PUBLIC UTILITIES COMMISSION
505 Van Ness Avenue
San Francisco CA 94102-3298

Pacific Gas & Electric Company
ELC (Corp ID 39)
Status of Advice Letter 6259E
As of October 13, 2022

Subject: Request for Approval of PG&E's VGI Pilots in Compliance with Decision 20-12-029.

Division Assigned: Energy

Date Filed: 07-15-2021

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Disposition:	**Signed**
Effective Date:	**05-05-2022**

Resolution Required: Yes

Resolution Number: E-5192

Commission Meeting Date: None

CPUC Contact Information:

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AL Certificate Contact Information:

Stuart Rubio
415-973-4587
PGETariffs@pge.com

PUBLIC UTILITIES COMMISSION
505 Van Ness Avenue
San Francisco CA 94102-3298

To: Energy Company Filing Advice Letter

From: Energy Division PAL Coordinator

Subject: Your Advice Letter Filing

The Energy Division of the California Public Utilities Commission has processed your recent Advice Letter (AL) filing and is returning an AL status certificate for your records.

The AL status certificate indicates:

Advice Letter Number
Name of Filer
CPUC Corporate ID number of Filer
Subject of Filing
Date Filed
Disposition of Filing (Accepted, Rejected, Withdrawn, etc.)
Effective Date of Filing
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The Energy Division has made no changes to your copy of the Advice Letter Filing; please review your Advice Letter Filing with the information contained in the AL status certificate, and update your Advice Letter and tariff records accordingly.

All inquiries to the California Public Utilities Commission on the status of your Advice Letter Filing will be answered by Energy Division staff based on the information contained in the Energy Division's PAL database from which the AL status certificate is generated. If you have any questions on this matter please contact the:

Energy Division's Tariff Unit by e-mail to
edtariffunit@cpuc.ca.gov

Pacific Gas and Electric Company®

Sidney Bob Dietz II
Director
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July 15, 2021

Advice 6259-E
(Pacific Gas and Electric Company U 39 E)

Public Utilities Commission of the State of California

Subject: **Request for Approval of PG&E's VGI Pilots in Compliance with Decision 20-12-029**

Purpose

Pursuant to Ordering Paragraph (OP) 14 of California Public Utilities Commission (CPUC or Commission) Decision (D.) 20-12-029, Pacific Gas and Electric Company (PG&E) hereby submits this Tier 3 advice letter requesting approval of four Vehicle Grid Integration (VGI) pilots, presented as an attachment to this advice letter.

Background

Senate Bill 676 (Ch. 484, Stats. 2019) (SB 676) enacted new Public Utilities Code Section 740.16. Section 740.16 requires the Commission to establish strategies and quantifiable metrics to maximize the use of feasible and cost-effective electric vehicle (EV) integration into the electrical grid (Vehicle Grid Integration, or VGI) by January 1, 2030. On December 21, 2020, the CPUC issued D.20-12-029 implementing SB 676 in Rulemaking (R.) 18-12-006. Among other things, D.20-12-029 adopted various strategies to promote VGI and ordered PG&E and other investor-owned utilities (IOUs) to implement various near-term policy actions that the Commission has found reasonable in support of the strategies.

Among the near-term policy actions that the Commission has found reasonable to promote VGI in D.20-12-029 are VGI pilots and demonstrations: "The pursuit of these activities will advance VGI…by ensuring that proven VGI technologies can be scaled and by expanding the technology required to advance VGI."[1]

D.20-12-029 authorized the large electrical corporations (collectively, the "Joint Utilities") to propose a variety of VGI pilots to address needs that fall outside of the scope of other state programs.

[1] D.20-12-029, p.19.

In collaboration with staff from the Commission's Energy Division, the Energy Commission, other California LSEs and stakeholders, the Joint Utilities (1) developed a list of priority needs for these VGI pilots, (2) ensured this list did not overlap with the scope of other programs (i.e. EPIC), (3) ensured that the pilots would not delay the implementation of VGI strategies currently ready for deployment at scale.

