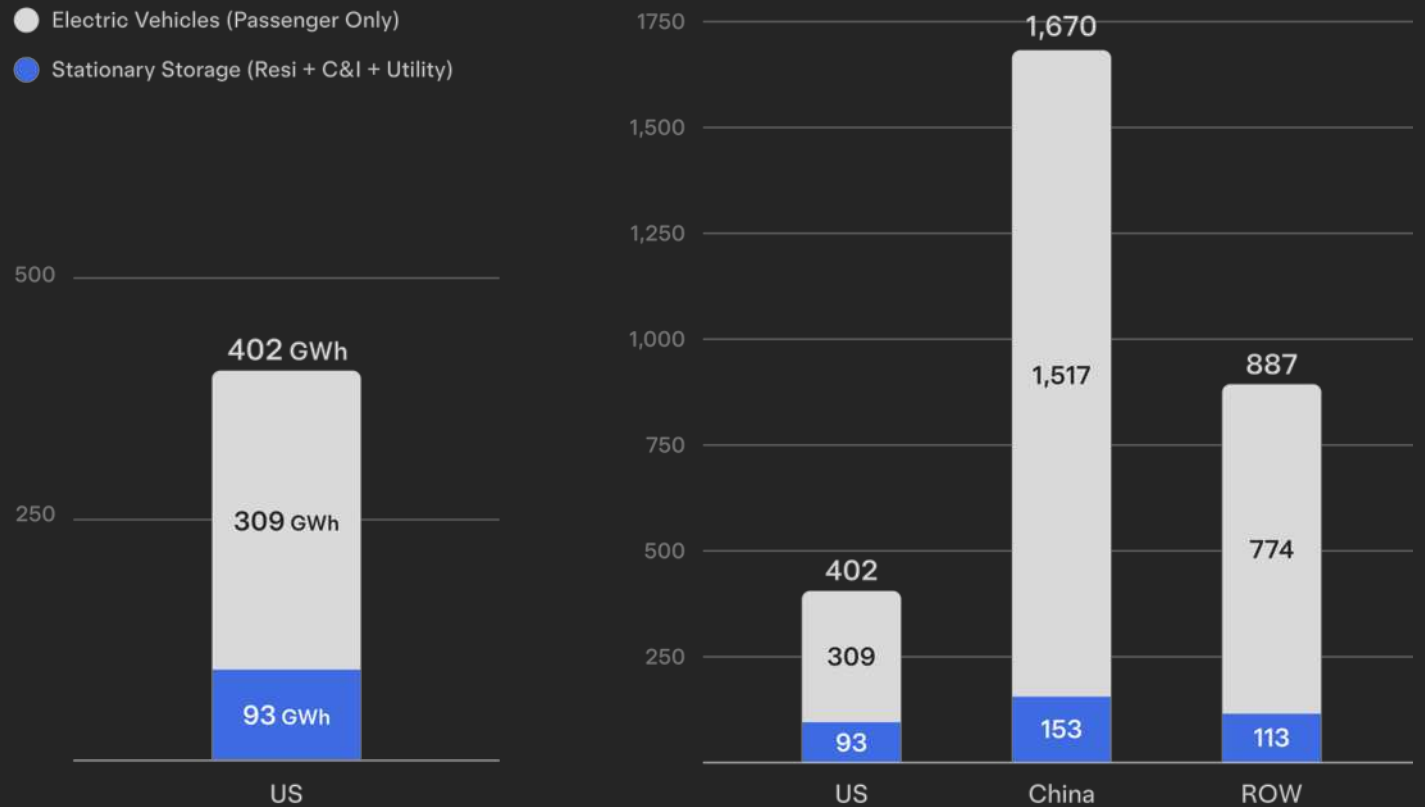


Maximizes the use of intermittent renewables

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*

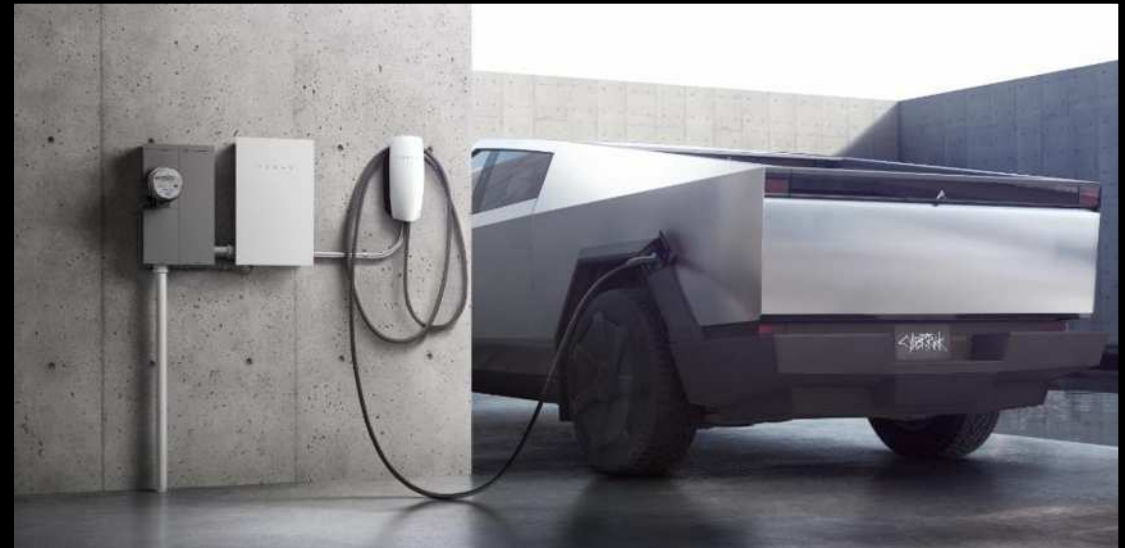
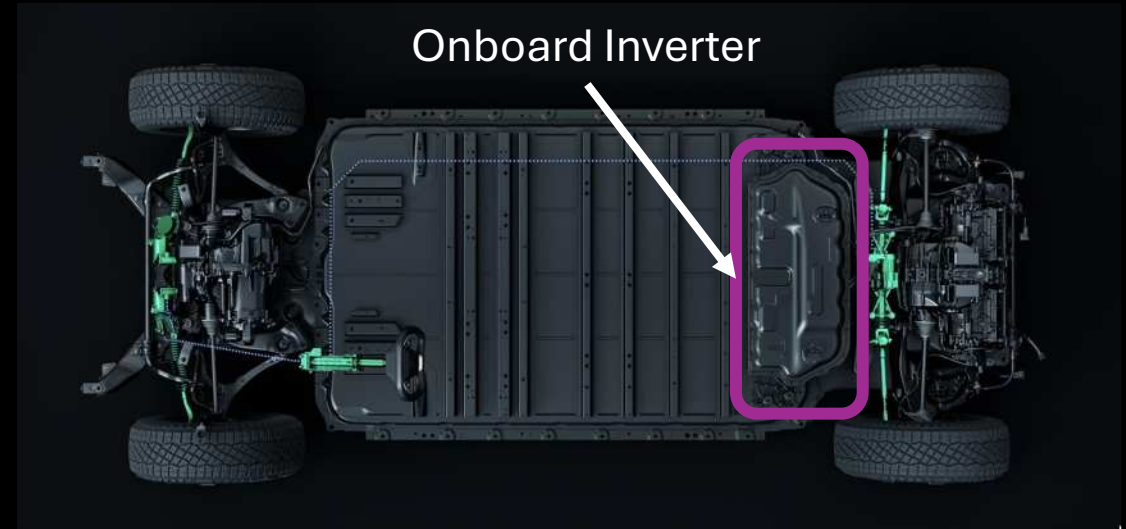
Tesla Powershare

