# Vehicle-Grid Integration Forum

*Audrey Neuman*

*Senior Transportation Electrification Analyst*

***Energy Division | CPUC***

March 22, 2024

California Public
Utilities Commission

# March 22nd VGI Forum Agenda

- Welcome and Introduction (9:00-9:20 a.m.)
- **Part 1—CPUC Energy Division and CEC Staff Introduction** (9:20-10:20 am)
  - **Objective:** Provide background information on relevant VGI work areas at the CPUC and CEC to provide a foundation for further discussion at the Forum and in the relevant proceedings.
- **Part 2—Identifying Near-Term VGI Solutions to Support Flexible/Scaled Service Agreements and Deployment of Automated Load Management** (10:30-11:40am + 12:50-1:45 pm)
  - **Objective:** Identify whether there are quick-wins to address technical or regulatory barriers related to leveraging VGI technology to enable utilities to advance options for flexible/scaled service agreements.
- **Part 3—Identifying Future Procedural Priorities and Topics for Future VGI Forums** (2:00-3:45 pm)
  - **Objective:** Identify additional needed action on VGI priorities, including grid connection barriers, which could be dealt with later in the TE proceeding, or in other proceedings as appropriate.

# Part 1: CPUC Energy Division and CEC Staff Introduction

# VGI Definition

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 and 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.

# VGI Forum Objectives from D.22-11-040

- Provide a venue to comprehensively discuss VGI topics that cut across multiple proceedings.
- Explore the adopted VGI strategic focus areas.
- Create an opportunity for further guidance on VGI policy, and for strategic communication, information sharing, and discussion of relevant VGI issues with stakeholders.
- To the extent feasible and relevant, incorporate learning from the VGI Forums into both Funding Cyle 0, Funding Cycle 1, and/or other Commission venues.
- Offer a venue for stakeholders to raise emerging or persistent issues related to VGI.

# Objectives for March 22nd VGI Forum

- Serve as a starting point to address VGI barriers within R.23-12-008, with a focus on identifying quick-wins.
    - Identify VGI solutions to support flexible/scaled service agreements, including identifying quick-wins for enabling automated load management (ALM);
    - Identify other VGI priorities and barriers for the IOUs and OIR to address within the next year, as relevant.
- Tee up potential priorities for the next VGI Forum (end of 2024), and for the CPUC to address in R.23-12-008 or other CPUC procedural venues.
- While there are other critical objectives for VGI (e.g., compensation), they will require ongoing policy development and research, and will not be the main focus of today's forum.

# D.22-11-040 Established 3 VGI Strategic Focus Areas

## 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.

# Key Policy Questions for Consideration at Today's VGI Forum

What are current barriers to expansion of scaled/flexible service agreements and the technology that enables them?

What are the risks, unknowns, and limits of enabling flexible/scaled service agreements at scale?

What are the risks and unknowns associated with increased deployment of Automated Load Management and Power Control Systems?

What are the technical definitions for V2H, V2G, and V2B, and which grid connection pathways should be applicable to each?

What other VGI solutions can support flexible/scaled service agreements in the near-term, and what are the barriers to their deployment?

What are quicker actions the IOUs and CPUC can take to enable pathways for flexible/scaled service agreements and supportive VGI technologies?

What are achievable VGI priorities for the next year?

What longer lead-time priorities should be the focus of future forums and the TE or other CPUC proceedings?

# California Public Utilities Commission

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California Public Utilities Commission

# Status of VGI in the California Demand Flexibility OIR (R.22-07-005)

**Achintya Madduri, PhD**

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

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

## Summary and Goals

1. **Develop policies to achieve widespread customer adoption of automated demand flexibility solutions throughout the state**
   - Reduce long-term system costs through more efficient pricing of electricity to:
     - Make electricity bills more affordable and equitable, and,
     - Enable widespread building/transportation electrification.
   - Develop scalable solutions that accommodate participation by both bundled and unbundled customers
2. **Ensure IOUs comply with CEC's adopted Load Management Standards (LMS) Amendments for dynamic hourly, cost-based rates**

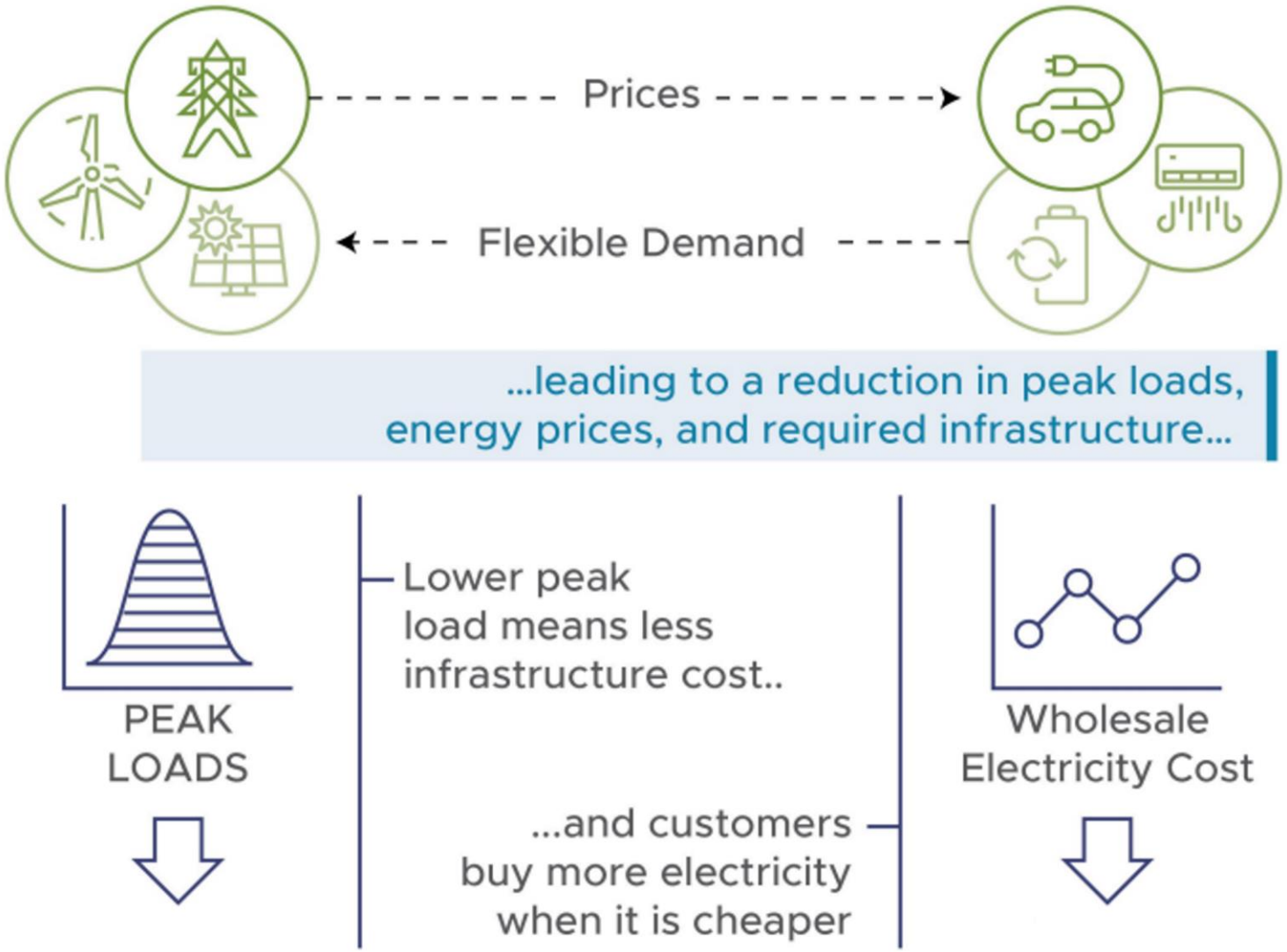
## Relationship to VGI

1. **Will the VGI ecosystem adopt rates that incorporate hourly dynamic prices?**
2. **Will the VGI ecosystem **respond** to rates that incorporate hourly dynamic prices?**

# Key Challenges for California: Affordability and Reliability

- **Residential Rate Challenge: Up to 40% of Californians are experiencing a range of affordability issues.**
  - Forecasts show rates rapidly outstripping inflation over the next decade.
- **Current rate offerings are not incentivizing behavior that can reduce long-term electric system costs**
- **Silver Linings?**
  - EV sales momentum + greater electrification *can* lead to lower household energy costs.
  - A statewide **Flexible Unified Signal for Energy (CalFUSE)** aims to reform rates to create more value for all customers.

# Vision for Demand Flexibility




➔ Widespread adoption of demand flexibility solutions

➔ Reduced peak loads, energy prices, infrastructure needs

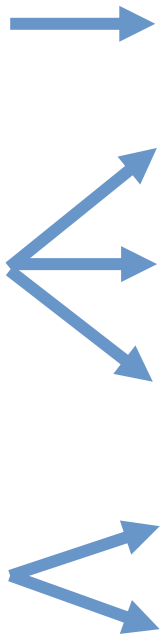
➔ Reduced cost of service



Image Source: PNNL DSO+T Study January 2022

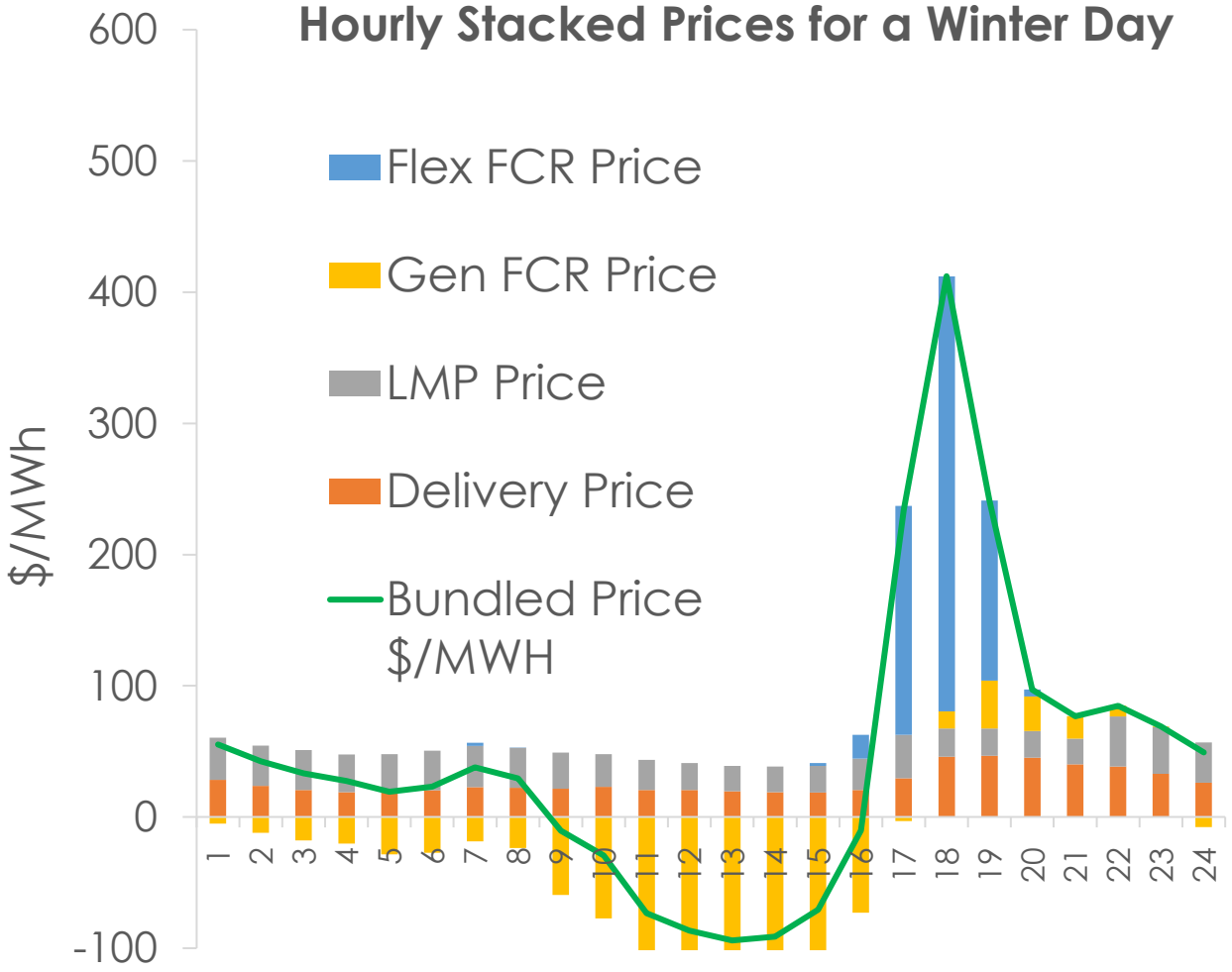
# California Flexible Unified Signal for Energy – CalFUSE "Framework"

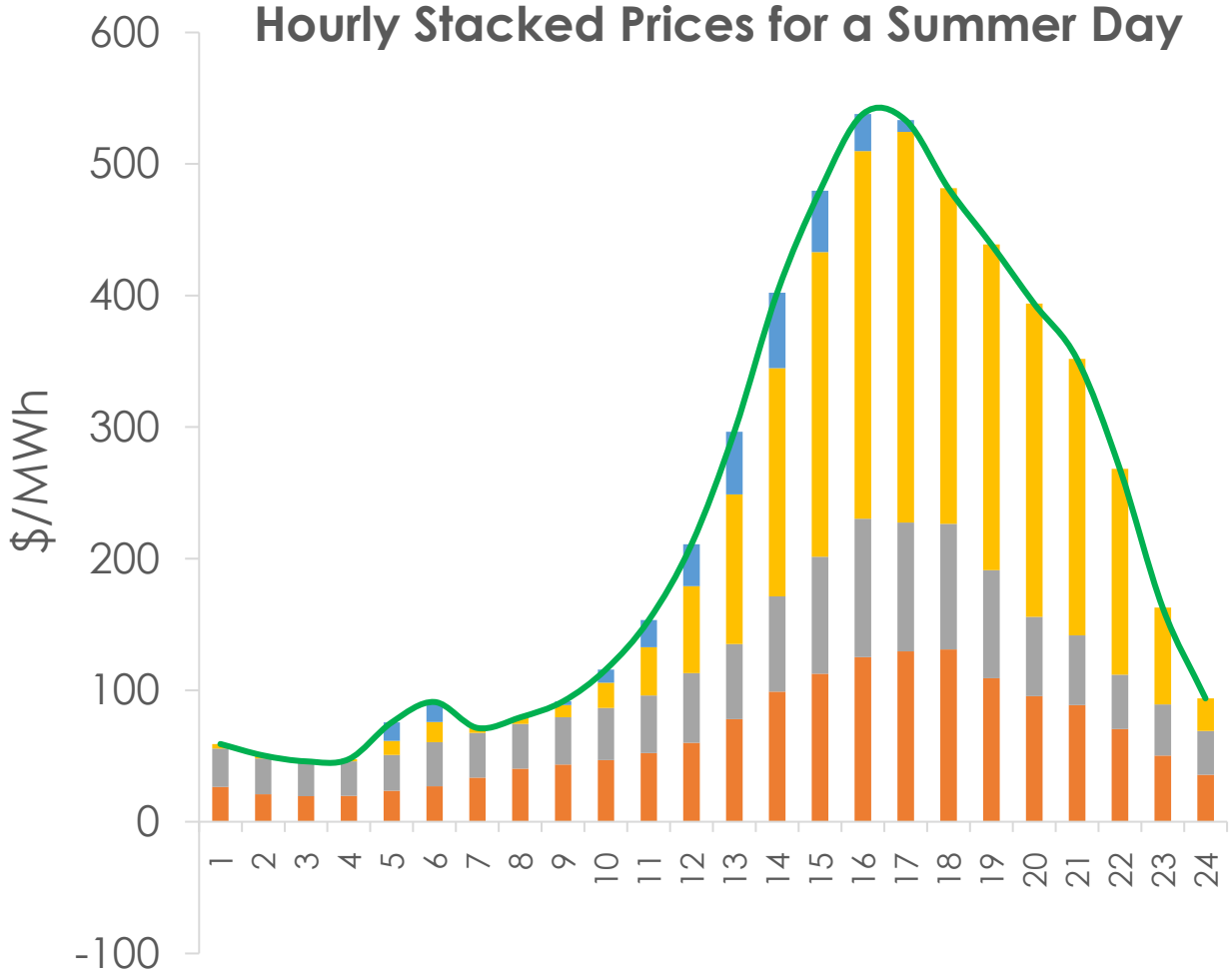
| Three Pillars | Six Elements |
|---|---|
| Price Presentation | Element 1: Standardized price access |
| Rate Reform (Three-prong strategy) | Element 2: Real-time energy prices |
| | Element 3: Real-time capacity prices |
| | Element 4: Bi-directional prices |
| Customer Options for Energy Optimization | Element 5: Subscription option |
| | Element 6: Transactive option |