The Joint Utilities held two public workshops[2] on the purpose and budgets of their proposed pilots. Feedback was solicited, received, and considered in the development of PG&E's VGI pilots.

In compliance with Ordering Paragraph (OP) 14 of D.20-12-029, PG&E hereby submits this Tier 3 advice letter with four proposed VGI pilots attached.

PG&E's Proposed Pilots

Pilot Name	**Pilot Summary**	**Total Pilot Budget**
Pilot #1 – V2X Residential Pilot Program	Residential V2X pilot program targeted at spurring the adoption of bidirectional light-duty vehicles (LDVs) at single-family homes through customer incentives.	$7.5 million
Pilot #2 – V2X Commercial Pilot Program	Commercial V2X pilot program targeted at spurring the adoption of bidirectional medium- and heavy-duty vehicle (MHDV) fleets through customer incentives.	$2.7 million
Pilot #3 – V2M PSPS Microgrid Pilot	Vehicle-to-Microgrid pilot aimed at enabling Behind-the-Meter bidirectional electric vehicles in PSPS-formed microgrids to support community resiliency.	$1.5 million
Pilot #4 – Exploring V2X Export Value Pilot	Small-scale pilot aimed at exploring the value of EV export (energy discharge beyond the customer's electricity meter) in CAISO market services using bidirectional school buses.	$2.3 million
Total SB 676 Budget		**$14 million**

[2] The first VGI Workshop was held on March 16, 2021 and the second VGI Workshop was held on June 4, 2021.

Protests

*****Due to the COVID-19 pandemic, PG&E is currently unable to receive protests or comments to this advice letter via U.S. mail or fax. Please submit protests or comments to this advice letter to EDTariffUnit@cpuc.ca.gov and PGETariffs@pge.com*****

Anyone wishing to protest this submittal may do so by letter sent via U.S. mail, facsimile or E-mail, no later than **August 4, 2021**, which is 20 days after the date of this submittal. Protests must be submitted to:

CPUC Energy Division
ED Tariff Unit
505 Van Ness Avenue, 4th Floor
San Francisco, California 94102

Facsimile: (415) 703-2200
E-mail: EDTariffUnit@cpuc.ca.gov

Copies of protests also should be mailed to the attention of the Director, Energy Division, Room 4004, at the address shown above.

The protest shall also be sent to PG&E either via E-mail or U.S. mail (and by facsimile, if possible) at the address shown below on the same date it is mailed or delivered to the Commission:

Sidney Bob Dietz II
Director, Regulatory Relations
c/o Megan Lawson
Pacific Gas and Electric Company
77 Beale Street, Mail Code B13U
P.O. Box 770000
San Francisco, California 94177

Facsimile: (415) 973-3582
E-mail: PGETariffs@pge.com

Any person (including individuals, groups, or organizations) may protest or respond to an advice letter (General Order 96-B, Section 7.4). The protest shall contain the following information: specification of the advice letter protested; grounds for the protest; supporting factual information or legal argument; name, telephone number, postal address, and (where appropriate) e-mail address of the protestant; and statement that the protest was sent to the utility no later than the day on which the protest was submitted to the reviewing Industry Division (General Order 96-B, Section 3.11).

Effective Date

PG&E requests that this **Tier 3** advice submittal become effective upon Commission approval.

Notice

In accordance with General Order 96-B, Section IV, a copy of this advice letter is being sent electronically and via U.S. mail to parties shown on the attached list and the parties on the service list for **R.18-12-006**. Address changes to the General Order 96-B service list should be directed to PG&E at email address PGETariffs@pge.com. For changes to any other service list, please contact the Commission's Process Office at (415) 703-2021 or at Process_Office@cpuc.ca.gov. Send all electronic approvals to PGETariffs@pge.com. Advice letter submittals can also be accessed electronically at: http://www.pge.com/tariffs/.