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)



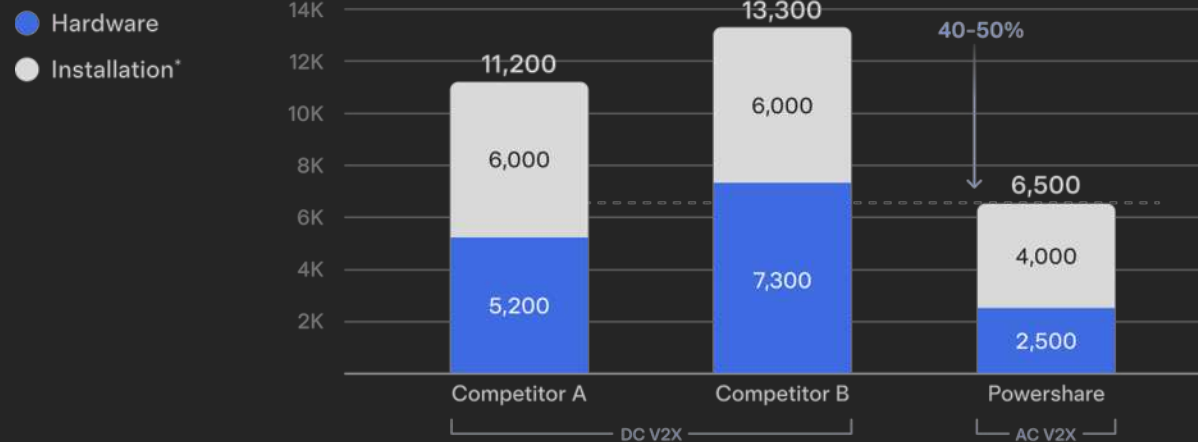
Lowest Cost, Most Affordable

- 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

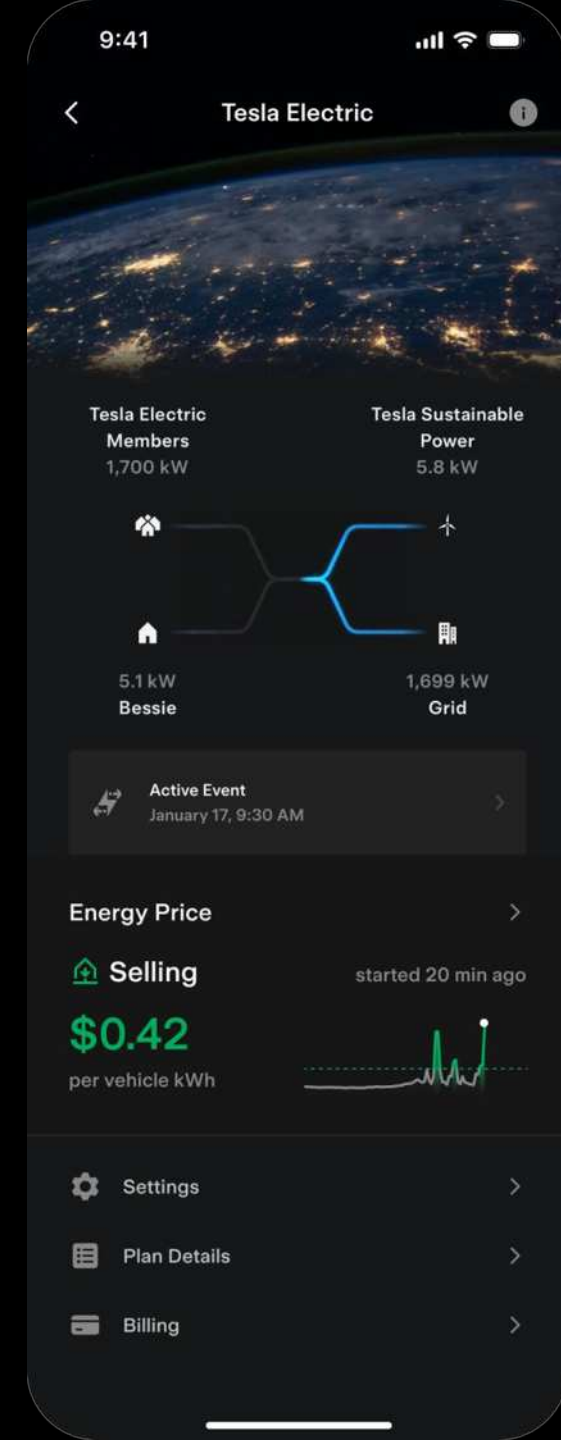
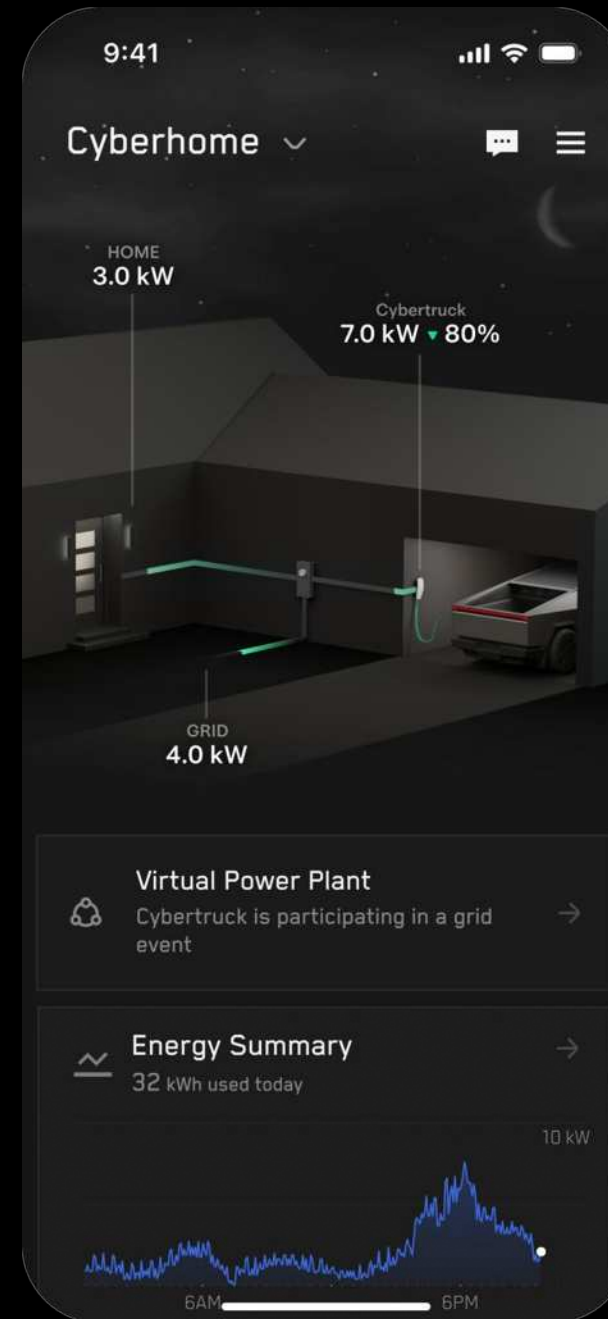
- ~5000 homes are now being backed up by Cybertruck

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 1,000,000th 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