# SCE CalFUSE Pilot – Illustrative Winter/Summer Prices

Composite Hourly Prices based on Hourly Capacity Utilization & CAISO LMP




FCR = Fixed Cost Recovery

Source: SCE/TeMix/UD "RATES" Pilot funded by CEC (EPIC)

# Timelines for Dynamic Retail Rates in CA

| Date | Milestone |
|---|---|
| **Mid 2024** | **Expanded CalFUSE Pilots to launch in SCE and PG&E(D.24-01-032)**<br>• Pilots include eligibility for VGI (including submetering)<br>• Enrollment target of 150 MW by 2027 |
| **Late 2024** | **PG&E V2X Pilot (SB 676) Phase 2 to launch**<br>• 1-year pilot that will provide export compensation for bidirectional EV charging on a CalFUSE rate for residential and commercial fleets |
| **2024-2026** | **IOUs to submit applications for opt-in dynamic hourly rates in response to CEC Load Management Standards** |
| **2027** | **CEC Load Management Standards require that large IOUs and CCA offer dynamic hourly rates for all customer classes** |
| **2030** | **CEC's adopted CA load shift goal – 7,000 MW** |

## For More Information:

- Staff Proposal on CalFUSE Framework
- Demand Flexibility Rulemaking

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# Interconnection and Distribution Engineering: Vehicle-Grid Integration Forum

**Eric Martinot (Presenter)**
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March 22, 2024

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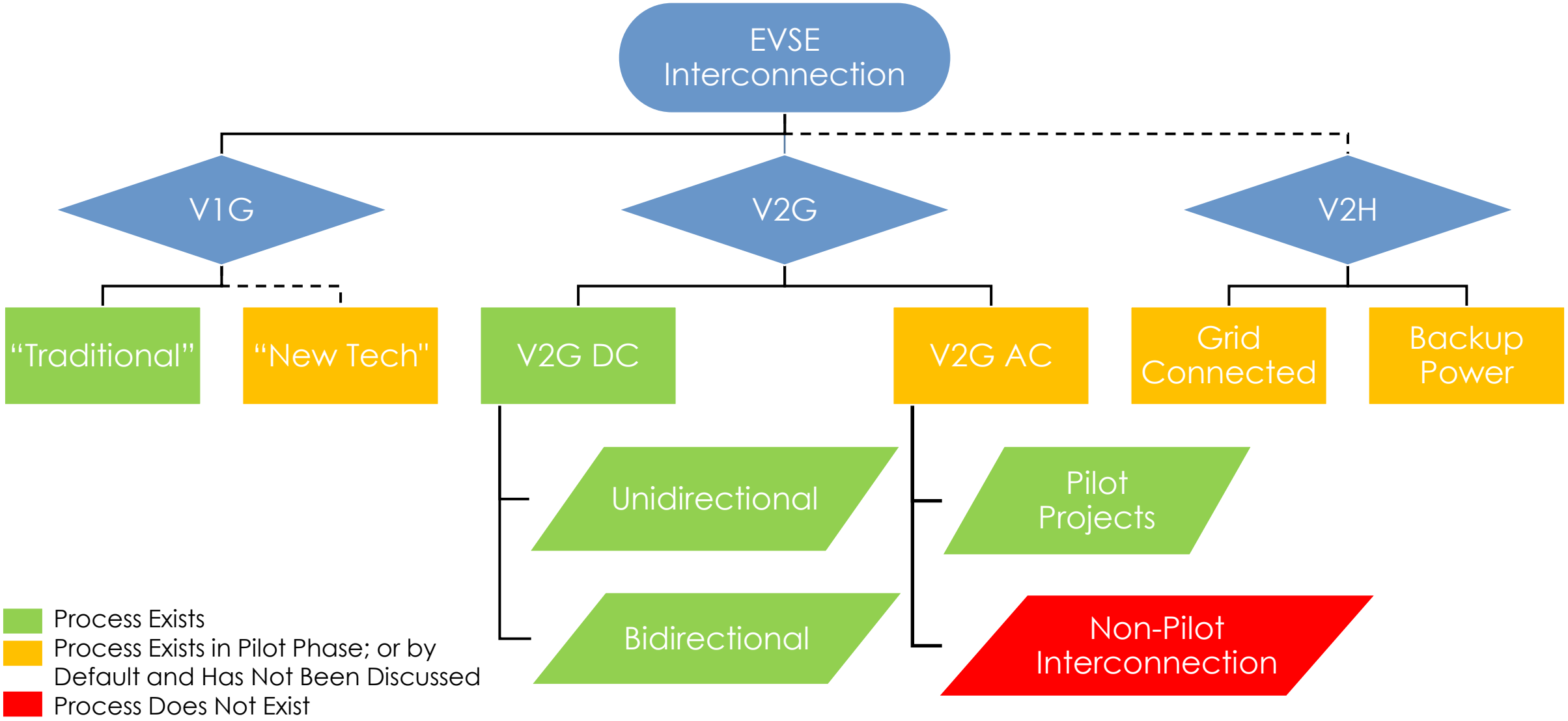
# EVSE Interconnection: Relevant Documents

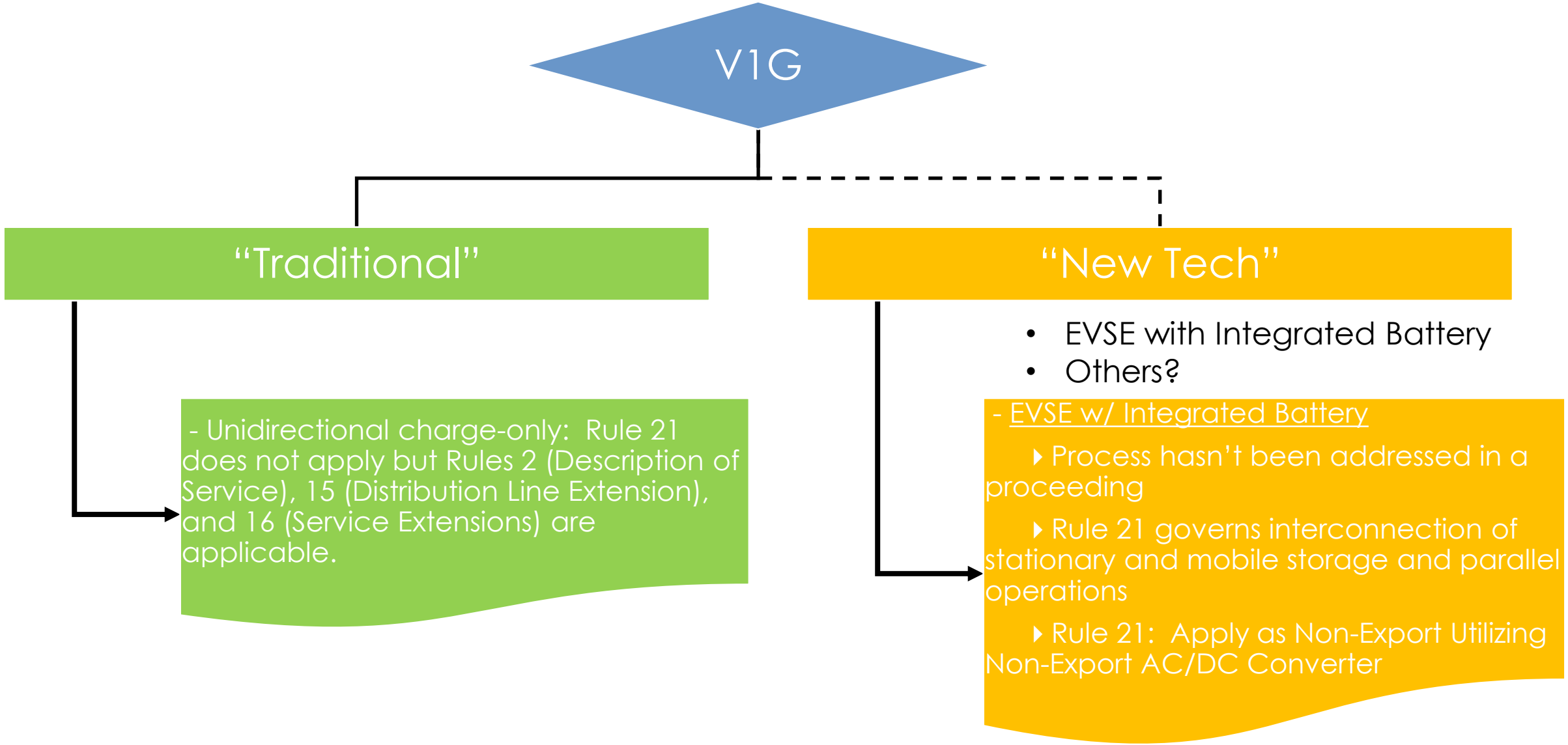
Rule 21 is a tariff that describes the interconnection, operating and metering requirements for certain generating and storage facilities seeking to connect to the electric distribution system.

- **Working Group Three Final Report** (June 14, 2019)
  - Discussed Issue 23: Should the Commission consider issues related to the interconnection of electric vehicles and related charging infrastructure and devices and, if so, how?
- **Final Report of the Vehicle to Grid Alternating Current Interconnection Subgroup** (Dec. 11, 2019)
- **Decision 20-09-035: Decision Adopting Recommendations from Working Groups Two, Three, and Subgroup** (Sept. 30, 2020)
  - Decision D2101027 - Order Correcting Errors in Decision 20-09-035
  - Adopted Issue 23 proposals that had consensus; and guidance for V2G AC systems
- **SDG&E Advice Letter (AL) 3774-E, SCE AL 4510-E, and PG&E 6209-E** (May 28, 2021)
  - Presents (1) the implementation plan for Proposal 23e, which allows V2G DC EVSE that has connected as load-only to switch to bidirectional mode upon receiving PTO from the utility, and (2) proposed temporary pathway for V2G AC EVSE interconnection (V2G AC Pilot)
- **Resolution E-5165: Approval, with Modifications, of Vehicle-to-Grid Implementation Plans and Technical Requirements in Compliance with Decision 20-09-035** (November 5, 2021)
- **PG&E AL 6500-E, SDG&E AL 3955-E, and SCE AL 4718-E** (February 11, 2022)
  - Submitted to incorporate Resolution E-5165's modifications
- **PG&E AL 7125-E, SCE AL 5185-E, and SDG&E AL 4350-E** (January 5, 2024)
  - Recommends (1) extending the V2G AC Pilot with the same requirements for an additional two years, and (2) further study of V2G AC interconnection pathways
- **Resolution Disposing of PG&E AL 7125-E, SCE AL 5185-E, and SDG&E AL 4350-E -- FORTHCOMING**