/S/
Sidney Bob Dietz II
Director, Regulatory Relations

Attachments

cc: Service List **R.18-12-006**

California Public Utilities Commission

ADVICE LETTER SUMMARY

ENERGY UTILITY

MUST BE COMPLETED BY UTILITY (Attach additional pages as needed)

Company name/CPUC Utility No.: Pacific Gas and Electric Company (U 39 E)

Utility type:
☑ ELC ☐ GAS ☐ WATER
☐ PLC ☐ HEAT

Contact Person: Stuart Rubio
Phone #: (415) 973-4587
E-mail: PGETariffs@pge.com
E-mail Disposition Notice to: SHR8@pge.com

EXPLANATION OF UTILITY TYPE
ELC = Electric GAS = Gas WATER = Water
PLC = Pipeline HEAT = Heat

(Date Submitted / Received Stamp by CPUC)

Advice Letter (AL) #: 6259-E

Tier Designation: 3

Subject of AL: Request for Approval of PG&E's VGI Pilots in Compliance with Decision 20-12-029

Keywords (choose from CPUC listing): Compliance, Transportation Electricication

AL Type: ☐ Monthly ☐ Quarterly ☐ Annual ☑ One-Time ☐ Other:

If AL submitted in compliance with a Commission order, indicate relevant Decision/Resolution #:
D.20-12-029

Does AL replace a withdrawn or rejected AL? If so, identify the prior AL: No

Summarize differences between the AL and the prior withdrawn or rejected AL: N/A

Confidential treatment requested? ☐ Yes ☑ No

If yes, specification of confidential information:
Confidential information will be made available to appropriate parties who execute a nondisclosure agreement. Name and contact information to request nondisclosure agreement/ access to confidential information:

Resolution required? ☑ Yes ☐ No

Requested effective date: No. of tariff sheets: 0

Estimated system annual revenue effect (%): N/A

Estimated system average rate effect (%): N/A

When rates are affected by AL, include attachment in AL showing average rate effects on customer classes (residential, small commercial, large C/I, agricultural, lighting).

Tariff schedules affected: N/A

Service affected and changes proposed[1]: N/A

Pending advice letters that revise the same tariff sheets: N/A

[1]Discuss in AL if more space is needed.

Clear Form

Protests and all other correspondence regarding this AL are due no later than 20 days after the date of this submittal, unless otherwise authorized by the Commission, and shall be sent to:

CPUC, Energy Division
Attention: Tariff Unit
505 Van Ness Avenue
San Francisco, CA 94102
Email: EDTariffUnit@cpuc.ca.gov

Name: Sidney Bob Dietz II, c/o Megan Lawson
Title: Director, Regulatory Relations
Utility Name: Pacific Gas and Electric Company
Address: 77 Beale Street, Mail Code B13U
City: San Francisco, CA 94177
State: California Zip: 94177
Telephone (xxx) xxx-xxxx: (415)973-2093
Facsimile (xxx) xxx-xxxx: (415)973-3582
Email: PGETariffs@pge.com

Name:
Title:
Utility Name:
Address:
City:
State: District of Columbia Zip:
Telephone (xxx) xxx-xxxx:
Facsimile (xxx) xxx-xxxx:
Email:

Clear Form

Advice 6259-E
July 15, 2021

Attachment 1

VGI Pilot Project Advice Letter Template

Purpose: This template will facilitate Energy Division review of the completeness of Vehicle-Grid Integration pilot advice letters and consistency with the Decision Concerning Implementation of Senate Bill 676 and Vehicle-Grid Integration Strategies, or D.20-12-029.