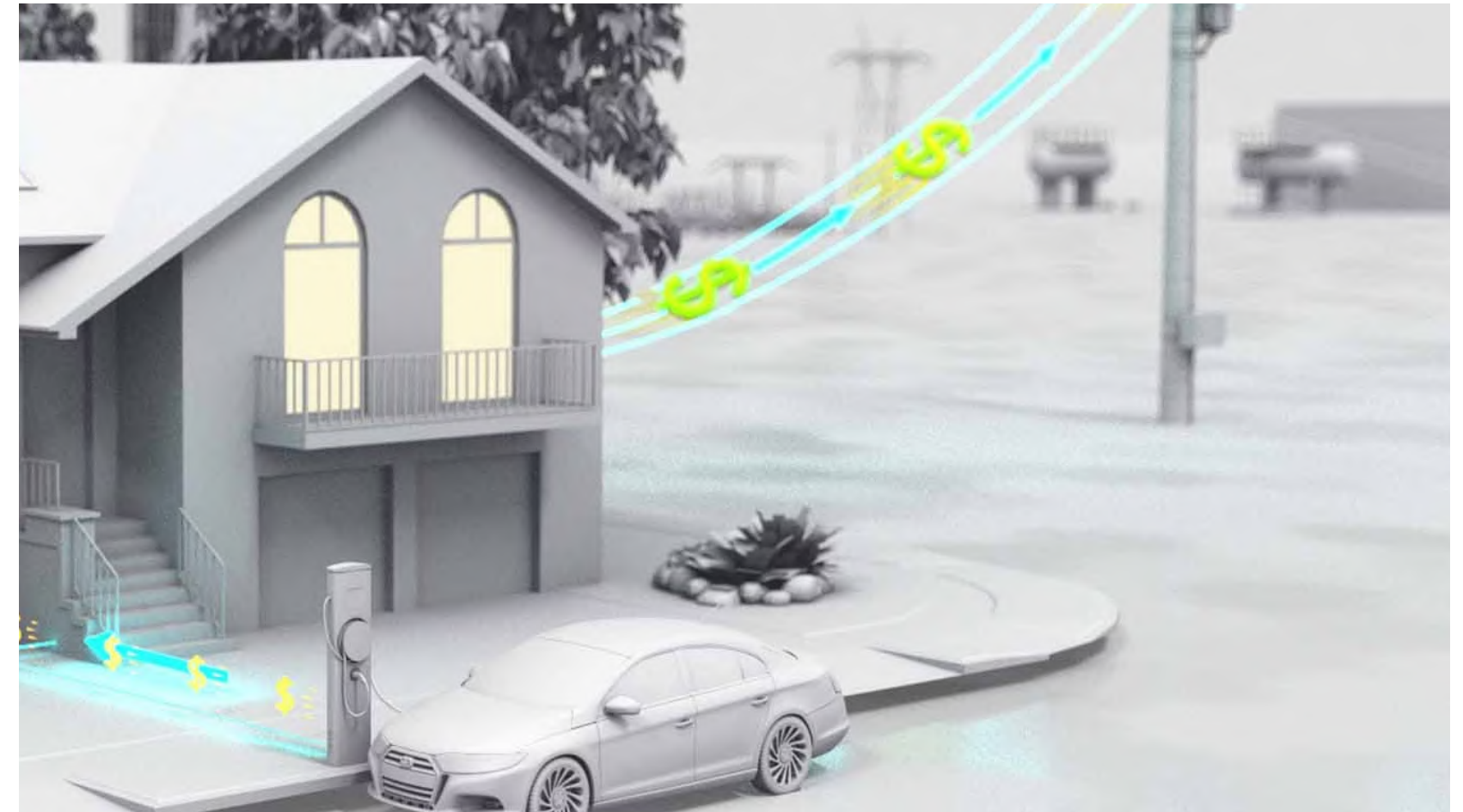
We **facilitate** customers' bidirectional charger installation and enable them to **earn** money by selling energy to the grid.

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:

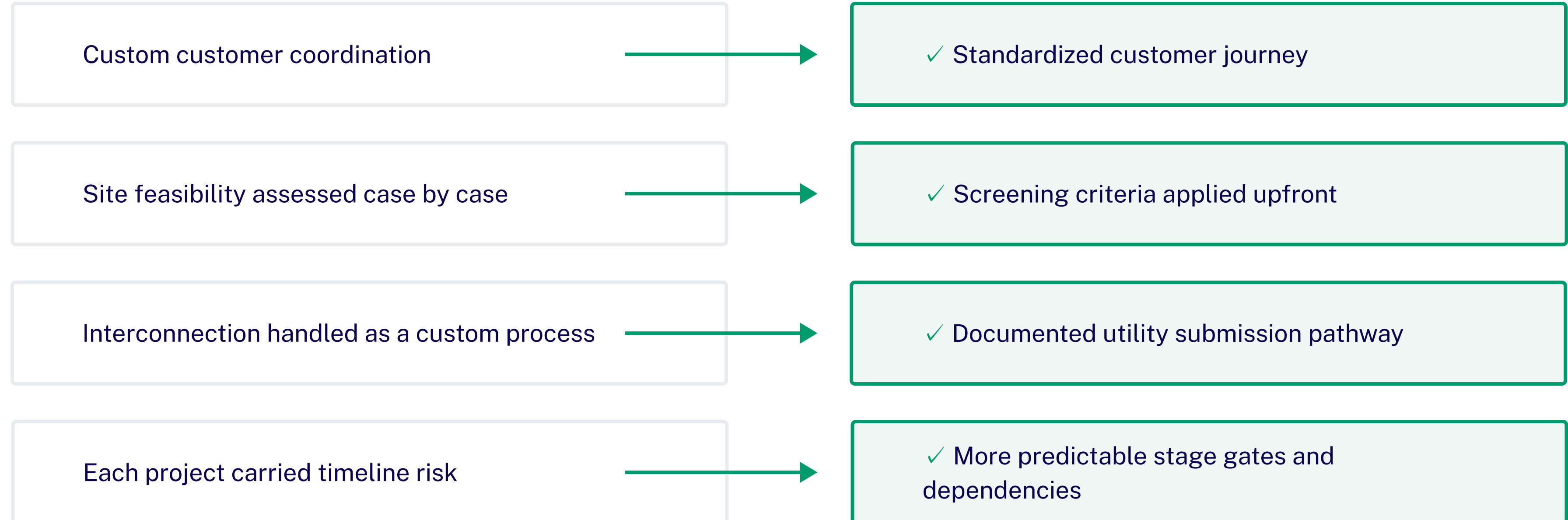
- Demonstrate grid support with four V2G chargers on a single multi-family site
- Install 100 V2G EV chargers

From first-of-a-kind to repeatable deployment

STANDARDIZING RESIDENTIAL V2G DEPLOYMENT ACROSS PROGRAMS

First-of-a-kind challenge:

Repeatable approach:



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**



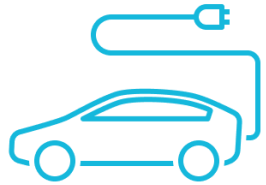
2026 Vehicle-Grid Integration Forum

March 25, 2026

Turning EVs into grid resources requires coordination

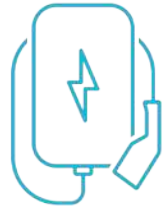


Key enablers of scalable V2X



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 fraction

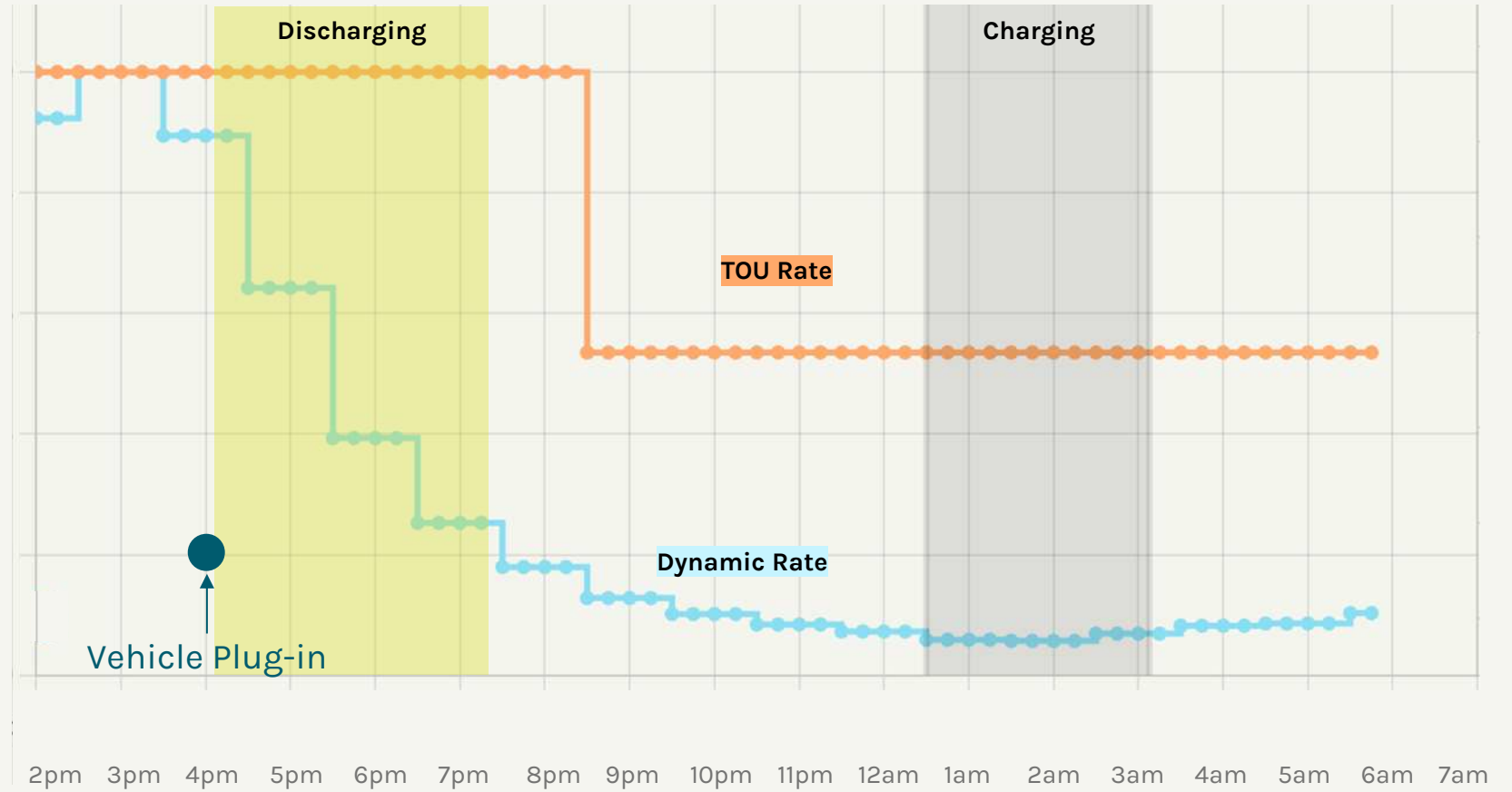


V2X

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

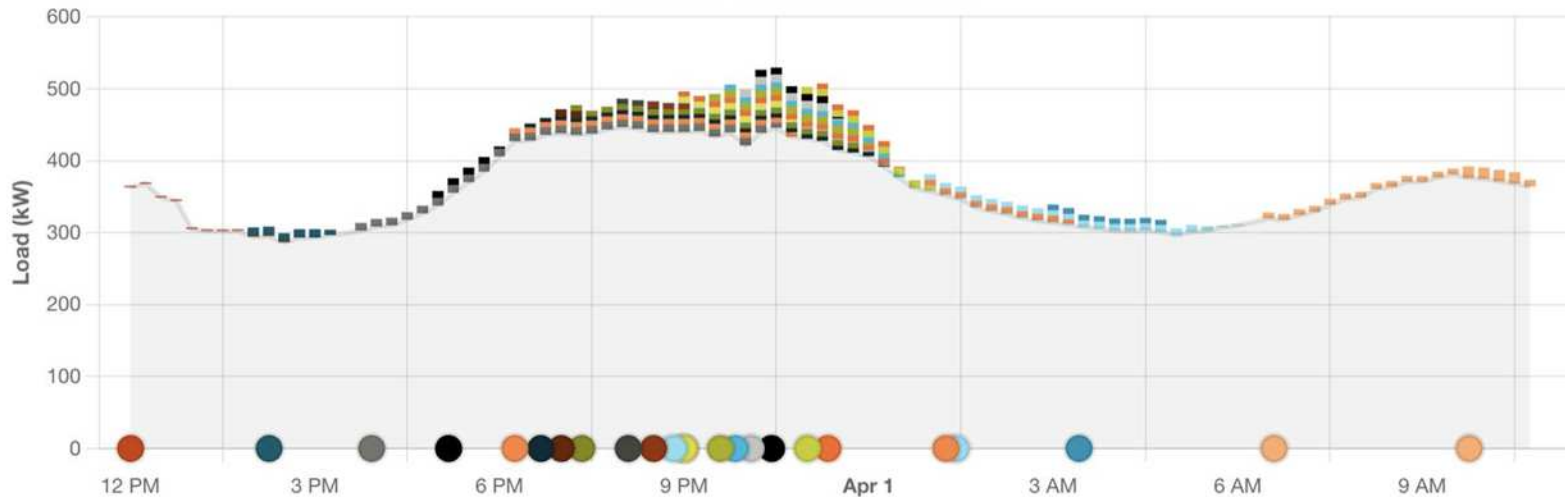
Charging and Dispatching

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

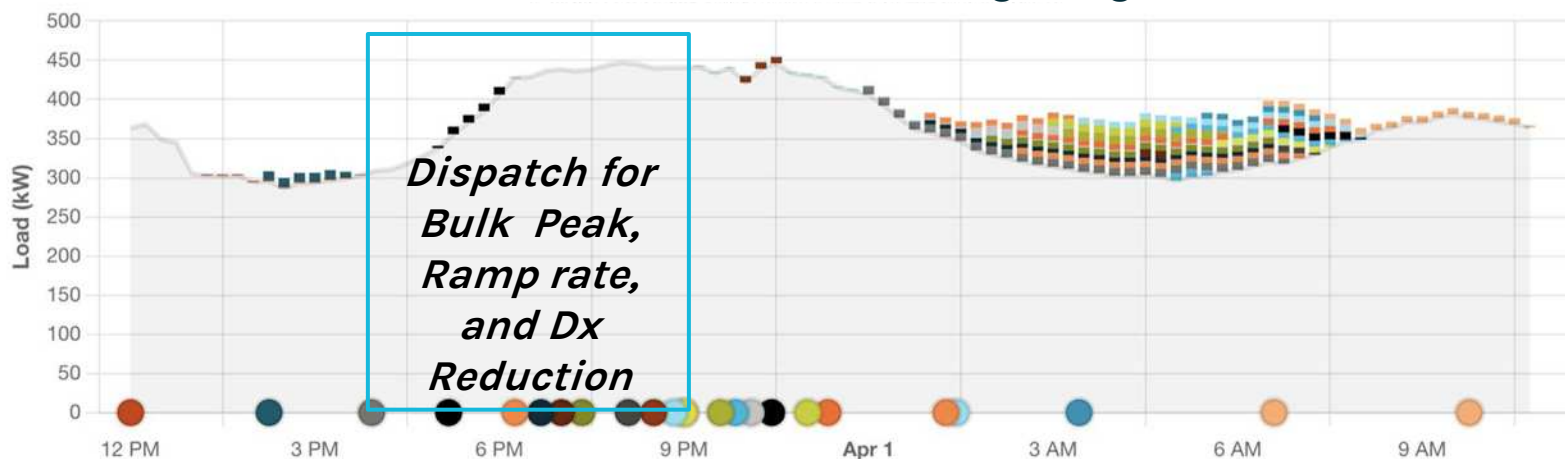


Adding V2X can expand the grid value of EV load orchestration

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

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..