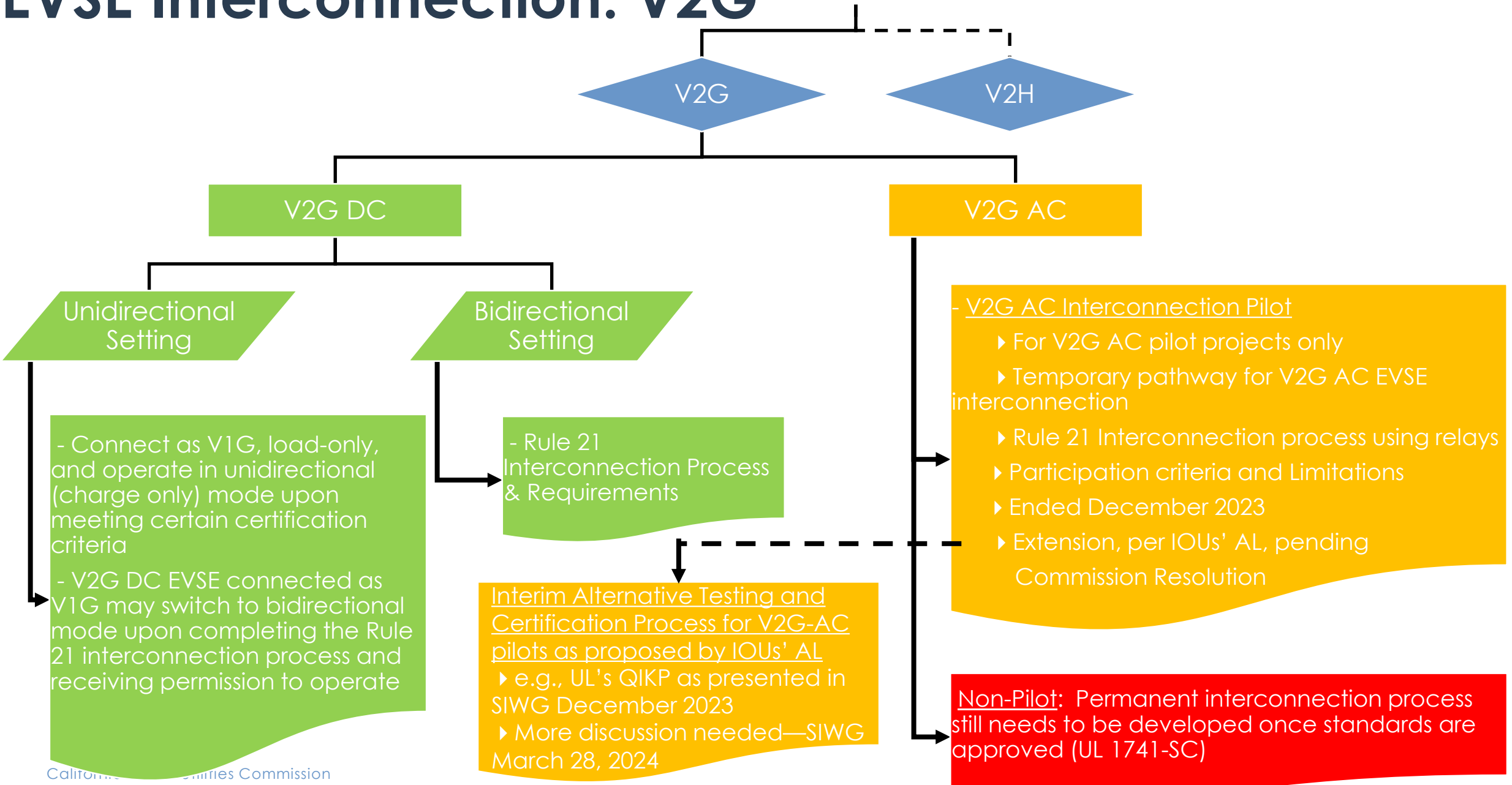
# EVSE Interconnection Landscape



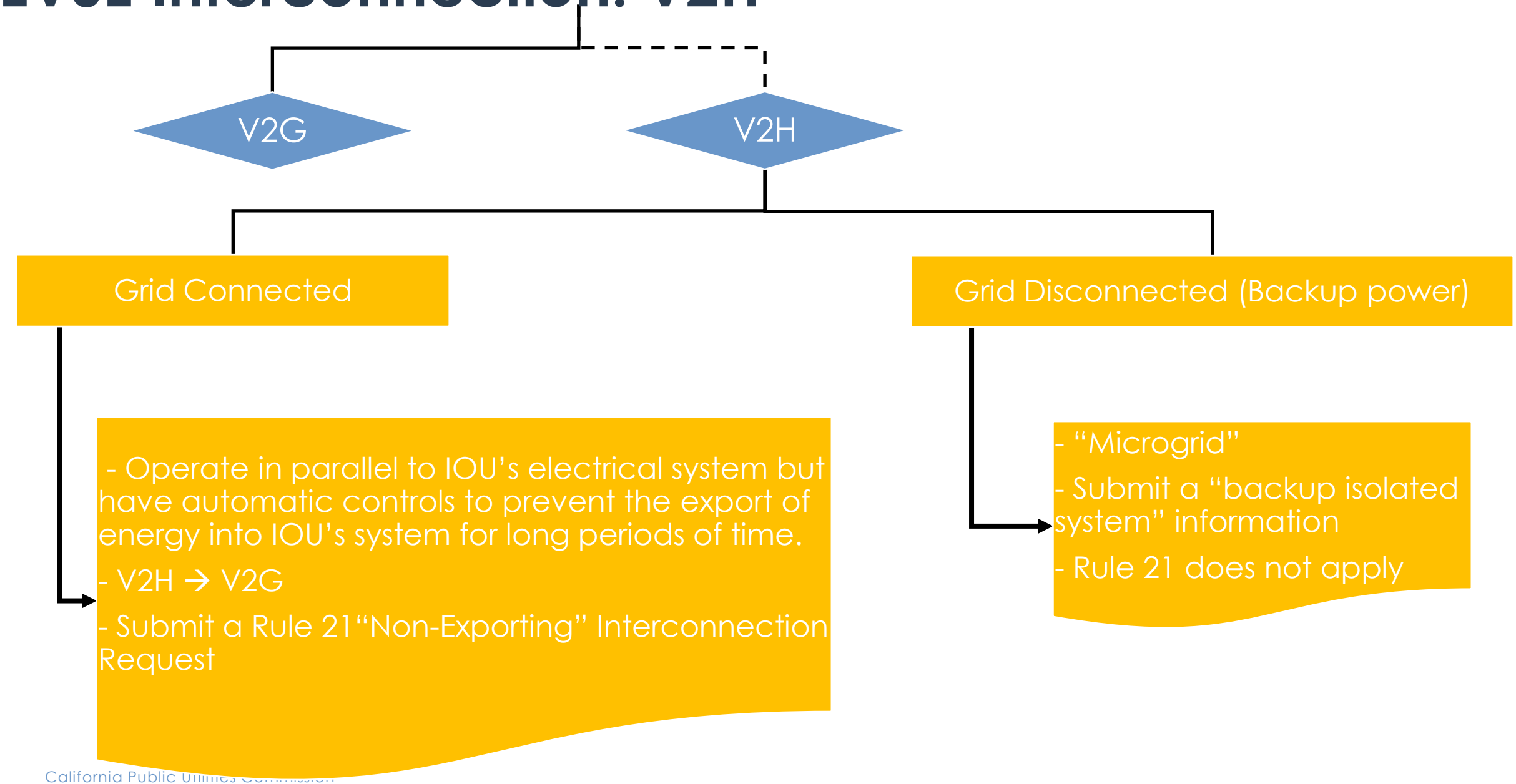
# EVSE Interconnection: V1G



# EVSE Interconnection: V2G



# EVSE Interconnection: V2H



# California Public Utilities Commission

For additional information on EVSE Interconnection contact:

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# High DER Future – Smart Inverter Operationalization Working Group: Vehicle-Grid Integration Forum

**Raymond Breault**

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March 22, 2024

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# Rulemaking 21-06-017: SIOWG - History, Background, & Scope

**Smart Inverter Working Group (SIWG)**

- Started in 2013 in Interconnection Rulemaking
- Developed functional requirements for inclusion in Rule 21 Interconnection Tariff
  - Phase 1: autonomous (default) functions
  - Phase 2: Establish communication protocols
  - Phase 3: Advanced Inverter Functions
- Various Decisions, Advice Letters, and Resolutions determined which smart inverter functions became operational and mandatory.

**Smart Inverter Operationalization Working Group (SIOWG)**

- Formed under Track 3 Phase 1 within the "*Order Instituting Rulemaking to* ***Modernize the Electric Grid for a High Distributed Energy Resources Future***", Rulemaking 21-06-017
- Tasked with identifying priority use cases that leverage the capabilities of smart inverters and provide value to grid operators and ratepayers and recommending how to operationalize these use cases.
- Previously established smart inverter functionality focused on interconnection and operation of export generation from PV and storage, but not the import of electricity staying within the confines of Rule 21.
- The SIOWG looked wholistically at business cases within Rule 21 and beyond to include Import Limits, Electric Vehicles, Community Microgrids, and CAISO Services.
- To better address the scoping questions of the SIOWG, a new broader definition of Smart Inverters was used within the report: "A type of DER unit using controllable DC to AC converters."
- The overarching focus of the SIOWG was operational flexibility – that is, the ability of a power system to respond reliably and safely to changes in electricity demand and generation

- The Smart Inverter Operationalization Cyber Security working group (SIO-CS), was formed concurrently to produce their own report to determine what existing cybersecurity standards should be applied to Smart Inverters & DERMS to ensure communications between the equipment and management systems are secure for DERS

# Key Findings of T3P1 SIOWG Report

The SIOWG has identified **operational flexibility** as the topmost priority:

- To DSOs' ability to use operational flexibility to **optimize capacity utilization** in a high DER future.
- Operational flexibility may **enable faster connections of DER** (generations and loads) **without grid infrastructure upgrades** while **ensuring grid safety and reliability**

The following concepts have been introduced to support operational flexibility.

- **Firm export/import limits** of **power**: Guaranteed upper limit under normal conditions (such as *90% of the lowest value in the Integration Capacity Analysis - Static Grid (ICA-SG))* as more DER (interconnection or energization) are connected to the grid.
- **Non-Firm export /import Capacity:** Non-guaranteed capacity that the DER facility can export or import beyond the Firm limit, such as the highest value in ICA-SG minus Firm limit, as more EVs and other loads need temporarily limited energization while waiting for distribution upgrades. DSOs can authorize Non-Firm export or import capacity when this would not impact grid safety or reliability.
- **Minimum export /import Requirement:** The contractually required minimum export or import in active power (watts) at the Point of Common Coupling (PCC) (i.e., site of DSO revenue meters) during the specified time period.
- **Command export /import:** The Distribution System Operate may issue commands during abnormal grid scenarios to reduce or supplement exports and imports as necessary to promote grid stability

# Business Case E: Operational Flexibility For Electric Vehicles Providing Distribution Services

Business Case E addresses the capabilities and potential requirements for Electric Vehicles to provide distribution grid support services while charging and/or discharging (i.e. bidirectional charging), similar to those provided by grid-connected DER.

- The purposes of EV distribution Grid Services fall into the following Categories: 1)Minimize impact on the grid 2)Provide Benefits to the grid 3)Provide benefits to EV Owners 4)Provide societal benefits
- Six Use Cases were identified as high priority for potentially being able to support the requirements for Business Case E
  - Use Case #E1: EV Peak Power Limiting - Enables demand response and import limiting in cases where planned or emergency load reduction is needed
  - Use Case #E4: Volt-Watt Response by EVs – Utilizes Volt-Watt to reduce power and maintain appropriate voltages to charging EVs when needed
  - Use Case #E8: Coordinated Charge/ Discharge of EVs – Ensure Desired State of Charge is Reached at the Requested Time while considering factors such as forecasted energy prices, load import limits, EV ability to provide other services
  - Use Case #E9: V2G EV as DER (Meeting Rule 21 Tariff requirements) - allows for Vehicle to Grid power flow to aid in load balancing
  - Use Case #E12: Watt-Var function – Allows for more controlled and balanced V2G discharging
  - Use Case #E15: Limit Active Power Export function – Promotes appropriate power discharge into the grid

**Note**: High Level goals were named Business cases("What"), while technical operations supporting the Business Cases were named Use Cases ("How")

# Challenges of T3P1 SIOWG Report

- **Export** and **import** limits must be managed by a **Power Control System (PCS)** and tested at the **Point of Common Coupling (PCC)** (i.e., site of DSO revenue meters) rather than at individual DER connection points.

- **Schedules** and/or **commands** of **export** and **import** limits will need to be **dynamic** and become **more granular**, namely by week, day of week, day, hour of day.

- The CPUC will need to determine the **regulations and tariffs necessary** to **support** this **operational flexibility** fairly and effectively. **Regulations** and **tariffs** need to consider whether **export** and **import** limits should be handled in **one proceeding** or in **two well-coordinated proceedings**. Many DERs have both generation and load attributes.

- **Timelines** for Technology and Testing:

  - The **DSOs** will need to ensure that their **power management systems** (ADMS, DERMS, and others) can **assess** the actual **capacity available** on **different circuits**, **send schedules and commands**, **verify performance**, and **take** any necessary **corrective actions**. The timeframe is an **estimated 2-5 years** of DSO development.

  - The **DSOs** and the **DER facilities** (and their aggregators) will need to support the **communications.** The deployment over an **estimated 2 to 10 years** with pilot projects and a focus on the larger DER facilities.

  - **Testing and certification requirements** will need to be developed and/or updated **to reflect** the new scheduling and command requirements **supported by Power Control Systems** rather than only type-testing of individual DER units. The **estimated timeframe is 1-2 years**.

# Next Steps & Tentative Schedule

- Q1 - Finalize and publish the Business & Use Case report
  - SIOWG Report distributed to Service List February 1
  - Comments & Reply Comments Pending

- Q 1&2 - Cybersecurity Subgroup report
  - Draft received by ED Staff
  - Issue both Reports as Ruling with questions
  - Comments & Reply Comments

- Q 2 & 3 - Staff Proposal - A future Staff Proposal will recommend CPUC actions based on the working group reports, party comments, staff research and analysis, and consultant perspective.
  - Working on detailed schedule
  - Comments & Reply Comments

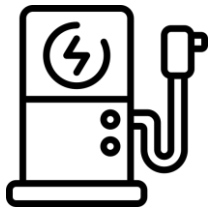
- Q 4 - Proposed Decision TBD


## 2024 CPUC/IOU Vehicle-Grid Integration Forum

# CEC Efforts Enabling Vehicle-Grid Integration

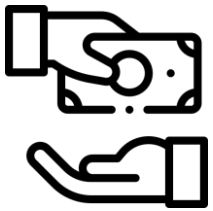
**March 2024** | Jeffrey Lu, Staff

# Four general categories of CEC VGI efforts



## Tech Funding

- EV charger funding via block grants and solicitations
- Charging related and load flex funding



## Regs / Programs

- Load Management Standards (marginal cost rates)
- Demand Side Grid Support (DSGS) Program

## Analysis / Reports

- Integrated Energy Policy Report
- AB 2127 Statewide Charging Infrastructure Assessment

## Standards Support

- Minimum standards for CEC funding
- Needs analysis
- V2G Equipment List

*This slide uses images from Flaticon.com*

# CEC is committed to realizing widespread VGI and load flexibility

- **Over $500M* available** in recent and near-term CEC funding opportunities to support VGI and load flex technology enablement
- Funding may be disbursed via various CEC divisions
  - Fuels and Transportation
  - Energy Research and Development
  - Reliability, Renewable Energy & Decarbonization Incentives

* Availability of certain funds is subject to project performance and/or pending state budget provisions

# Recent opportunities (now closed)

| GFO-22-609<br>REDWDS | GFO-22-612<br>School Bus Bidi Infra | GFO-22-615<br>Innovative MDHD Charging |
|---|---|---|
| • ~$20M in proposed Phase 1 awards, up to another ~$188M in Phase 2 awards<br>• Demonstrate products that manage charging in response to dynamic signals<br>• Phase 2 funds subject to project performance and funding availability | • ~$10.8M in proposed awards<br>• Deployment of bidi charging at school bus yards with enrollment in export compensation program (such as ELRP, DSGS)<br>• Possible Phase 2 funding | • ~$33M in proposed awards<br>• Demonstrate innovative business model or charging solution for MDHD EV applications<br>• Minimum deployment of 10 chargers as part of demonstration |

DSGS = Demand Side Grid Support Program, ELRP = Emergency Load Reduction Program, MDHD = Medium/Heavy Duty

# Pending and upcoming opportunities (1/2)

| GFO-23-306<br>**Grid Supportive Electrification** | GFO-23-309<br>**VPP-FLEX** |
|---|---|
| • $21M available across 3 project groups<br>• Demonstrate products that enable flexible load management for upgrade deferral, DC hub architecture, or grid friendly opportunity charging solutions<br>• March 29 application deadline ***(soon!)*** | • $21M available across 2 project groups<br>• Demonstrate VPP with automated load shifting in partnership with a local government or nonprofit, or interoperable energy management systems for commercial buildings<br>• July 1 application deadline |

# Pending and upcoming opportunities (2/2)

| [GFO # TBD]<br>***Draft* DEBA DER** | [GFO # TBD]<br>**Tech Enablers for EVs As DERs** |
|---|---|
| • $250M available across 3 project groups<br>• Demonstrate deployment of large DERs, VPPs, or load flex aggregation with minimum 6-15 MW capacity<br>• Earliest deployments must be complete in time for summer 2025 and reimbursement will be contingent on DER performance<br>• Anticipated release in next 1-2 months | • $12.6M expected to be available<br>• Would fund research, development, and demonstration of telematics-based metering and AC V2G<br>• Anticipated release June-September 2024 |

DEBA = Distributed Electricity Backup Assets, DER = Distributed Energy Resource, AC = Alternating Current