Each large electrical corporation must show that each proposed VGI pilot fits within the scope of D.20-12-029 by showing that the pilot:

- *is scoped to overcome barrier(s) necessary to create a pathway to deployment of a technology and/or use case in an IOU program that would further the goals of SB 676;*
- *is an efficient use of ratepayer funds;*
- *would address VGI strategies and/or near-term policy actions listed in D.20-12-029;*
- *should not be accomplished through an IOU program without the need for a VGI pilot; and*
- *would advance one of the VGI pilot opportunities listed in D.20-12-029, or provide rationale for why the proposed pilot is a higher priority.*

The template also contains suggested guidelines for the length of each individual section.

PILOT 1 - V2X Residential Pilot Program

PG&E Pilot #1 – V2X Residential Pilot Program

I. Subject

Pacific Gas and Electric Company Proposal for Senate Bill (SB) 676 Vehicle-Grid Integration (VGI) Pilot: V2X Residential Pilot

II. Pilot overview

Please provide an overview that addresses the topics that were included in the summaries provided to stakeholders (with updates as appropriate). Also include key partnerships, specific sources and amounts of non-ratepayer funding, and key metrics to evaluate project success.

PG&E's V2X Residential Pilot Program is a three-year pilot focused on spurring adoption of vehicle-to-everything (V2X) bidirectional technologies for residential customers with light-duty (LD) electric vehicles (EVs). The V2X Residential Pilot's goals are to demonstrate the value of V2X/bidirectional LD EVs for customers and the electricity grid and reduce the total cost of EV ownership by understanding potential revenue streams for the services provided and identifying potential barriers that inhibit access to these revenue streams. The services tested in this pilot and the technology deployed (different EV types and different EVSE technology) will be different from that tested in the Commercial V2X Pilot and therefore, the value & benefits that can be captured may differ. It will be important to note these differences when evaluating the cost-effectiveness of LD EVs at single-family homes for grid services versus medium- and heavy-duty EVs at commercial facilities.

This pilot will test five applications: backup power, customer bill management, system real-time energy, system renewable integration and EV export for grid services (such as system RA, system capacity) with an aim to sign up 1,000 residential customers using participating provider technology by the end of the second year (2023). Participating technology providers include: four to five automotive manufacturers (including BMW of North America, LLC and Nissan North America, Inc.), one EVSE supplier (dcbel) and one system integrator (Nuvve). Additional technology providers may be onboarded over the course of the pilot, however, participation in the pilot will be dependent on continued availability of funding.

The total budget for this pilot is $7.5 million. Where funds are available, LCFS revenue will be used in favor of ratepayer dollars to cover such pilot costs as customer incentives, PG&E internal costs and software integration of utility backend systems. Funding for some of the pilot activities will be provided in-kind by the technology providers (i.e., product research and development (R&D), software development, electric vehicle (EV) to electric vehicle supply equipment (EVSE) compatibility testing and customer enrollment). Pilot success will be measured by: reaching the customer sign-up target of 1,000 participants by the end of the second year (2023), achieving ongoing performance in value-stream applications, determining the value of bidirectional vehicles to customers and the electricity grid, achieving cost transparency of VGI technology deployments (one of the Vehicle-Grid Integration Working

Group (VGI WG) Final Report "next steps" recommendations) and creating sustainable pathways for bidirectional vehicles to participate in vehicle-grid integration services.

III. Need for Pilot (approximately 15% of narrative)

A. Describe the market-readiness of the technology (and/or use cases) addressed by the proposed VGI pilot; as well as practical barrier(s) to deploying at scale via an IOU program.

i. *What is the status of technology development and deployment?*

ii. *What technical standards have been established, how technically robust are existing standards, and how widely are they adopted in the marketplace? What gaps need to be filled in standards development and/or deployment?*

iii. *Are business models well-established, and if not, what barriers must be overcome to establish business models?*

iv. *Do any existing policies, rules, or tariffs create barrier(s) and if so, what are these barriers and how can they be overcome?*

v. *What customer education is necessary?*

vi. *What existing and/or ongoing pilots or research can be leveraged to provide information and/or physical resources for the pilot? How will the pilot avoid duplication of existing work?*