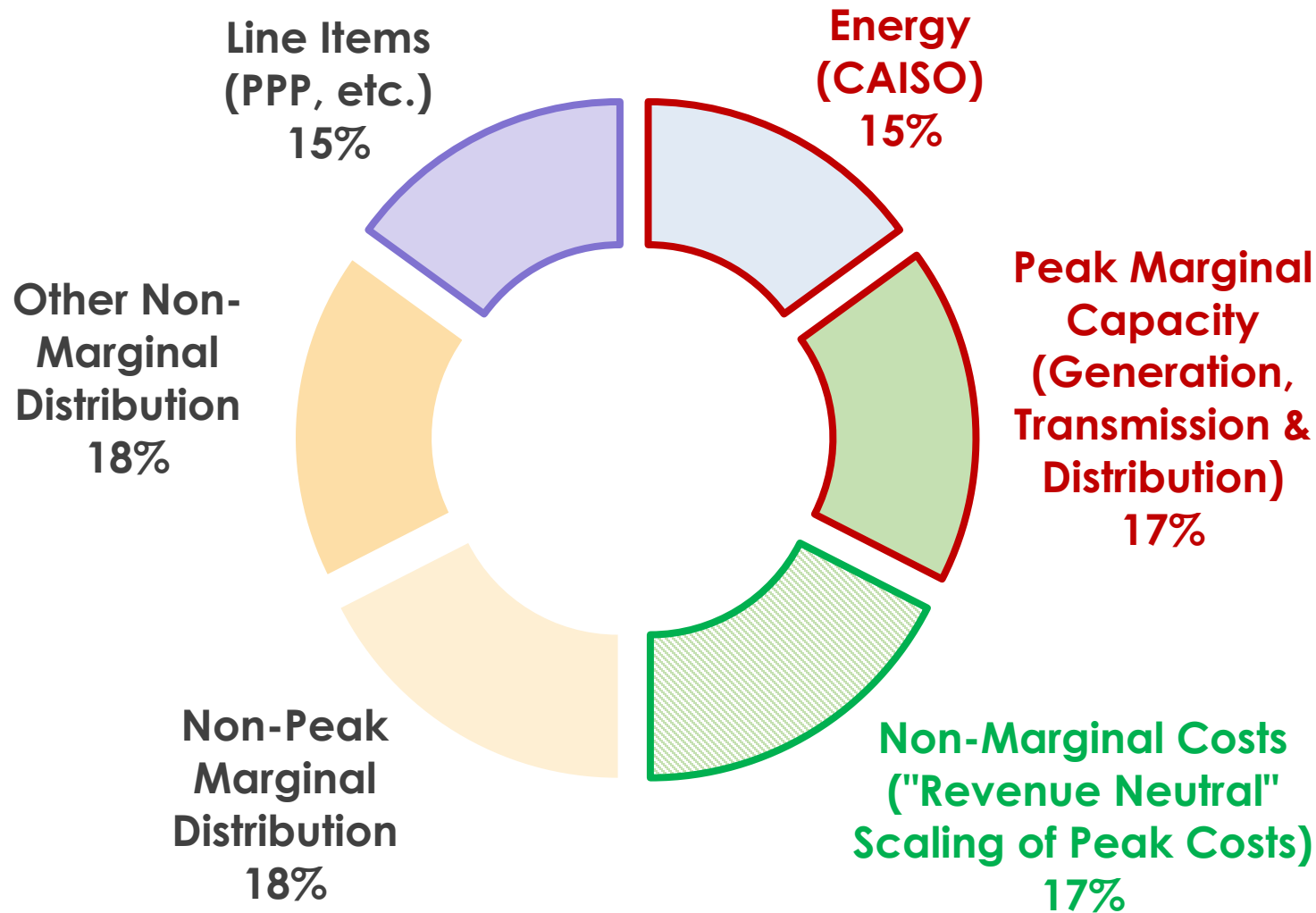
...and customers buy more electricity when it is cheaper



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
Total	100%	40

Regulatory Timeline for Dynamic Retail Rates in CA

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

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 20th 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

VGI Pilots and Analysis



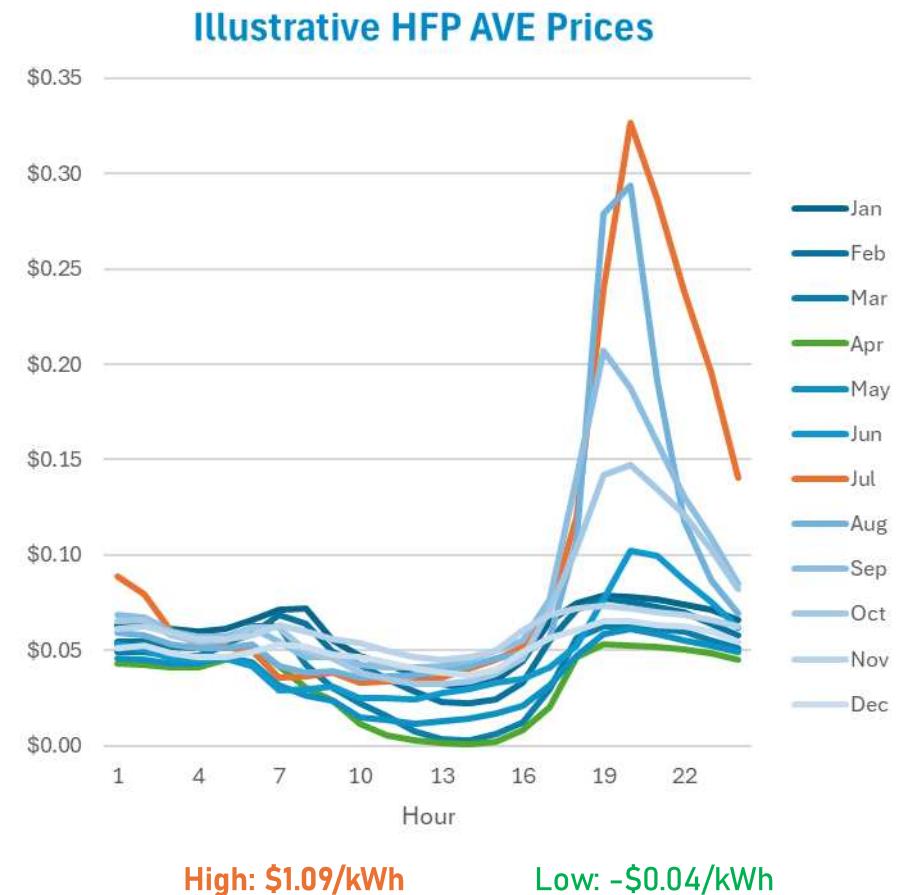
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Hourly Flex Pricing At Glance