# PG&E Flexible Service Connection

## VGI Forum – Program Overview

***Panel 1: IOUs present on status of and barriers to Automated Load Management and Power Control Systems to support flexible/scaled service agreements.***

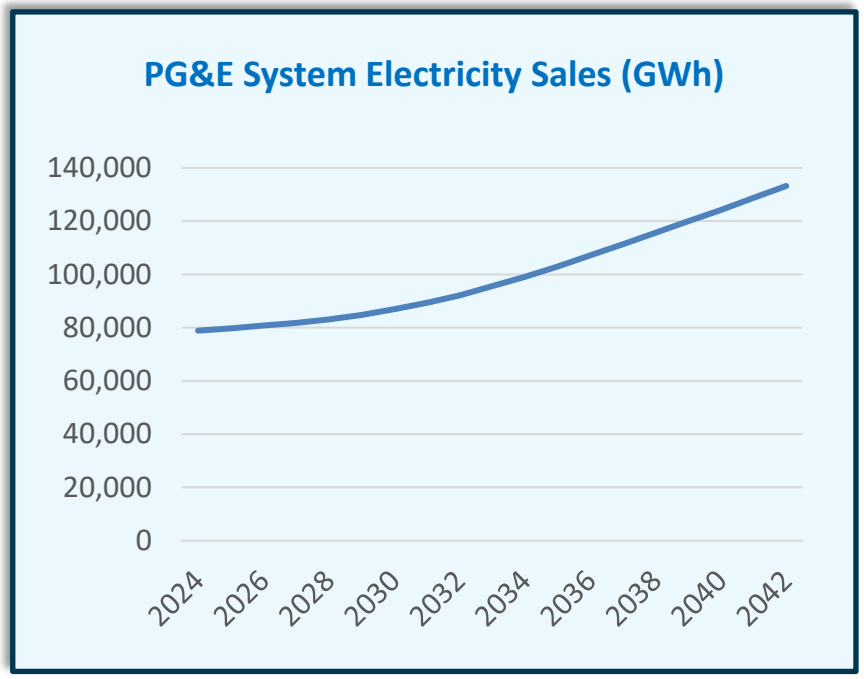
March 2024 – Grid Innovation

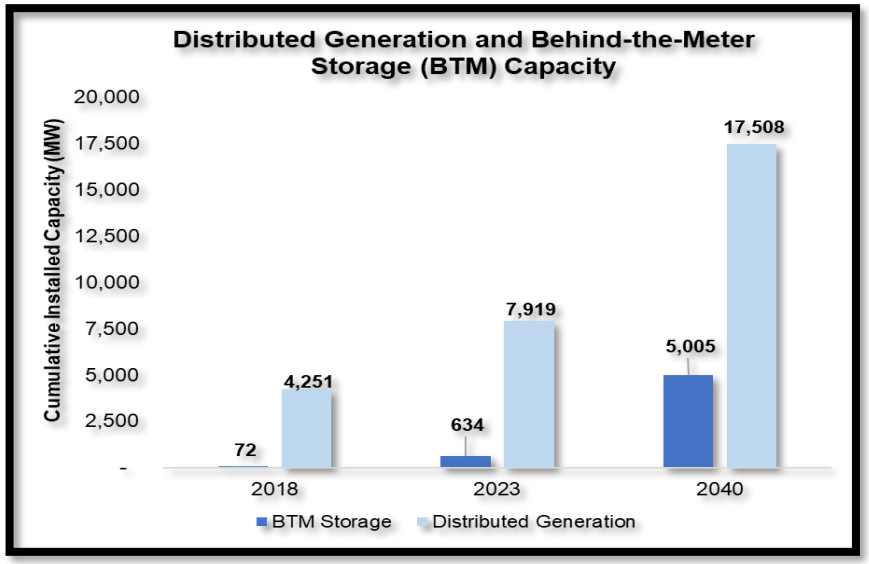
Together, Building a Better California

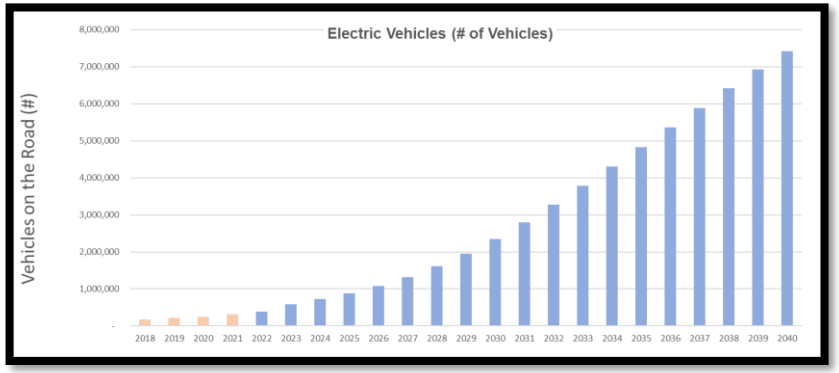
# Context Setting: The need for new DER Management Tools & Processes

PG&E anticipates increased load driven by EV adoption and building electrification – coupled with continued adoption of distributed solar, significant growth of behind-the-meter storage and flexible loads.

New tools and processes to orchestrate Distributed Energy Resources (DERs) are necessary to safely and effectively operate the grid.




*7/25 PG&E Innovation Summit announcing DERMS Initiative*

*Source: PG&E's Spring 2023 Annual Load Forecast*

# PG&E's Flexible Service Connection Concept

Flexible Service Connection aims to allow customers with controllable loads to connect to the system without waiting for a service upgrade as a bridge solution

## Customer Value

***Quicker connections***

- Avoid Long Wait Times
- More Available Energy
- Improved Utility Partnership

## Distribution Value

***Improved customer experience***

- Unlock Available Capacity
- Higher Grid Utilization
- Operational Flexibility

## Energy System Value

***Support EV industry goals***

- Timely Energization
- Cost Effectiveness
- Manage Grid Constraints

# Real World Example of Potential Benefits

| Hour of the Day | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 1 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 2 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 3 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 4 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 5 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 6 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 7 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 8 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 9 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 10 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 11 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 12 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 13 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 14 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 15 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 16 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 17 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 18 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 19 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 20 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 21 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 22 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |
| 23 | 71% | 71% | 71% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 71% | 71% |

**STATUS QUO: Planning Limits for 3.8MW EV Charging Station**

| Hour of the Day | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 100% | 100% | 100% | 100% | 100% | 100% | 92% | 100% | 99% | 100% | 100% | 100% |
| 1 | 100% | 100% | 100% | 100% | 100% | 100% | 98% | 100% | 100% | 100% | 100% | 100% |
| 2 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| 3 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| 4 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| 5 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| 6 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| 7 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| 8 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| 9 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| 10 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| 11 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| 12 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| 13 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| 14 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| 15 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 87% | 100% | 100% | 100% |
| 16 | 100% | 100% | 100% | 100% | 100% | 100% | 89% | 94% | 83% | 100% | 100% | 100% |
| 17 | 100% | 100% | 100% | 100% | 100% | 100% | 75% | 83% | 71% | 100% | 100% | 100% |
| 18 | 100% | 100% | 100% | 100% | 100% | 100% | 59% | 68% | 64% | 100% | 100% | 100% |
| 19 | 100% | 100% | 100% | 100% | 100% | 100% | 63% | 66% | 56% | 100% | 100% | 100% |
| 20 | 100% | 100% | 100% | 100% | 100% | 100% | 64% | 66% | 59% | 100% | 100% | 100% |
| 21 | 100% | 100% | 100% | 100% | 100% | 100% | 75% | 76% | 73% | 100% | 100% | 100% |
| 22 | 100% | 100% | 100% | 100% | 100% | 100% | 85% | 87% | 84% | 100% | 100% | 100% |
| 23 | 100% | 100% | 100% | 100% | 100% | 100% | 85% | 94% | 88% | 100% | 100% | 100% |

**FLEX CONNECT: Can Support Full Request ~90% of the time on Average**

**Key Takeaway** – If a customer can reduce consumption for 3 months during 3-11PM we can serve their full load request

# Customer Journey for participation in Flexible Service Connection MVP

In 2024 PG&E will be working to standardize customer engagement and site evaluation processes based on initial learnings

## 1 Identify

Customer identifies a site and PG&E checks eligibility

## 2 Evaluate

PG&E evaluates suitability for MVP & provides Customer with historical site analysis

## 3 Agree

Customer evaluates benefits and agrees to program terms

## 4 Build

Customer contracts with aggregator and controls vendors

## 5 Deploy

PG&E supports Customer with testing and commissioning

## 6 Operate

PG&E communicates day-ahead hourly capacity forecast

# Flexible Service Connection Operations

## 24hr ahead DER customer import limits

**Enabling customers with eligible loads to connect sooner by dynamically managing consumption based on grid availability**

Customer and DER data

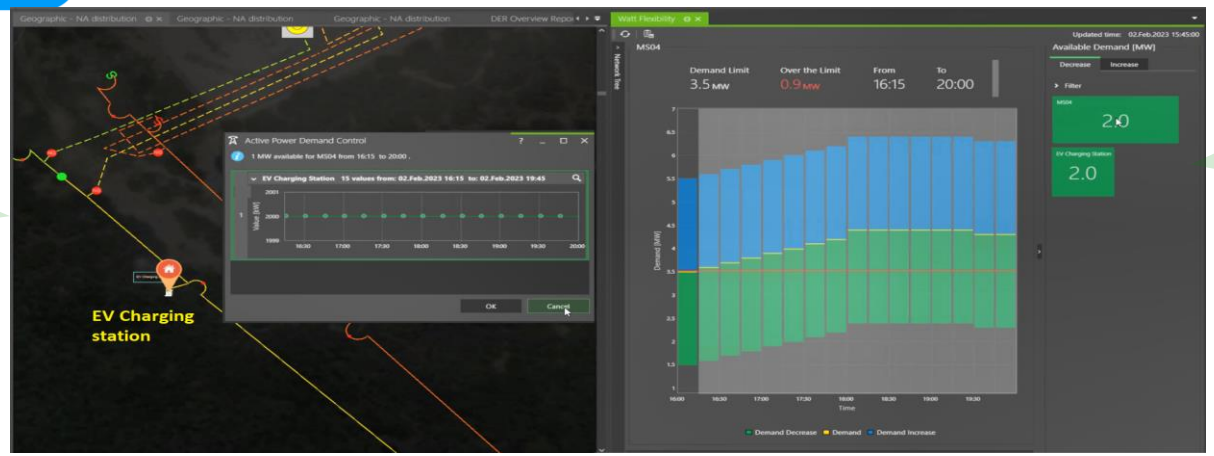
Flexible service parameters

Network connectivity data

Historical data

Weather data

Microsoft Azure



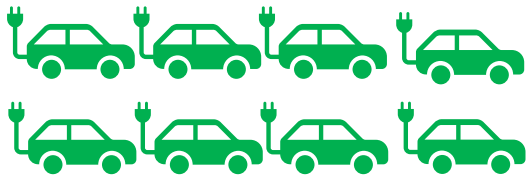

Determine dynamic site limit

Detect feeder loading capacity constraints

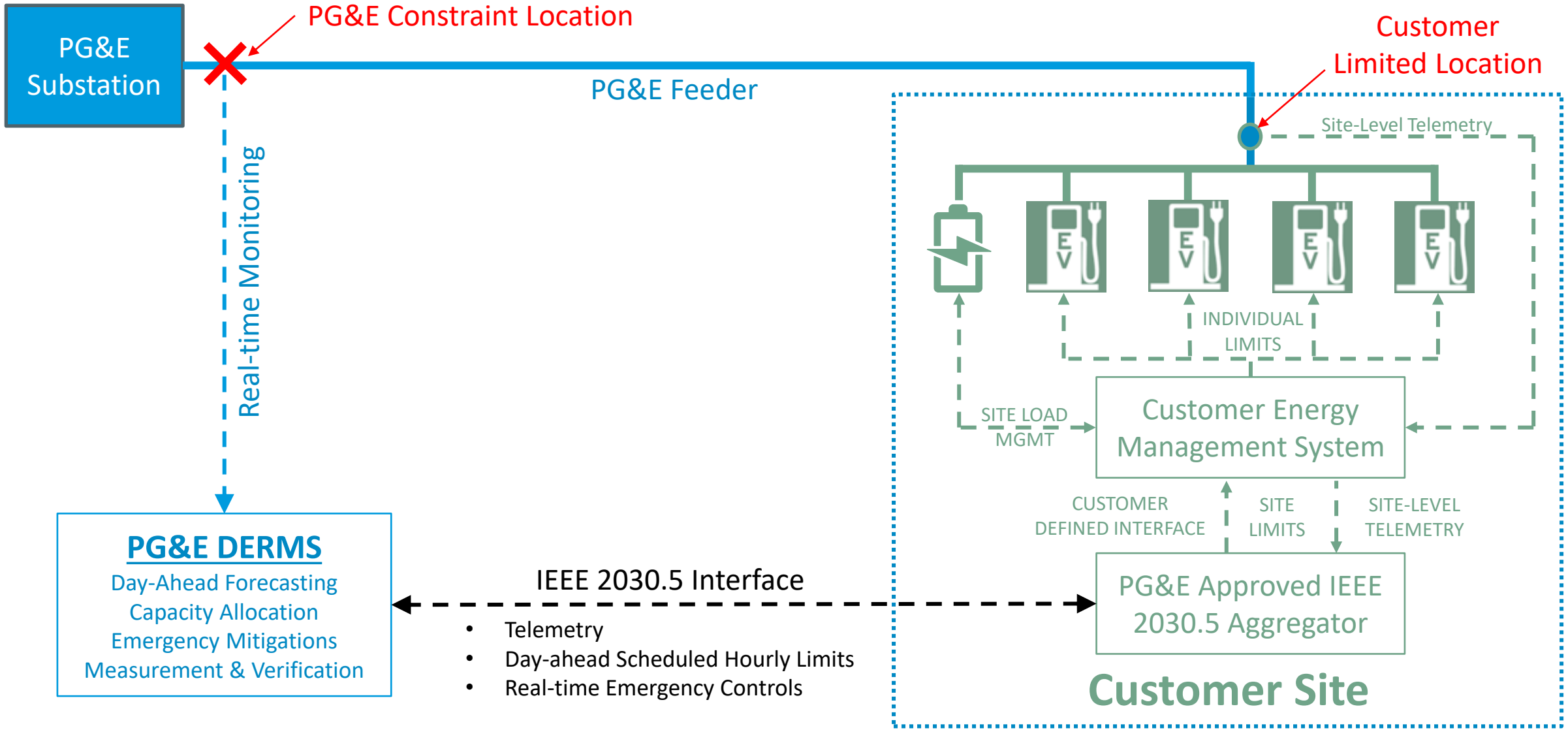
Re-calculate flexible capacity

Telemetry

Dynamic site limits



# Illustrative Site Configuration



# Agility is required to rapidly iterate toward a future end state

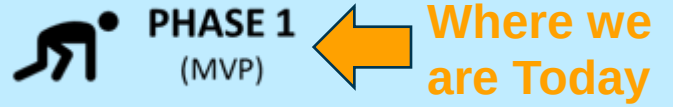
Capabilities, technology and processes are still being developed and require validation and further evaluation prior to scaling