Many research and development (R&D) pilots have been done with bidirectional EVs and EVSEs, but most, if not all, have interconnected to the grid via commercial buildings (i.e., 3-phase power grid). While these R&D pilots have explored the capabilities of bidirectional charging on a technology level, there have not been any pilots in the U.S. to date that have explored large-scale adoption and ongoing business models of bidirectional charging. This pilot will leverage the technological advancements achieved in prior R&D pilots, including compatibility testing between EV and EVSE, implementation of standard communication protocols for bidirectional charging, testing of communication protocols to enable EV and/or EVSE resources to receive grid signals and implementation strategies for testing value-stream applications.

The market has not yet seen mass adoption of bidirectional capabilities from light-duty vehicle manufacturers. That is, we are just beginning to see announcements of future light-duty electric vehicle products coming to market with bidirectional capabilities. The commercial bidirectional charger market (3-phase power grid) is more mature than the single-family residential bidirectional charger market (1-phase power grid) because most (if not all) currently existing DC unidirectional chargers were designed for a 3-phase power grid. Very few, if any, DC chargers exist for single-family homes because of the additional cost for DC chargers. DC chargers have power conversion electronics which AC chargers do not. When a customer is parked at a single-family home, they are likely there overnight and can afford to utilize a cheaper AC charger which has a technological limit on the maximum power capacity below that of DC chargers. With DC chargers, the upper threshold of maximum power is greatly increased, and these types of chargers have become more commonplace at commercial settings such as

shopping malls and charging depots along freeway corridors were EV drivers need/want to charge at faster rates.

Reducing barriers to participation in customer-sided benefits and grid services for light-duty vehicles at single-family homes and activating potential revenue streams through exploration in our pilot will help enable the single-phase DC bidirectional charger market to evolve. We are seeing new players and companies forming to develop bidirectional charging equipment for the single-family residential market. We hope that by the end of this pilot program to see more electric vehicles and charging stations capable of bidirectional charging available for the residential sector. In the near-term, technology partners (such as automotive manufacturers) may explore modification of existing vehicle models to enable bidirectional functionality. These vehicles could then be used by initial customers enrolled in the pilot if production vehicles with bidirectional charging capabilities are not yet available.

There are two approaches to bidirectional charging: direct current (DC) and alternating current (AC). DC bidirectional charging is where the power conversion equipment resides offboard the electric vehicle in the EVSE and AC bidirectional charging is where the power conversion equipment resides onboard the electric vehicle. This pilot will focus on exploring large-scale adoption of the DC bidirectional charging approach in the near-term because the market for the DC bidirectional charging approach is more mature – there are more EV and EVSE products available using the DC approach, the communication standards between EV and EVSE are more readily available, and the electrical interconnection process is clearly defined (adopted by Rule 21). As the AC bidirectional charging market matures, the pilot may adapt to include AC bidirectional charging EVs and EVSEs, pending available funding. The value-stream applications explored in this pilot are not hindered by the use of the AC versus DC bidirectional charging however, any cost-effectiveness evaluations done by this pilot with the use of DC bidirectional charging technology will not be applicable to AC bidirectional charging technology because of the differences in cost and potential benefit due to differences in technical attributes (efficiency, maximum power, etc.).

There are a limited number of available bidirectional charging standards enabling communication between the EV and EVSE. For vehicles that use the CHAdeMO standard already for DC charging, there is a fully enabled communication protocol for bidirectional charging. For vehicles that use the Combined Charging Standard (CCS) for DC charging, there are two existing pathways to enable bidirectional charging. One is through the DIN 70121 specification, and one is through the ISO 15118-20 specification. The DIN 70121 specification has been finalized and is therefore, currently more mature in functionality than the ISO 15118-20 specification, which is targeted to be formalized sometime at the beginning of 2022.