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



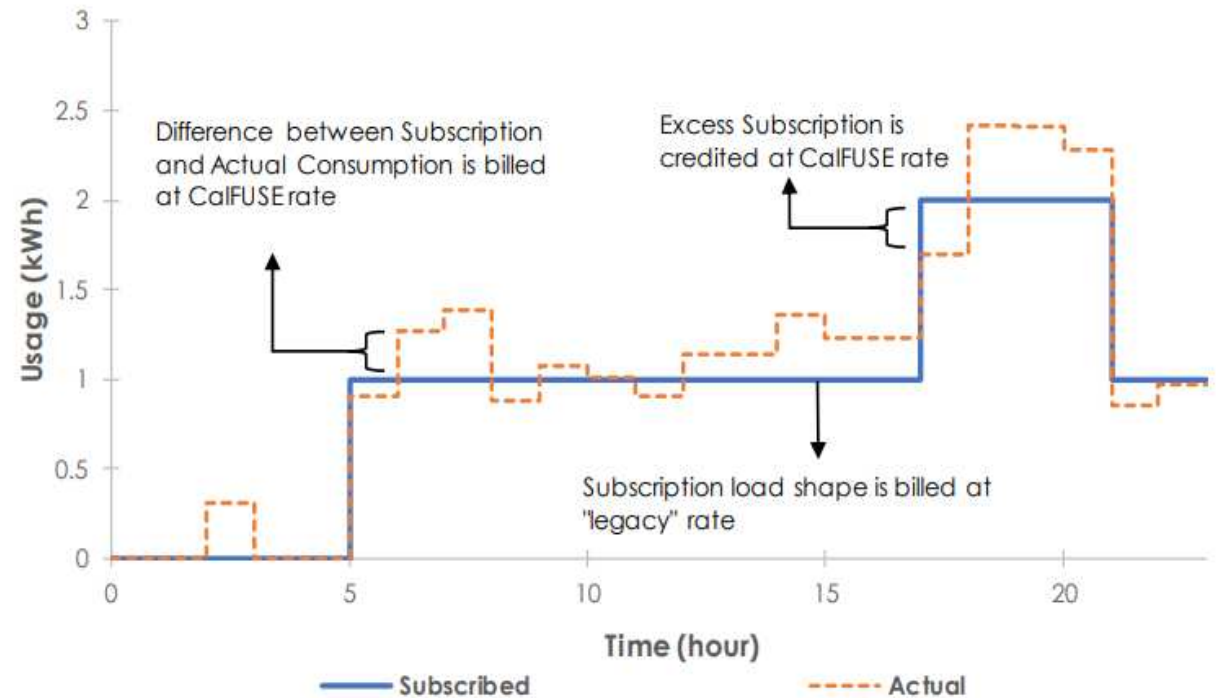
Learn more at <http://pge.com/hfprates>



HFP Rate Design

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


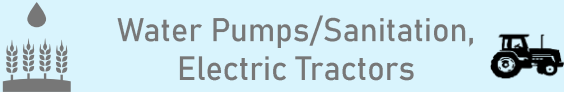


- **HFP Generation** component consists of day-ahead Marginal Energy Cost (MEC) and Marginal Generation Capacity Cost (MGCC).
- **HFP Distribution** component consists of Marginal Distribution Costs (MDC) and prices vary based on load at the circuit.
- **HFP Subscription** is based on the customer's 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

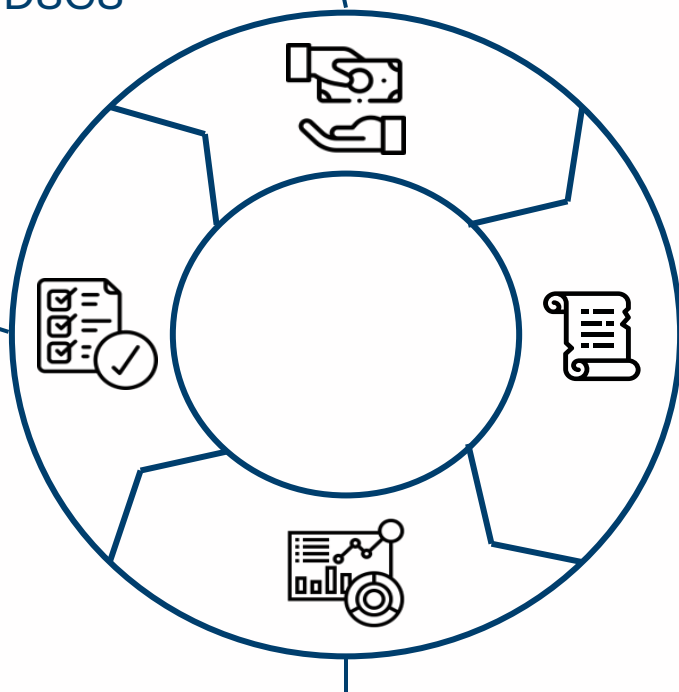
*Peter Chen, Supervisor
Transportation Unit, Energy Research and Development Division*



CEC actions are supporting VGI

Funding Programs

- REDWDS
- EPIC
- DSGS



Technology Standardization

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

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](#)