**Key Customer considerations:**

- Value vs cost
- Customer experience impacts
- Local site technology readiness and timing
- Ability to adhere to dynamic limits

**Key Utility considerations:**

- PG&E technology and DERMS readiness – Forecasting, dispatching, and integrations with 3rd-party and internal systems
  - Key enhancements based on initial deployment already identified
  - Geographic expansion of DERMS capabilities
- Building confidence in customer-owned solutions and ensuring failsafes and contingencies
- Operational integration
- “Next-customer” considerations





# Thank you

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Together, Building
a Better California

# Vehicle Grid Integration Forum
## Load Control Management Systems (LCMS)

VGI Forum – March 22, 2024

Roger Salas P.E., MSEE
Distribution System Analysis Principal Manager

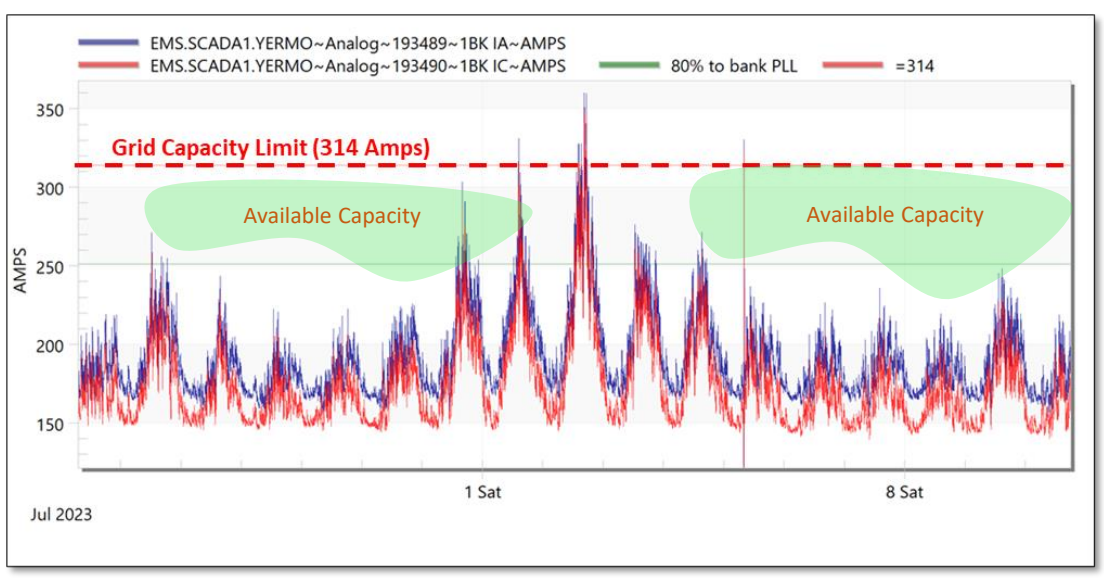
# Discussion Topics

- LCMS Use Case As Bridging Solution
- Challenges to Implement LCMS
- SCE LCMS pilot
- SCE Pilot Schedule
- Q/A

# LCMS Use Case As Bridging Solution

## Faster Service Energization

- Increased demand is causing capacity constraints in certain areas of the grid.
  - Many grid upgrades will take years 3+ years, which prompts utilities to start the planning and designing of grid upgrades much earlier than before.
- Much of new electrical demand is from flexible load systems (e.g., charging stations)
- While grid upgrades are completed, the service can be energized and allowed to consume electrical power as function of time (seasons, time of day) depending on customer control capability
- Allowing LCMS to support faster service energization will allow for maximum utilization of grid assets and good customer service while traditional infrastructure is built
- LCMS is highly depending on load profiles and will not be option in all cases

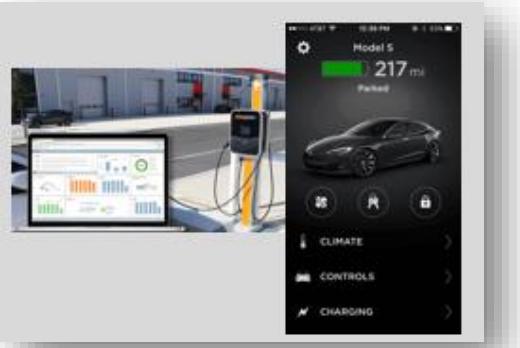



An LCMS can be used to allow the flexible load (e.g., charging station) to use more capacity outside the peak period

# Challenges in Implementing LCMS

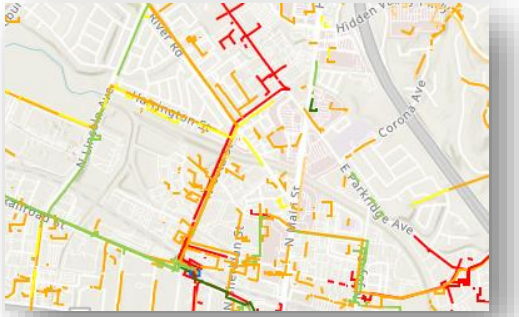
## Technology Challenges

- There are no national standards for testing and certifying LCMS equipment
- SCE participating in development of UL3141. While the standard is developed, SCE will evaluate and accept LCMS for system that meet SCE's technical requirements. Not ideal for engineering efficiency but will do for now.




## Operational Challenges:

- No established operating procedures for operating the grid when using LCMS technology
- SCE developed operational procedures
  - What actions are taken in real time if LCMS fails?
  - How are real time operations coordinated with facilities that employ LCMS control?




## Legal/Regulatory Challenges

- Currently no established regulatory procedures to accept this type of technology in the planning and operation of the distribution system
- SCE filed and received CPUC approval to implement an LCMS and related LCMS agreement via Advice Letter 5138-E/E-A, which we are using for pilot participants

# LCMS Pilot

SCE initiated an LCMS pilot project to test the operational capabilities and challenges associated with using LCMS


**Localized Autonomous LCMS:**

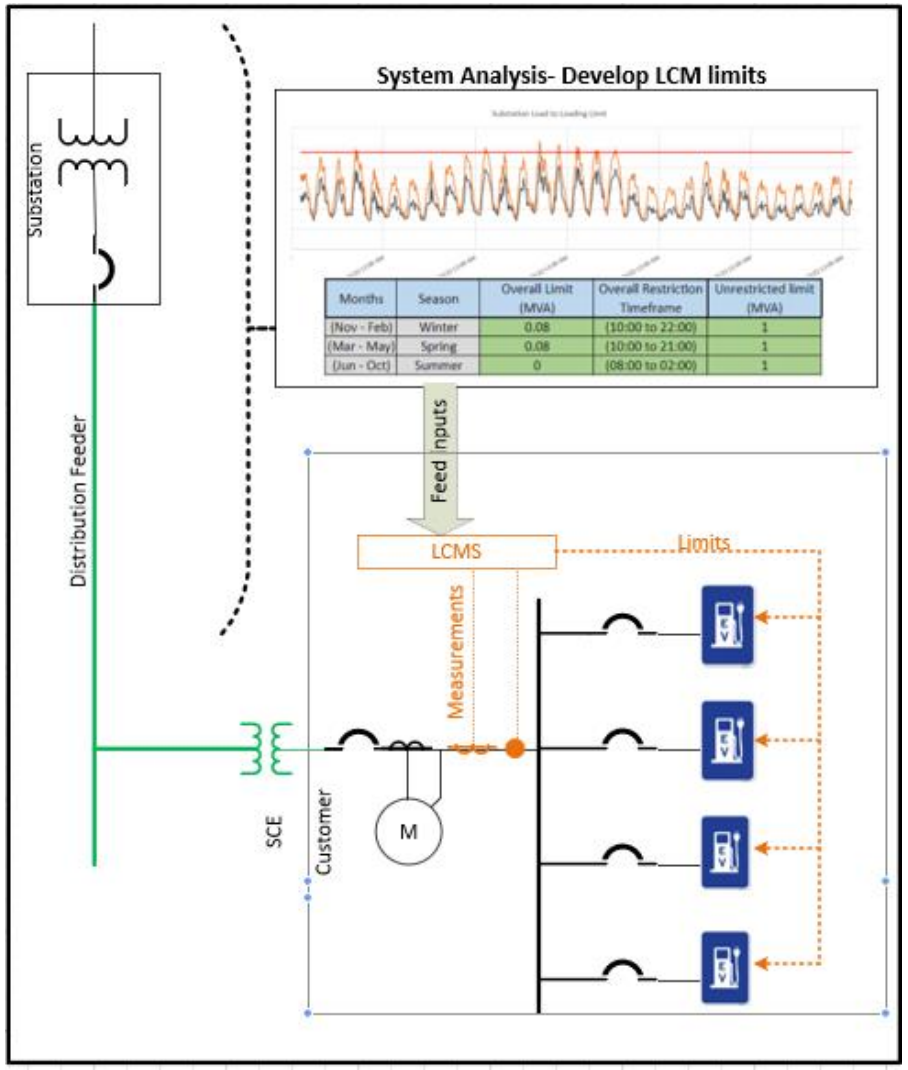
- Local Control Controls owned/operated by host customer
- SCE reviews technical documents and confirms operational performance (typically lab testing)
- Agreement execution and documentation process
- Operational performance monitored by SCE and alarming emails sent to customer for nonperformance

**Communication-Based LCMS:**

- Evaluate ability of SCE to send limits via communication using different intervals (day-ahead, real time, other intervals)
- Evaluate communication mechanism (direct vs cloud server/aggregator)
- Evaluate utilization/challenges of IEEE 2030.5 for load management and bi-directional communication
- Evaluate compliance to new settings sent via communications

# SCE Pilot Details (Localized Autonomous LCMS)

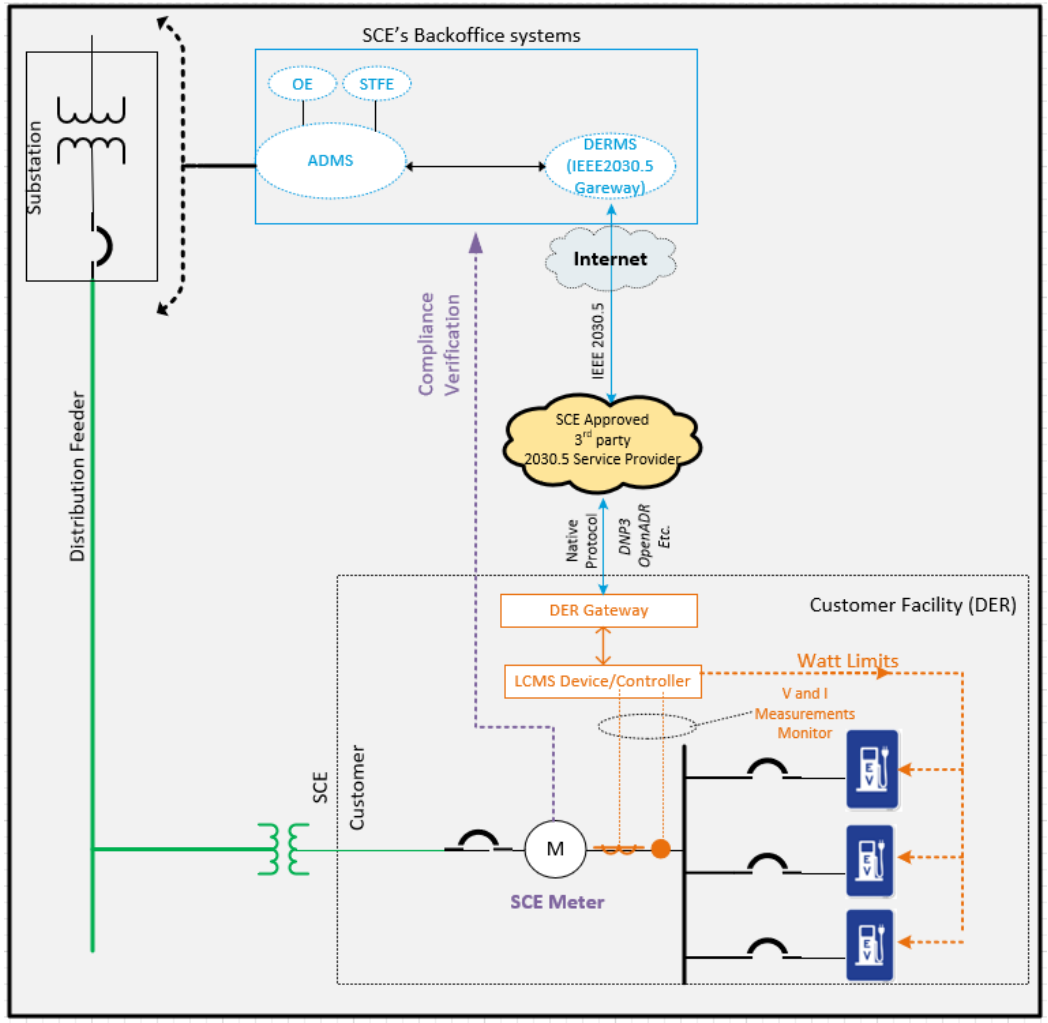
## Currently Being Deployed




- SCE reviews technical specification and performance of the LCMS which may include lab or field performance verification
- SCE develops charging profiles based on of the following:
  - Flat value (limit on 8760 hours)
  - Season (summer, winter, etc.)
  - Time of day (9am-9pm; 9pm-9am)
- Customer executed LCMS agreement
- Customer programs the limits into the LCMS
- SCE monitors for performance and takes action as may be required

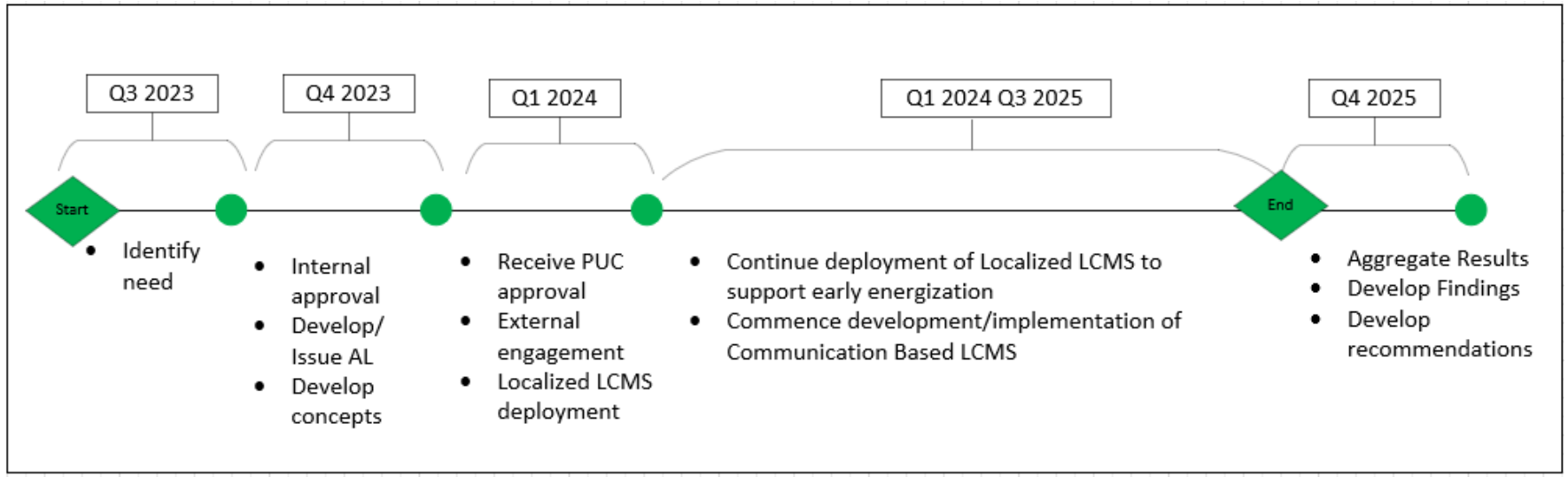
# SCE Pilot Details (Communication-Based LCMS)