The business model for bidirectional charging is not fully mature. One goal of this pilot is to help the business model evolve by creating market mechanisms for customers to achieve additional revenue through the participation of the bidirectional electric vehicles in value-stream applications. There is currently an incremental cost to consumers to procure a bidirectional charging EVSE over a non-bidirectional EVSE due to the additional power electronics

components in bidirectional EVSEs. The incremental cost for bidirectional EVSEs is expected to decline over time, but to what extent is unknown. Therefore, by creating market pathways for bidirectional vehicles to earn additional revenue, customers will have an incentive to procure bidirectional vehicles and associated EVSE equipment which may have a higher upfront capital cost than non-bidirectional EVSE equipment.

Not only will these market mechanisms need to be defined and adopted by the pilot, but customer education may be necessary to create awareness of the benefits both for owning and/or leasing bidirectional charging vehicles and equipment in order to create a long-term, robust and sustainable market. To date, there have not been clear market incentives and/or mechanisms for owning and/or leasing bidirectional charging vehicles and associated EVSE equipment, and while there have been two global automotive brands with production-ready vehicles for many years, a compounding factor limiting wide-scale adoption is the current lack of bidirectional EVSE equipment for the residential single-family market. With new products for the residential market announced, the greatest barrier will likely be incenting customers to pay any incremental cost(s) on the bidirectional EVSE equipment. This pilot will aim to overcome these market barriers and create a long-term, sustainable business case for single-family consumers.

To fully enable the customer business model and market, there will likely need to be modifications in either existing utility tariffs and programs and/or the establishment of new utility programs specifically for bidirectional charging vehicles and equipment in the future. For example, PG&E's existing Net Energy Metering (NEM) tariff and the Self-Generation Incentive Program (SGIP) exclude bidirectional-capable electric vehicles from participating and/or receiving incentives. While bidirectional electric vehicles can technically provide the same benefits and services as stationary battery storage, the main difference is that bidirectional electric vehicles are mobile and there is not a process to guarantee they have only charged from renewable sources (in the case of NEM qualification). Customers with bidirectional electric vehicles could technically participate under PG&E's Capacity Bidding Program (CBP) and utilize their bidirectional capable vehicles to reduce onsite load during events, however, the vehicles would not receive any incremental compensation for reducing load beyond the site premise. Therefore, bidirectional vehicles under this program would be limited in the compensation they can receive for their unique ability to export energy onto the electricity grid. Through the course of this pilot, the aim is to find the most appropriate pathway(s) to enable the revenue streams for services provided by bidirectional charging vehicles, similar to other more mature technology solutions, such as battery storage or battery paired with solar.

IV. Pilot Proposal (approximately 40% of narrative)

Describe how the proposed pilot will contribute to development of IOU programs that will achieve the goals of D.20-12-029.

A. ***Description**:*

i. *Describe the proposed pilot, including customer segments served and number of customers served, program delivery mechanism, etc.*
ii. *What recommendation(s) from the June 2020 VGI Working Group Final Report the pilot will address and how? How will the pilot address the specific barriers identified above under section III?*
iii. *What technologies will be used and why were they selected? Do the technologies enable, facilitate, or hinder other VGI use cases even if not the focus of the proposed pilot?*
iv. *How was the pilot project technology(s) previously demonstrated?*

Pilot Description

PG&E's V2X Residential Pilot Program is a three-year pilot focused on spurring adoption of V2X (bidirectional technologies) for single-family residential customers with light-duty electric vehicles. The pilot's goals are to demonstrate the value of V2X/bidirectional LD EVs for customers and the electricity grid and reduce the total cost of EV ownership by understanding potential revenue streams for the services provided and identifying potential barriers that inhibit access to these revenue streams. The pilot will test five value-stream applications: backup power, customer bill management, system real-time energy, system renewable integration and EV export for grid services (such as system RA, system capacity) with an aim to sign up 1,000 residential customers using participating provider technology by the end of the second pilot year (2023).