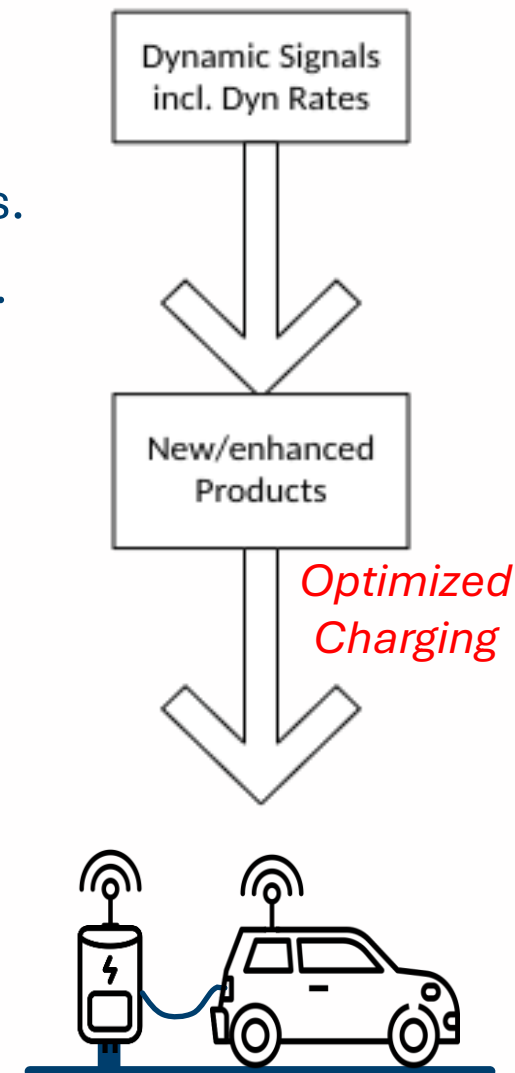
REDWDS

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



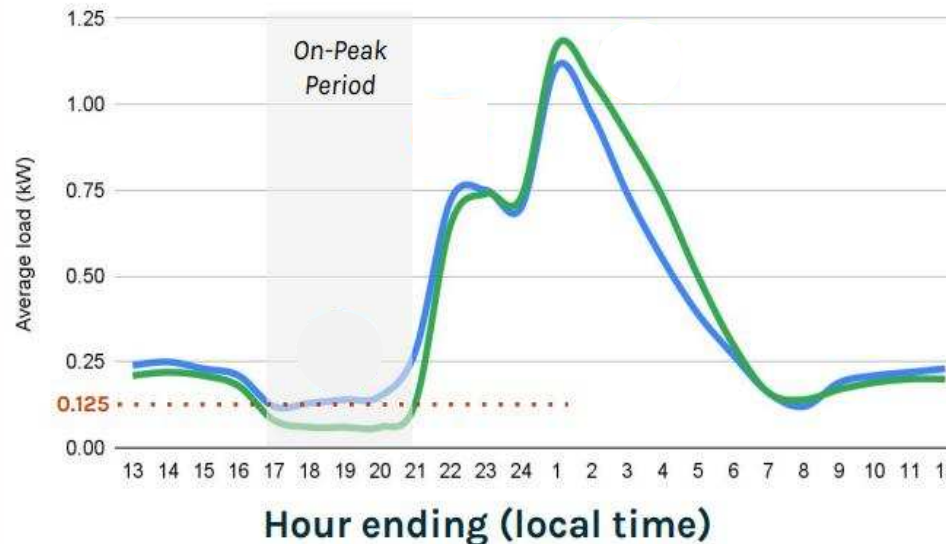


REDWDS

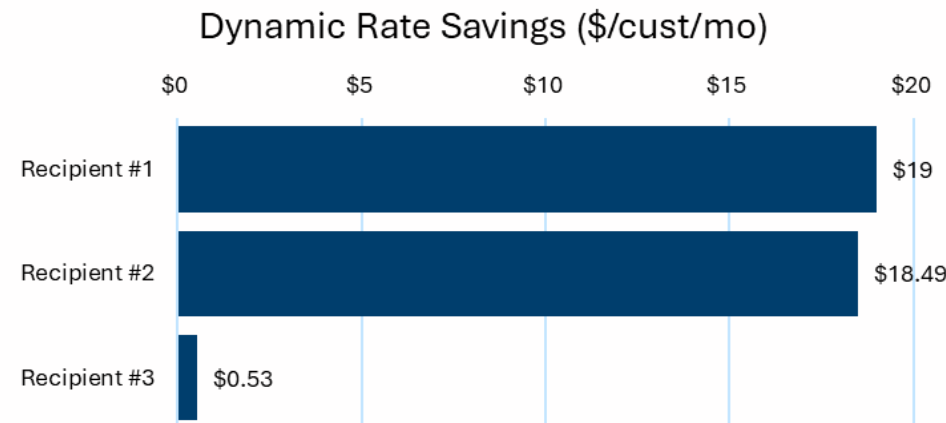
Preliminary data

- 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

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:



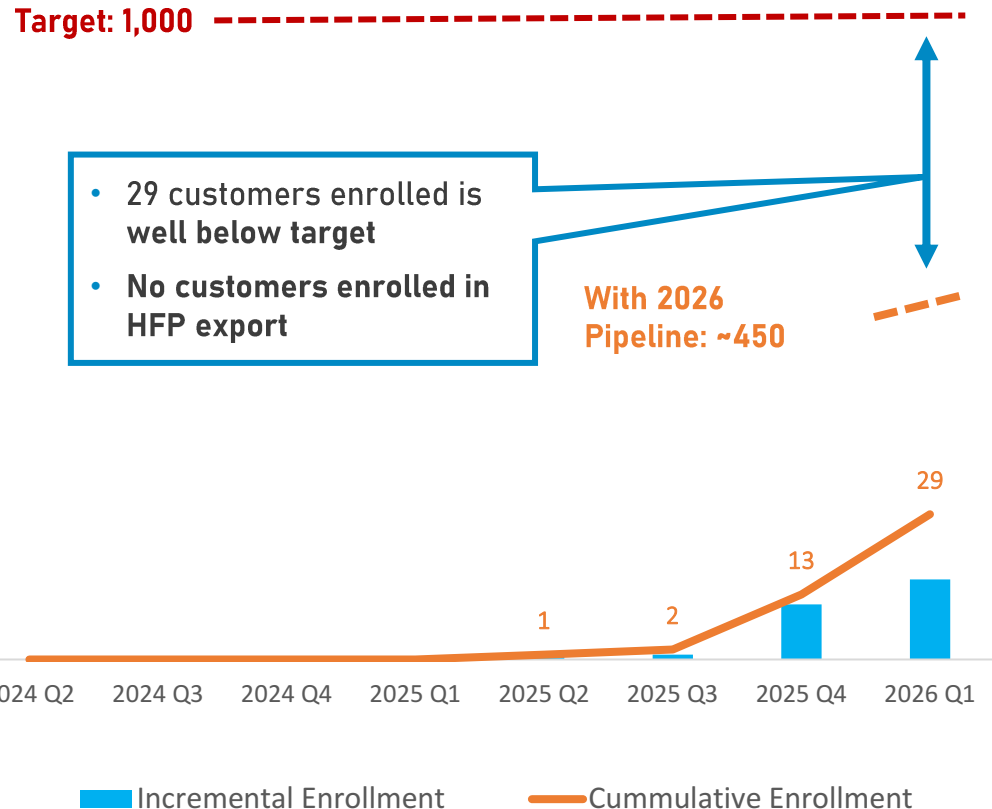
1. Demonstrate the value of V2X/bidirectional EVs for customers and the electricity grid.
2. Reduce the total cost of EV ownership by understanding potential revenue streams for the services provided and identify potential barriers that inhibit access to these revenue streams.
3. Implement a VGI Dynamic 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