## Discussing With Potential Pilot Participants




- SCE ADMS determine limits based on grid conditions, forecasting, and optimization .
- SCE DERMS sends limits to customer via EEE2030.5 protocol through cloud-based interface protocol translator or directly to the facility communication interface
- Facility communications interface receives information and send to LCMS
- LCMS executes the limits
- The limits can be refreshed based on real-time, day-ahead, or other intervals
- LCMS communicated back to SCE on its performance
- SCE verifies permeance via AMI data
- Action taken for nonperformance

# SCE Pilot Specifications




- 2-year pilot
- Open to all developers (EV or not)
- Participants must agree with the terms of the pilot
- Piloting both
  - Localized Autonomous LCMS
  - Communication-Based LCMS
- At the end of the two-year pilot, SCE will evaluate overall results and will recommend to make a permanent option or not to pursue for future use

# Near-Term Solutions to Supporting VGI

March 22, 2024

# Part 2

## Identifying Near-Term Solutions to Support Flexible/Scaled Service Agreements and Deployment of Supporting VGI Technology, including ALM

**Objective:**

- Identify technical or regulatory barriers associated with leveraging VGI technology to enable utilities to advance options for flexible/scaled service agreements
- Identify potential quick wins to address these barriers

# Implementing Type I ALM

Today, many customers are implementing Type I ALM. While the site details vary, the concept is the same and can provide benefits to the customer and the utility.

| | |
|---|---|
| **Example** | MUD customer installing 50 L2 charging stations, each rated at 50 amps or ~10 kw. Traditionally, SDG&E would plan for the full load (as if all ports could be turned on simultaneously) and would need capacity for 0.5 MW (50 ports @ 10 kw = 500 kw). |
| **Solution** | Customers install metering equipment with much smaller capacity (*e.g.*, 600 amps) and implementing Type I ALM behind the meter to throttle chargers or shift charging to different times so that the total load never exceeds the 600 amps capacity of the panel. |

# Mutual Benefits

## Customer

- Difference in cost between a 600-amp meter pedestal and 2,500-amp switchgear is significant.
- The lead time to get the higher capacity switchgear is currently about a year.  They can get a 600-amp meter pedestal in about 10 weeks.
- ***Downside*:** There are costs for that purchasing and installing ALM, and driver expectations might not be met if their charging is throttled, or their vehicle is not charged when expected.

## Utility

- Matching the service and transformer size to 600-amp panel instead of 2,500-amp.
- Avoid bottlenecks and costs associated with grid upgrades.

# Looking Forward

## Barriers

- Lack of DERMS
- Communications and integration with grid operations
- Need for pilots, experience, learning
- Regulatory pathways

## Opportunities

- Learn from other pilots
- Many vendors
- Technological advancements

# Enabling standardized use of UL 3141-certified Power Control Systems (aka ALM) and Flexible Connection Agreements in IOU tariffs

CPUC VGI Forum

March 22, 2024

# Barriers

- Power Import Limiting challenges the concept of “Obligation to Serve”
- PCS functionality is included in Rule 21, but not in Rules 2, 3, 15, 16, 29/45
  - SCE updated its Rule 16 to allow for ALM per its LCMS pilot
  - PG&E Rule 2, Sec. H. Connected Load Ratings cites nameplate ratings
- The lack of standardized tariff provisions, forms, T&Cs, limited import / export profile options, and technical product requirements inhibit uptake
  - Customers and developers have no awareness of offerings
  - Technology providers lack direction for product development
  - Utility service planners lack basis (or impetus) to study PCS setpoints

ENPHASE.

# UL 3141

- New standard published January 2024 covering Power Control System functionality for loads and generation (taking over from UL 1741 PCS-CRD)
- First version includes test protocols for Power Export Limiting (PEL) and Power Import Limiting (PIL) at the **device level**, defined for energy storage (but also applicable to standalone EVSE loads behind a single meter)
- Second version is currently under development and will develop protocols for PIL at the **Point of Common Coupling (PCC)**, inclusive of controllable and non-controllable loads

# Regulatory needs

- Develop clear language in IOU energization rules to recognize UL 3141-certified import limiting PCS as an alternative to connected load ratings (similar to language in Rule 21 for PEL) as part of a Flexible Connection agreement
  - Outcomes will help define (and refine) UL 3141
  - Precedent from Rule 21 and SIWG to adopt rules + requirements that don't go into effect until standards are ready
- Scope:
  - Define "firm," "non-firm" service levels through lens of scheduling (e.g., # of hourly values + structure), operational needs, and customer agreements
  - Prioritize "autonomous functionality" (à la SIWG Phase 1), i.e., "out of the box" static PIL / PEL schedules that are programmed upon commissioning
  - Then consider operational flexibility that likely requires DERMS comms – what are criteria for throttling loads, and how is this effectuated?

ENPHASE.

# Procedural Recommendations

- Build on SIOWG Report issued in February 2024 in Track 3 of the High DER Proceeding (R.21-06-017)
  - To the extent possible, must avoid bespoke implementation of the same concepts across the 3-4 relevant proceedings (EV, Energization, High DER, R21)
- New scoping memo in Track 3 to tee up revisions to IOU load rules to incorporate UL 3141, PCS, and optional Flexible Connections agreements
- Start with workshop, develop into SIOWG Phase 2 (?)



ENPHASE.

THE MOBILITY HOUSE

# Enabling and scaling flexible connections

For EVs, small generation, controlled and uncontrolled loads

PIERO / Inaugural VGI Forum / 3-22-24

# Two ALM/flexible connection implementations

| | Static site limit ("ALM") | Flexible connection |
|---|---|---|
| Method | • Consistent, hard limit on aggregate kW usage | • Contractual agreement either for static limit or to temporarily curtail aggregatekW usage during predetermined periods |
| Intended impact | • **Site panel**<br>• Overcurrent Protection devices on site | • **Utility-side infrastructure**<br>• Feeder/transformer/substation |
| Duration | • Life of site<br>• Until electrified fleet increases | • Life of site<br>• Until utility-side infrastructure is upgraded |
| Communication | • No external signal | • Notification, then trigger<br>• Text/Email<br>• Via smart meter<br>• API |
| Utility involvement | Notification-only with AHJ approval and appropriate certifications | Essential: utility determines limit based on infra constraints; may call curtailment events |
| Planning impact | Short term/upon energization request | Potential medium- to long-term infra planning & investment |
| Value | • $<br>• Single customer time to energization | • $$$<br>• Multiple customers' ability to energize at all |

Barrier

# Standards ambiguity: CPUC can accelerate rollout by assessing and adopting UL 3141

- UL 3141
  - Builds and (and will replace) existing Power Control Systems guidance for inverters, previously attached to UL 1741
  - Enables various real-world VGI applications
    - EVs
    - Inverters
    - Controlled loads/inverters coordinating with uncontrolled loads
  - California Smart Inverter Working Group will host presentation in late April
- Various other standards have been considered or briefly accepted for EV load control, leading to confusion in industry
- Confirmed inappropriate by UL for EV load management when oversubscribing infrastructure
  - UL 916
  - UL 60730-1
- CSA SPE-343:21
  - Canadian standard, still in progress
  - EVs only

# Regulatory development: Now vs Later (or at all)

- What is necessary to standardize and scale flexible connections?
  - What elements can be iterated and adjusted
    - Must be accessible to utilities of varying technical resources
      - Static vs dynamic limits; basic vs most advanced metering; temporary vs permanent limitations
  - What needs to be in place Day One
    - Contracts
    - Customer journey
    - Assessment criteria
  - What requires years of data
    - IRP/GRC impacts
- What needs worked out in a formal proceeding?
  - Site criteria for eligibility
    - Cost? Time? Inability to serve? Any time a utility-side upgrade is triggered?
      - Or is it up to the customer?
  - Study and report content
    - Study methodologies: some framework should exist while allowing for competition and innovation
  - Customer contract
    - What constitutes an “informed” customer who can make this choice
    - Who carries liability and risk?
- How do we allow innovation and competition while ensuring customer has predictable experience

THE MOBILITY HOUSE

Contact: jacqueline.piero@mobilityhouse.com

VEHICLE-GRID INTEGRATION COUNCIL

# Process Improvements to Enable Mass-Market Limited/Scaled Service Connection

Zach Woogen

March 22, 2024 | VGI Forum

Vehicle-Grid Integration Council is exclusively focused on unlocking the value of flexible charging, V2X, and DER-paired charging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# Technologies to Support Limited/Scaled Service Connection

## Software-Based Power Control (e.g., workplace charging, multi-family homes, fleet depots)

1. Instead of each station operating at full power all the time, **stations are controlled individually** based on charging demand.
2. This allows **more charging stations** to be installed while only using a fraction of the aggregate power traditionally required.
3. Businesses shave as much as **60% off** the cost of electrical system upgrades and peak demand charges.

Source: PowerFlex / EDF Renewables

## Integrated or Co-Located Energy Storage (e.g., fleet depots, public DC fast chargers)


Source: FreeWire Technologies, Inc.

| | |
|---|---|
| OUTPUT POWER | Any combination of OCPP compliant EV chargers and other loads up to 240 kW |
| INPUT POWER | 10 kW to 165 kW for each VPort |

Source: Veloce Energy

# Re: SCE's LCMS Pilot

SCE AL 5138-E: "*Includes both localized autonomous LCMS and communications-based LCMS:*

- ***Localized Autonomous LCMS:*** *uses a programmed limit, operates autonomously to locally control flexible loads to maintain the power import level to the programmed limit without external communications; can be programmed locally or remotely via communications*
- ***Communications-based LCMS:*** *limits received from SCE via "communications." cloud-based services or directly to the load customer facility by an SCE-approved comms gateway"*

- In the near-term, localized autonomous LCMS is likely most feasible and suitable for EV charging use cases, which rely on some level of predictability (i.e., pre-determined setpoint) to support charging needs

# Why now?

- Several recent policy and market drivers place limited/scaled service connection center stage:
  - ACC II, ACF, ACT, and overall pace of EV deployment in the face of existing distribution grid constraints
  - California's Limited Generation Profile Implementation
  - California's Smart Inverter Operationalization Working Group Report
  - High DER OIR Staff Proposal
  - SCE's LCMS Pilot & PG&E's Flexible Service Connection Pilot
  - CA's new TE OIR and new Energization Timelines OIR
  - NY's Load Management Technology Incentive Programs & MA's Automated Load Management Implementation
  - Publication of UL 3141 and upcoming revision

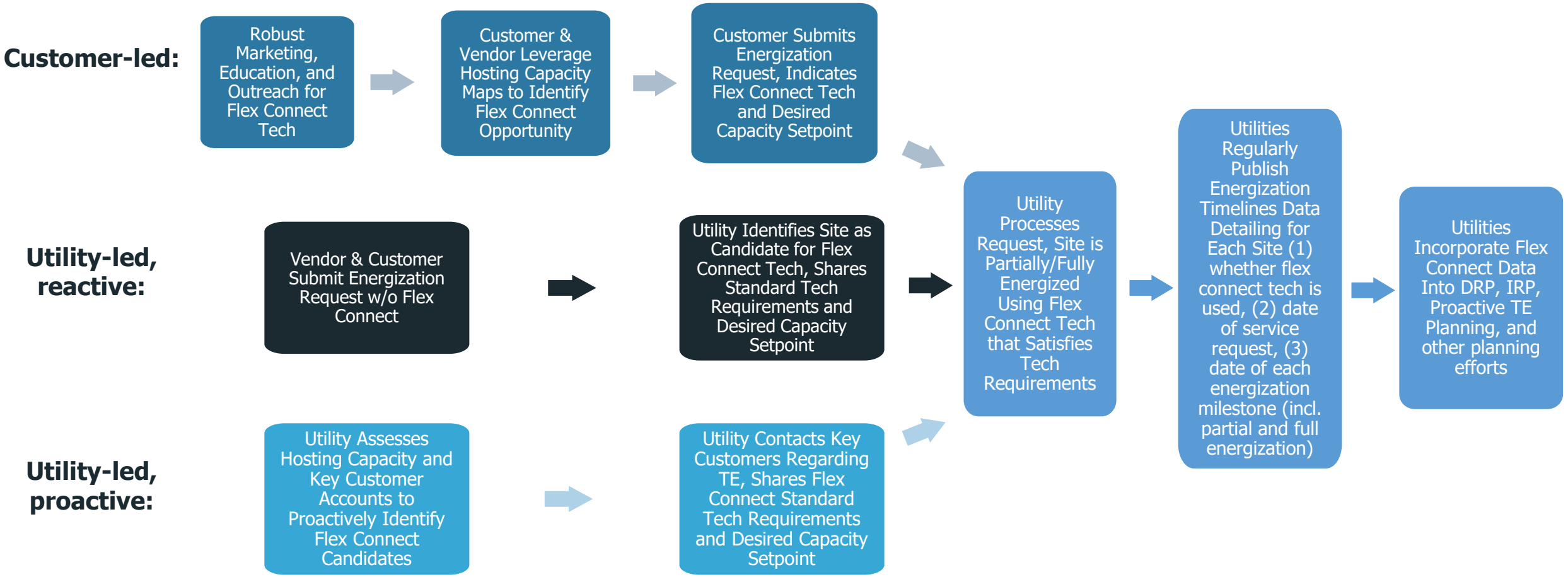
# Potential Design Elements for Limited/Scaled Service Connection Framework

- **Customer choice:** Must be a customer choice, e.g., to wait for upgrade vs limited/scaled service connection.
- **Marketing, education, and outreach:** Customers need information on options available to them and the implications of their decision.
- **Customer enablement tools:** Customers and developers need tools to interact with utilities that enable limited/scaled service connection. This may include pro-forma applications, more accurate/real-time hosting capacity maps, etc.
- **Site and tech requirements:** Vendors need clear rules and requirements. Consistency and shared technical requirements across utilities may be most scalable.
- **Public reporting:** Stakeholders need clear and consistent data collected to support future program and/or rule revisions.
- **Impact on grid planning:** Load must be assessed dynamically, rather than statically, and incorporated into utility planning as such.

# Key Questions

- Who "initiates" limited/scaled service connection discussion/election?
  - Does the utility assess the site and support customers in finding technologies?
  - Does the customer work with the vendor to incorporate tech before submitting energization request?
- What tools are needed to operationalize limited/scaled service connection?
  - E.g., pro-forma application with fields identifying (a) technology to be used (e.g., UL 3141 software, integrated storage, localized autonomous control, communications-based control, etc.), (b) kW power limit, (c) timeline for scaling service limit
  - E.g., accurate, up-to-date hosting capacity maps
- What incentives or shared savings models may be needed to accelerate the use of enabling technologies?
  - E.g., program-scale benefit-cost analysis vs site-specific avoided costs

# Potential Discrete (or Co-Existing) Models for Initiating Limited/Scaled Connect



# 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

# Part 3

## Identifying Future Procedural Priorities and Topics for Future VGI Forums

**Objective:**

- Identify additional needed action on VGI priorities including discussion of interconnection and VGI, which could be addressed later in other proceedings as appropriate such as the TE Policy (R.23-12-008) and Infrastructure proceeding.
- Allow industry to discuss perceived challenges and barriers to connection of EVSE and VGI technologies to the grid (including energization and interconnection).

# Where we are today

## DRIVE OIR

- Working Group
- Integration Strategies
- Pathways for ongoing conversations around VGI advancement
- LCFS holdback

## Interconnection

- V2G DC EVSE enablement
- UL Power Control Systems CRD
- V2G AC pilot pathways
- CEC V2G Equipment List

## VGI Projects

- ELRP
- Dynamic export rates
- ALM
- EPIC projects
- VGI Pilots

# Priorities and Regulatory Action Needed

Streamlined approval

Compensation Mechanisms

Technology & Standards

Interconnection

Customer Experience

# Priorities and Regulatory Action Needed

## Priorities

- Standards and interoperability
- Pilots and lessons-learned
- Clear ecosystem roles and responsibilities
- Integration of new technologies
- Targeted use cases and scaling

## Regulatory Action

- Narrow, targeted scope for VGI in new proceeding
- Collaboration with industry to problem-solve around technical gaps and barriers
- Streamlined regulatory pathways to pursue pilots and programs for VGI initiatives
- Ability to appropriately compensate participants

Fermata Energy

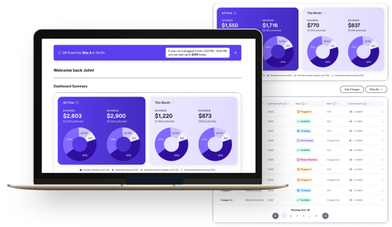
Park It. Plug It. Profit.

# Inaugural VGI Form: Part 3 Panel #2—Emerging Issues in Interconnection/Energization

Anna Bella Korbatov
Director of Regulatory Affairs

March 22, 2024

# Fermata Energy V2X Product + Services Ecosystem



## Fermata Energy Cloud Software

- Forecasting & Optimization
- V2X + V1G operations + reporting
- V2X event notifications
- Charge scheduling
- Site + building load monitoring
- Charger + EV data analytics
- Several awarded patents + IP filings including battery thermal management

## OEM Services

- Use Case Development
- Preserve Battery Warranty
- Software White Label + API

## Charger Integration

- FE-20 20kW bidirectional charger developed with Heliox
- Borg Warner 60kW charger
- Integrating with others

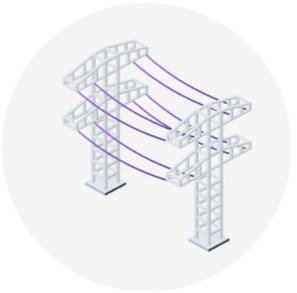
heliox

## FE Link

- Site Controller
- IoT Gateway
- Building Meter


## Site Load Integration

- Electricity savings
- Revenue streams
- Solar
- Load Management
- Resilience Support



## Utility Integration

- DERMS integration
- Demand Response
- Interconnection

# Rhode Island municipal deployment earns $12,500+

**When:** **Summers 2021, 2022, & 2023**

**What:** Vehicle-to-grid (V2G) demand response using Fermata Energy's V2X bidirectional charging platform

**EV Earned:** **$12,553 with 1 EV and 1 Fermata Energy V2G bidirectional charging platform**

**Where:** Municipal wastewater treatment facility

**Program:** **Rhode Island Energy - "Connected Solutions."** Discharging energy in an EV battery back to the grid at times of peak grid demand, during 2-3 hour long events in late afternoon.


"These results help to give us confidence that **electric vehicles can be a reliable partner in providing a clean and resilient electricity grid** for the future," said John Isberg, Vice President of Customer Sales and Solutions at National Grid (now a Rhode Island Energy project).

# CEC Grant 22-612: ESB Bidirectional Infrastructure

**When:** Q1 2025

**What:** 2.5 MW V2G deployment

$3 million grant to deploy 21 BorgWarner 125 kW bidirectional chargers + 20 LionD electric school buses + Fermata energy V2X software

**Where:** Long Beach & Thousand Oaks High School

**Programs:** ELRP, SCE Dynamic Rate Pilot


BORGWARNER

LION ELECTRIC

Fermata Energy

AMERICAN TRANSPORTATION

“With this new technology, electric school buses are not only delivering **cleaner air to our children and cost savings to our school districts, but also providing extra power to the grid when we need it most**,” said **Patty Monahan, California Energy Commission’s Lead Commissioner for Transportation.**

V2G DEPLOYMENTS| FERMATA ENERGY

# V2G Interconnection Experience

**Interconnected chargers BTM, separately metered, for microgrid projects and for a variety of use cases, including:**

- Demand Response
- Demand Charge Management
- Frequency Regulation
- Microgrid Testbeds
- Dynamic Rates

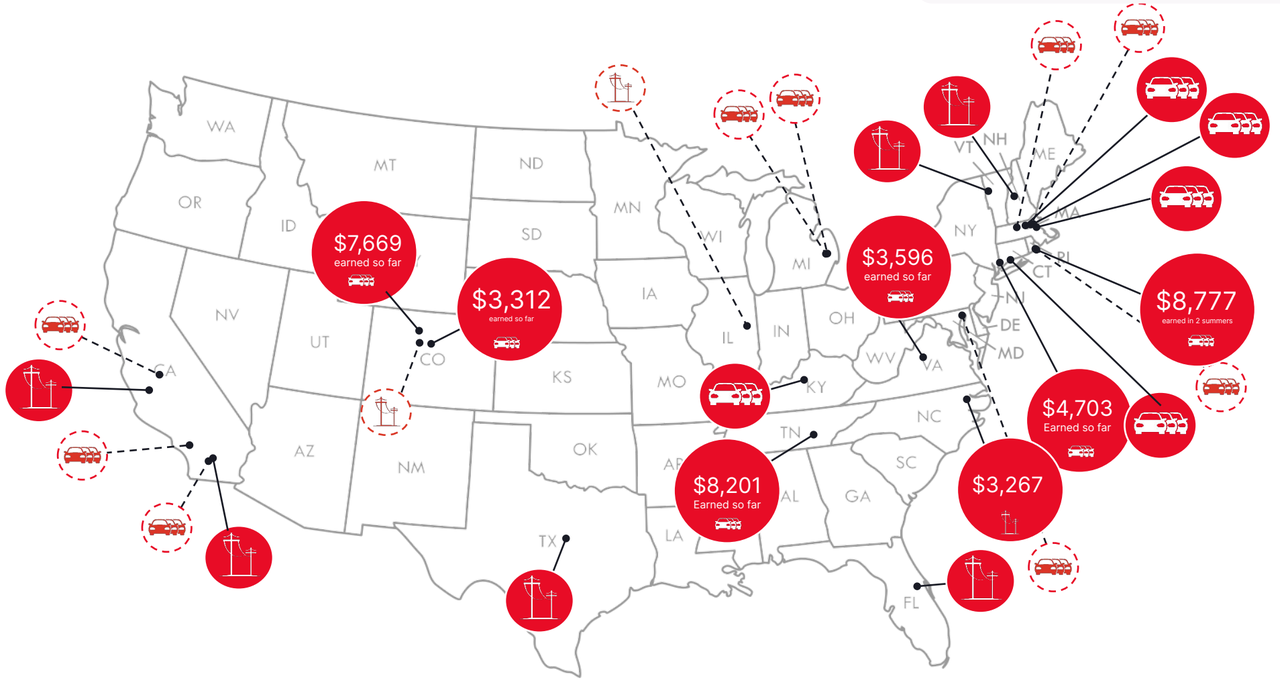
**Interconnected and operating 30+ V2X sites**

**Worked with 21 utilities across 17 states and 2 countries to interconnect customer V2X sites**

- CA, CO, CT, FL, GA, KY, MA, MI, NC, NH, NY, PA, TN, TX, RI, VA, VT, British Columbia, Nova Scotia

**Verified V2G operations with**

- Utilities
- Federal government
- Municipalities
- Private deployments
- Automotive manufacturers





Fleet site operating

Fleet site in development

Utility site operating

Utility site in development

V2G earning for customers

# Lessons Learned & Best Practices from Around the Country

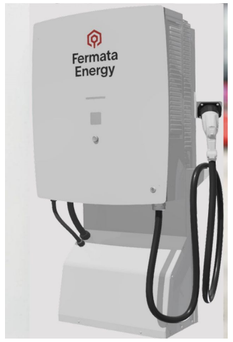
- **Appropriate size thresholds** for “small generator or stationary storage” interconnections for relatively small V2X EVSE (e.g., 15kW and 20kW)
- **Timely, clear communication and explanation of the process flow and timelines for review**
- **Dispute resolution process** should be used to mediate disputes via a third-party (i.e., other than the public utilities commission).
- **V2X-specific commissioning tests, instead of requiring solar commissioning tests** that are not applicable to batteries or V2X
- Utilities often do not know whether V2X should be considered under the **BESS or EV interconnection process**
- **Interconnection pre-application reports to assess hosting capacity**

# Quick Wins for CPUC and IOUs on V2G DC Interconnection

Interconnection exemptions for **DEBA GFO, DSGS, and SDG&E Dynamic Rate Pilot** to enable interconnection of V2G DC EVSE not certified to UL 1741-SA or SB

Interconnection exemptions already exist for ELRP and SCE and PG&E Dynamic Export Rate Pilots

Clarify purpose of **CEC V2G Equipment List**


How can the CEC V2G EL help IOUs and VGI industry?

Reduce **$800 interconnection fee** per application, especially for DAC customers

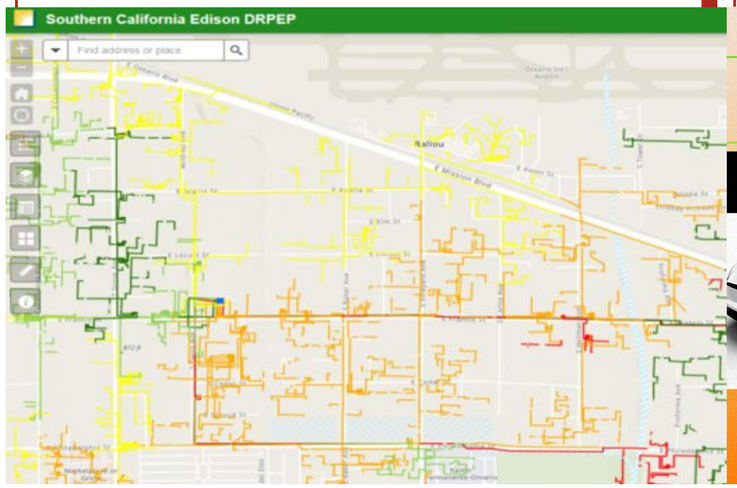
Interconnection fees in CA are 2-8X that of Ix fees in other parts of the country

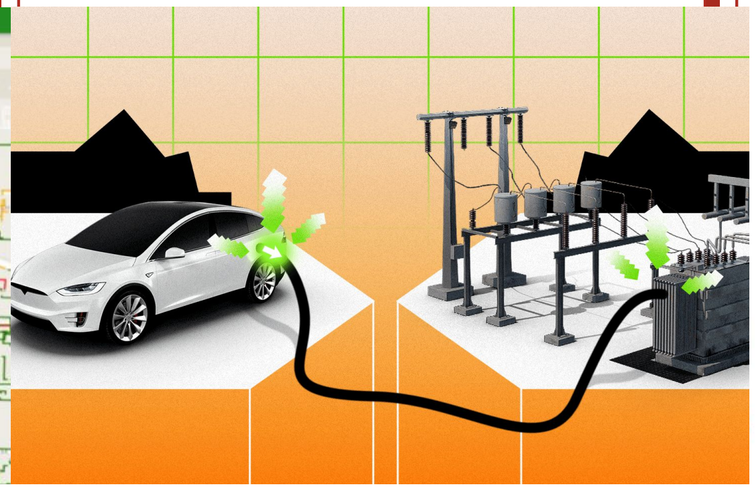
# Longer-Term Action on V2G Interconnection

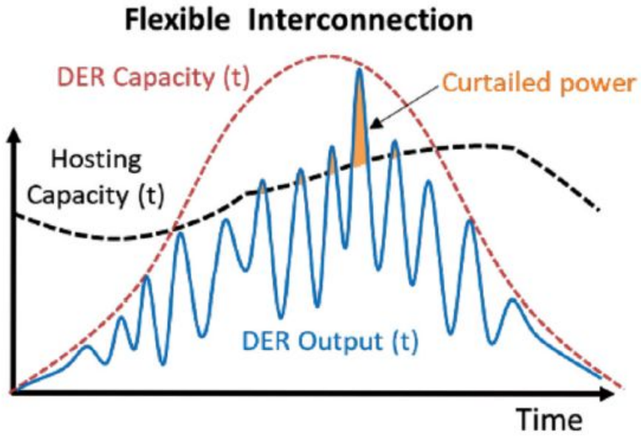
Improved IOU hosting capacity maps and tools to assist in project planning and site design

Build internal capacity to prepare for high volume of Ix apps; streamline and automate parts of app process

Consideration of flexible interconnection / limited generation profiles to speed up interconnection of V2G projects





# Opportunities to Scale Bidirectional Charging

**Parity with Stationary Storage**

- incentive programs comparable to those for stationary storage (e.g. SGIP-like); upfront and performance-based incentives
- integrate V2X in utility planning processes
- allow V2X to value stack and dual participate in rates/programs

**Make-Ready and EV Charging Infrastructure Funding Access**

- access for bidirectional chargers to utility make-ready funding opportunities on par with V1G EVSE
- technology-neutral rebates for V2G chargers and associated equipment

**Newly convened TE-OIR (R.23.12.008) is the right venue for addressing both of these barriers to the scale adoption of V2X**

# Conclusions

**For V2X to Scale in CA:**

- V2X needs to be fundamental to TE planning, not an afterthought
- Need to ensure interconnection is not a barrier
- V2X ALSO needs supportive policies to scale
  - Access to upfront incentives and performance-based incentives on par with stationary storage
  - Ensure access to infrastructure funding on par with V1G