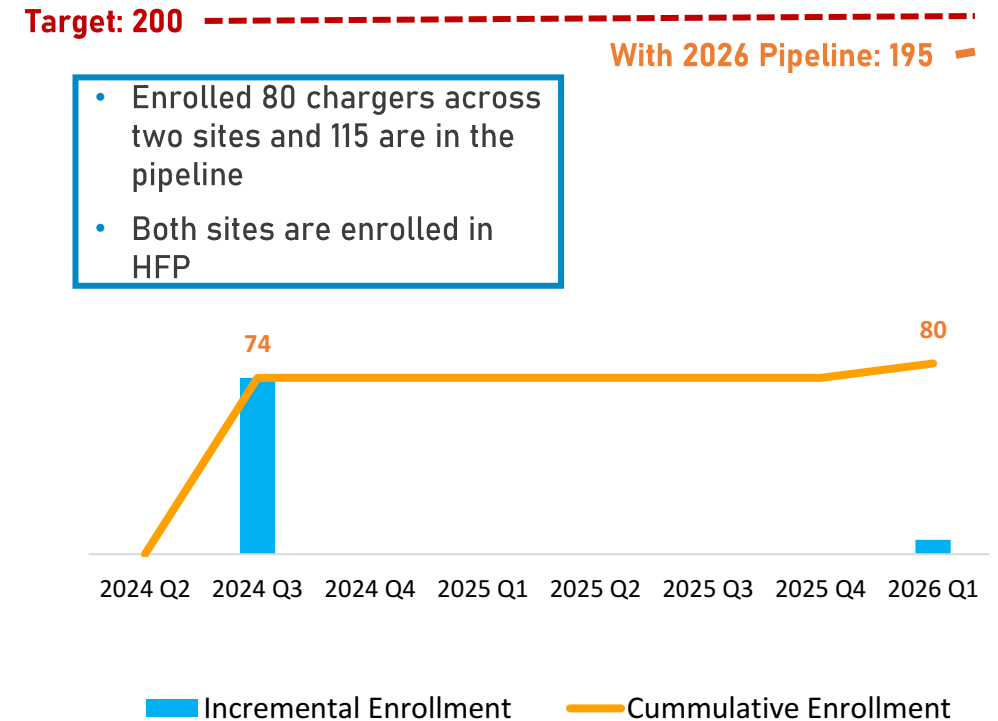
V2X Pilots Enrollment Update

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

For more information about PG&E's V2X Pilots: www.pge.com/vgi

VGI Lessons Learned

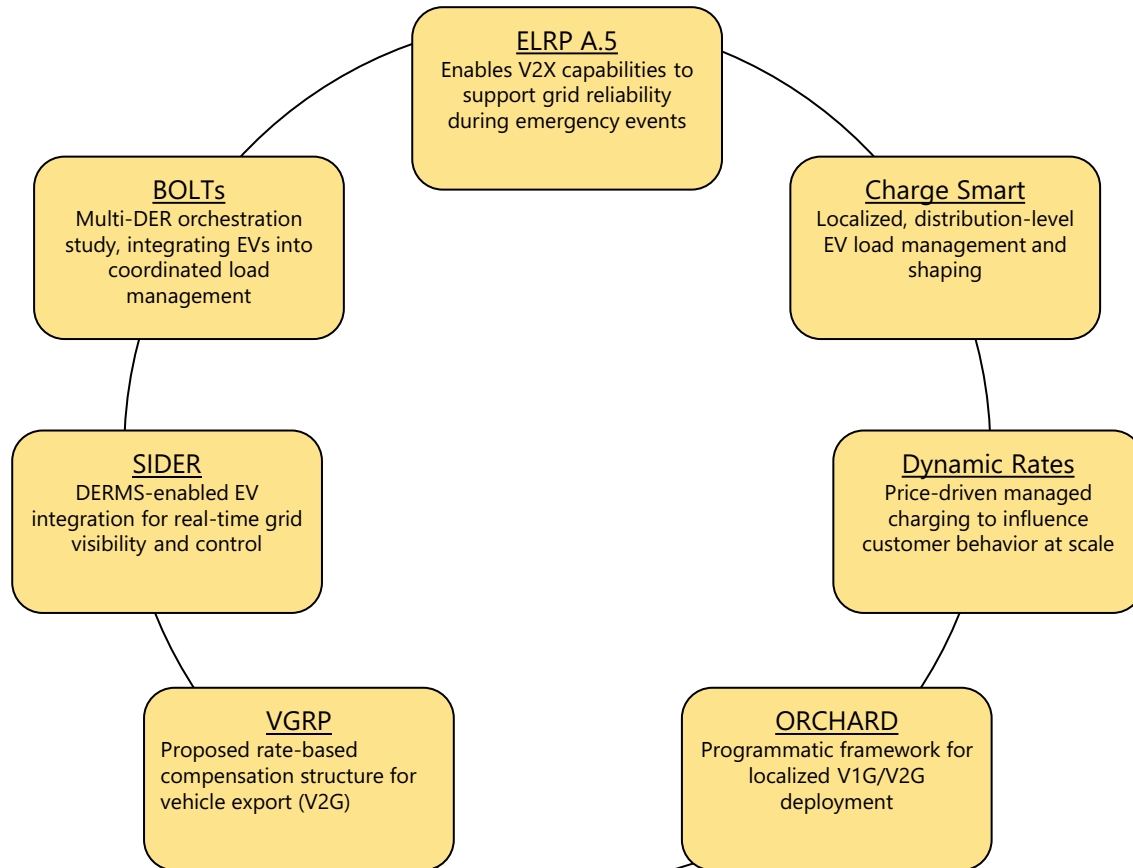


Energy for What's Ahead



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

EFFORTS / PROJECTS



Core Objectives

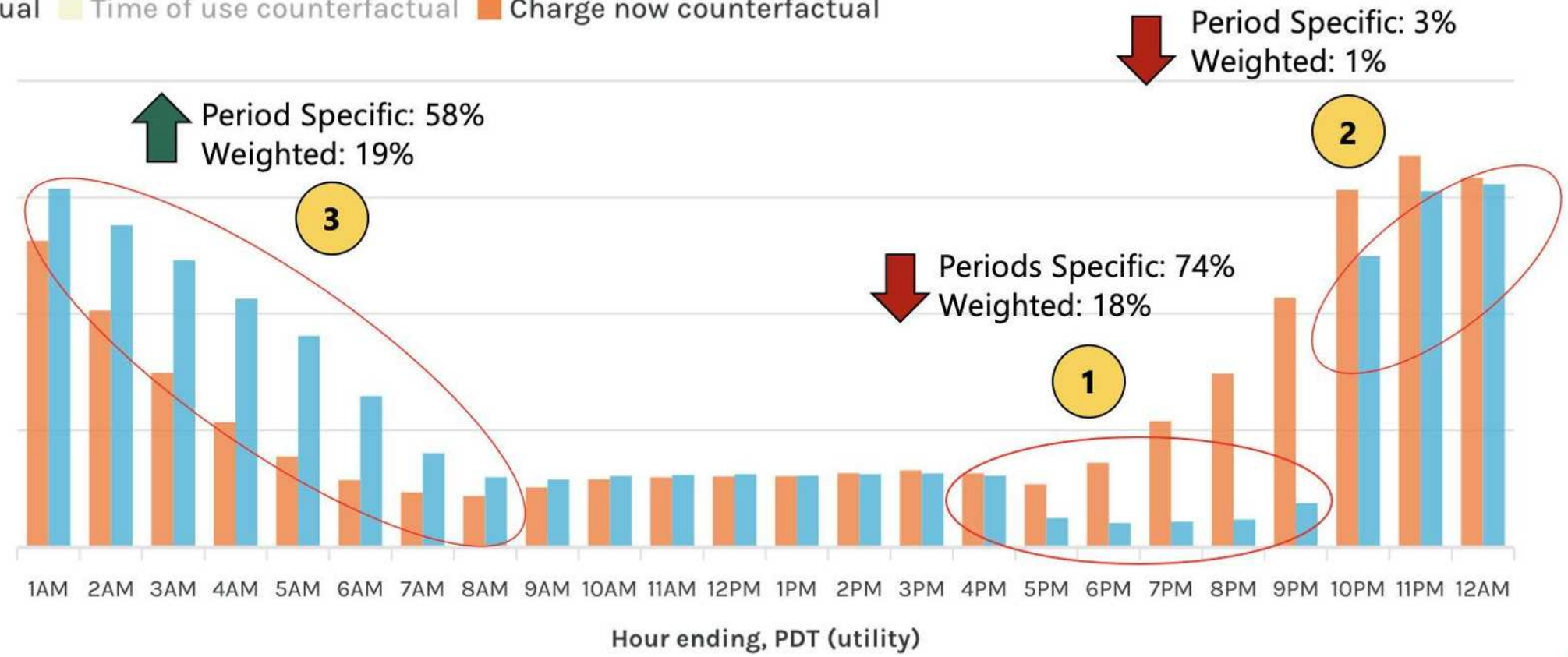
- 1 Optimize Grid Investments**
Defer near-term infrastructure upgrades while minimizing long-term capital needs through flexible load orchestration
- 2 Deliver Customer Value**
Enable tangible customer savings and unlock new revenue streams through participation in grid services
- 3 Scale Demand Flexibility**
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	Background	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	Why Charge Smart - SoCal	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	Value Proposition	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	How Charge Smart Works	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	Program Specifics	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

Use Cases	<ul style="list-style-type: none">• Residential EVs are proving to be a highly effective resource for mitigating secondary peaks, particularly in post-TOU periods where unmanaged load rebound occurs.
Customer Experience	<ul style="list-style-type: none">• 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.
Marketing, Education & Outreach	<ul style="list-style-type: none">• Programs led and endorsed by utilities and OEMs drive the highest participation, reflecting the importance of trusted channels in customer decision-making.
Vendor Management & Ecosystem Readiness	<ul style="list-style-type: none">• Vendor capabilities remain inconsistent in practice, highlighting the need for stronger validation, standardization, and performance accountability across the ecosystem.
Incentive Design & Customer Value	<ul style="list-style-type: none">• 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.

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>Residential: Ford and GM Systems Only (V2X Pilots)</p> <p>Non-Residential: 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	Residential: Ford and GM Systems Only (V2X Pilots) Non-Residential: 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"> Deferred (DAH RTP) Proposed (GRC II) 	-	-
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

Zach Woogen, Executive Director, VGIC | zwoogen@vgicouncil.org

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 30th, 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)