# Thank you.

**For more information, please visit**

www.fermataenergy.com

or contact

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Mainspring

# Powering the grid transition

# Our Vision

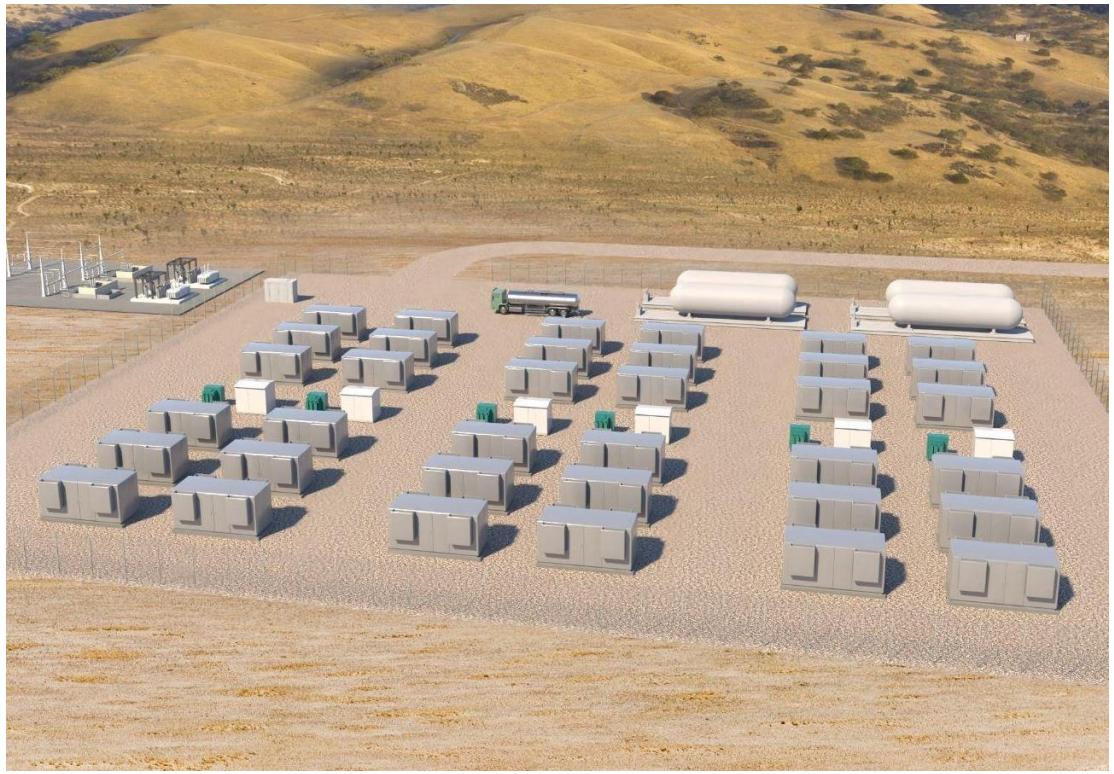
Accelerating
the transition to the
clean electric grid
by providing local,
scalable, fuel-flexible
power

Mainspring

# Local, scalable, fuel-flexible power

## Commercial Behind-the-Meter

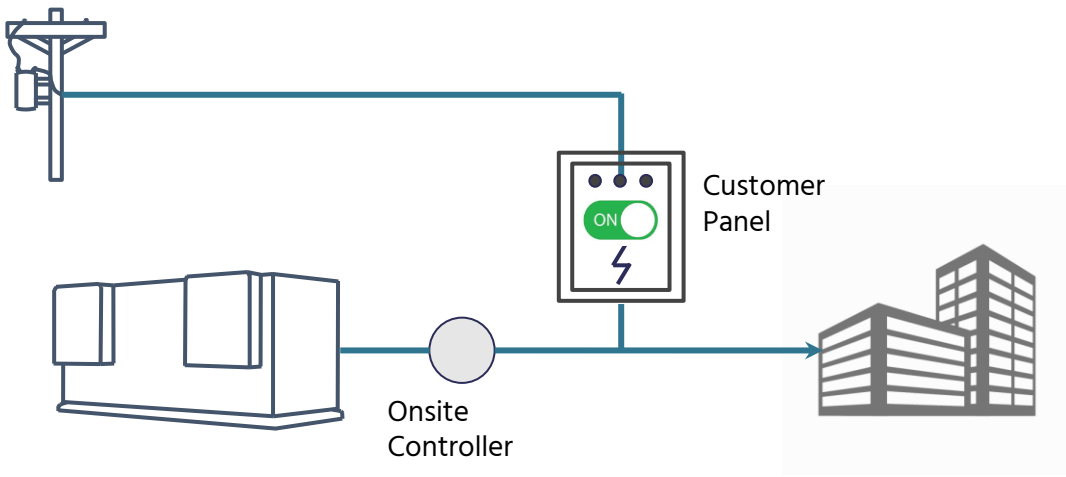

## Zero-Carbon Grid-Scale Capacity



*Rendering of 9 MW ammonia storage project*

# Mainspring powers with and without grid power

**Grid ON**

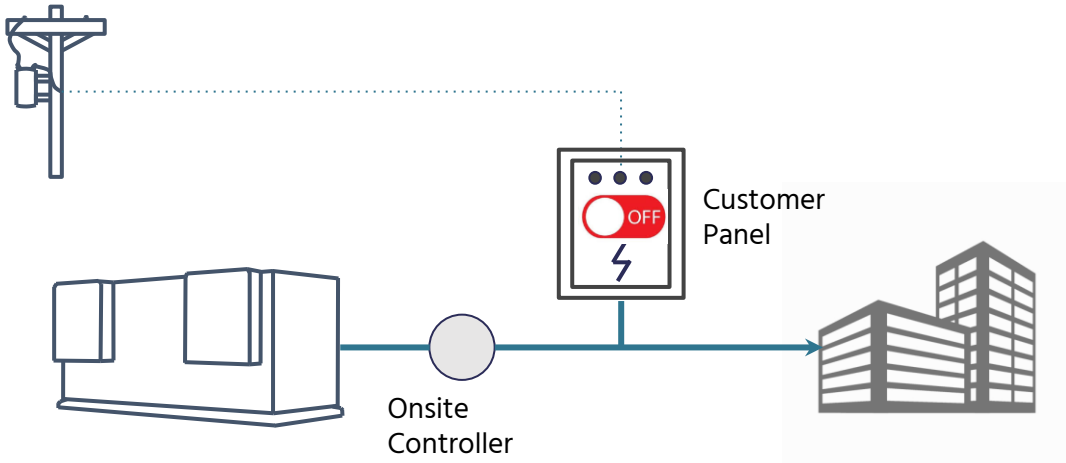



**Grid-parallel** operation typically means one of the two following modes, though there is flexibility if needed:

- Prime mode: Minimize power draw from grid at all times
- Peak shaving mode: Minimize power draw from grid during highest priced hours as defined by the utility tariff

Capable of accepting full load from grid-parallel or standby in 10 seconds

**Grid OFF**

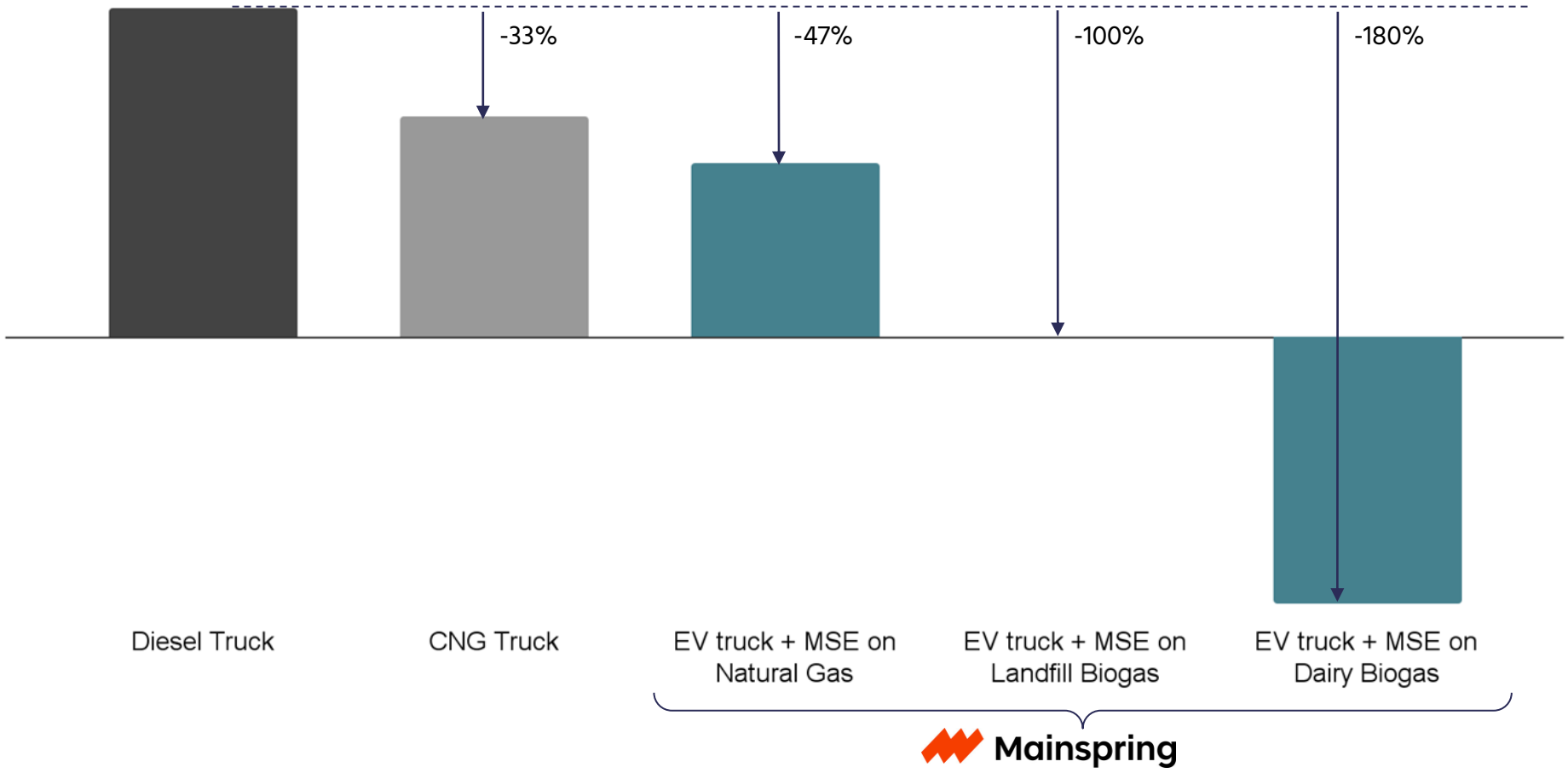



**Grid-forming/islanded** operation provides power when the grid is down and can seamlessly transfer back to grid-parallel.

- Requires additional onsite equipment (e.g., transfer switch)
- 250 kVA continuous and 300 kVA for 10 seconds (limited by inverter capabilities)

# A clear pathway to zero or negative emissions

**CO2 Emissions in metric tons per 100 miles driven**




Assumptions: EV truck efficiency 2.2 kWh / mile, charger efficiency 94%, diesel truck mileage 4.9 mpg, CNG truck mileage 5.3 mpg diesel equ.

# Clean, onsite EV fleet charging

- Speeds power build-out for EV expansion
- Builds local resilience
- Incentivizes investment in EV fleets
- Fuel-flexibility reduces risk
- Local installations reduce grid congestion

*Mainspring delivers Prologis cost savings over traditional generators AND a path to clean fuel alternatives while shrinking the time to power from more than 2 years to 8 months.*

*Rendering of 9 MW truck fleet EV charging microgrid*

# V2X Adoption: Customer Installation and Interconnection Barriers

Vehicle-Grid Integration (VGI) Forum

March 22, 2024

Michelle Bogen

Project Manager, Grid Services

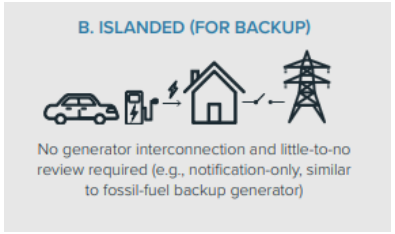
# Value Beyond Mobility

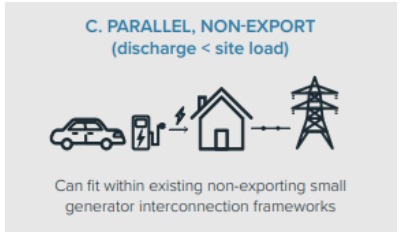
VALUE BEYOND MOBILITY

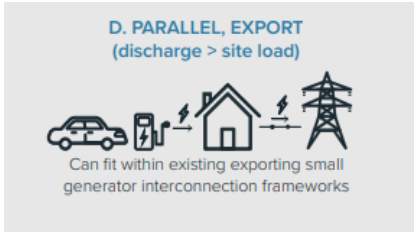
# Intelligent Backup Power (IBP)

## What is it?

- Ford F-150 Lightning – All-electric light-duty truck with bidirectional charging capabilities
- IBP System includes 3 distinct components
  - 1) Vehicle, 2) Ford Charge Station Pro, and 3) Home Integration System (includes Microgrid Interconnection Device, inverter and dark-start battery)
  - During a grid outage, the system disconnects & isolates from the grid
- Definitions within Automotive/Ford
  - Backup Power: Operates like a backup fossil fuel generator with a transfer switch
  - V2H: Grid-connected, bi-directional charging with zero net export across the main electrical meter
  - V2G: Grid-connected, bi-directional charging with export across the main electrical meter




Source: Vehicle-Grid Integration Council (VGIC). V2X Bidirectional Charging Systems: Best Practices for Service Connection or Interconnection. VGIC-Special-Initiative-2022.pdf (squarespace.com). August 2022.

# Collaboration with PG&E

## Lessons Learned

- **Installation complexity**
- **High-variability in costs**
- **Need for more customer education, and**
- **Incentive programs that consider high-variability in existing home conditions.**

**PG&E and Ford Accelerating Vehicle-to-Home Technology in California**

PG&E and Ford Motor Company today announced that the all-electric Ford F-150 Lightning (model years 2022 or 2023) paired with Ford Charge Station Pro & Home Integration System has been approved as the first equipment set eligible for participation in PG&E's residential Vehicle-to-Everything pilot.

Intelligent Backup Power Early Install Project

- 2 PG&E employees
- Goals: run through end-to-end installation process with Ford, PG&E and Sunrun teams
- Witness testing/demonstration with PG&E's interconnection engineers

Participation in PG&E's Residential V2X Pilot

- Ford F-150 Lightning was 1st eligible vehicle
- Phase 1 – backup power testing (currently, a few enrolled customers)
- Phase 2 – grid-connected, bidirectional charging that follows real-time, day-ahead signals

Collaboration between utilities, OEMs and installers is key to learning how to improve processes and make bidirectional EV technologies ubiquitous and simple for customers to adopt.

# Customer Barriers to V2X Adoption

## Best Practices & Recommendations

### Installation

- Complexity
- Lack of customer knowledge & education
- Cost variability

### Interconnection

- Uncertainty around what “types” of bidirectional EV technologies require interconnection
  - Causes installation delays and frustration from customers
- Uncertainty around the interconnection process itself
  - At the state-level, ensure current rules are clear
  - Easy process to transition between different “modes”
- Streamlined incentive program across the state to help reduce costs for early adopters

### Key Takeaways

**Avoid reinventing the wheel.**

V2X systems can fit within existing processes.

**Minimize unnecessary review.**

Load-only and islanded systems should require little-to-no interconnection review.

**Provide customers with flexible options.**

Systems initially used in load-only or islanded modes should be permitted to seek grid-parallel interconnection at a later date.

Source: Vehicle-Grid Integration Council (VGIC). V2X Bidirectional Charging Systems: Best Practices for Service Connection or Interconnection. VGIC-Special-Initiative-2022.pdf (squarespace.com). August 2022.