PG&E will administer the pilot program with support from the technology providers (automotive companies and EVSE suppliers). Upfront and ongoing performance-based incentives will be paid directly to the residential customers. The upfront incentive – ranging from $2,500-$3,000 – will be paid upon completion of the necessary requirements for pilot participation – those are, purchase of an eligible bidirectional-capable electric vehicle and EVSE and installation of the EVSE equipment at the customer's residence.

A list of participating provider technology (EV and EVSE) will be made available on the pilot's online homepage. PG&E will implement a process for qualifying provider technology. The EVSE will need to be Underwriters Laboratories (UL) certified to existing standards and be capable of islanding from the grid. An EV will need to be bidirectional/V2X compatible with at least one EVSE and vice versa prior to being eligible for participation. That is, the EV Original Equipment Manufacturer (OEM) and EVSE supplier will need to verify and test communications between their respective equipment, perform interoperability testing, and ensure safe and reliable bidirectional communications prior to either provider being eligible to participate. Additionally, either the EV OEM or EVSE supplier in a bidirectional pairing will need to offer the following functionalities to customers (either through their own in-house development or offered through a third party): (1) customer phone applications (for customers to monitor and track performance of their vehicle during value-stream application testing, receive notifications of upcoming value-stream application events, allow the user to set preferences, etc.), (2)

optimization of dis(charging) so customers can participate in value-stream applications, and (3) ability for customer hardware (EV or EVSE) to receive value-stream application event signals via standardized protocols, such as OpenADR or IEEE 2030.5.

Ongoing performance-based incentives will be paid to customers based on their participation and performance in the testing of the pilot's value-stream applications, such as backup power, system real-time energy, system renewable integration and EV export for grid services (such as system RA, system capacity). Customers can earn up to an additional $2,000 each as part of the ongoing performance-based incentives. The pilot does not plan on compensating customers with incentives for participating in the testing of the value-stream application of customer bill management because this application should inherently provide savings to the customer without additional incentives.

Recommendations Considered from VGI WG

The June 2020 Vehicle-Grid Integration Working Group (VGI WG) Final Report contemplated the question, "What VGI use cases can provide value now, and how can that value be captured?".[1] To address this question, the VGI WG created a framework to classify and define use cases. The framework identified six dimensions by which a use case can be described. The six dimensions include (1) sector (where the vehicle is used and charged/discharged), (2) application(s) (services the vehicle aims to provide), (3) type (determines the power flow to and/or from the vehicle), (4) approach (mechanism through which the vehicle's charge and/or discharge is controlled), (5) resource alignment (specifies whether the "EV actor" and the "EVSE actor" are controlled by the same actor and have coinciding intentions/incentives), and (5) technology (hardware and software utilized, including standards, communication protocols, vehicle type, etc.). This pilot will focus on use case(s) defined by the following dimensions:

- **Sector:** Residential Single-Family Home
- **Application(s):** Customer-Bill Management; Customer-Backup, Resiliency; System-Renewable Integration, System-Real-Time Energy and potentially System-RA, System Capacity
- **Type:** V2G
- **Approach:** Direct (active)
- **Resource Alignment:** unified and aligned
- **Technology:** Charging type (DC with stationary inverter)

Utilizing the use case classification framework described above along with a process for quantifying the "benefit"(i.e. the revenue potential per EV per year for each particular use case), a total of 320 use cases were identified and subsequently, ranked by the VGI WG. Of those 320 use cases, 240 were light-duty vehicle (LDV) use cases and 80 were V2G use cases. Six (6) LDV V2G use cases received the highest "benefit" score possible of $800 per EV per year. Many of the V2G use cases scored highly for benefits but most scored more poorly for costs

[1] *Final Report of the California Joint Agencies Vehicle-Grid Integration Working Group*. June 30, 2020. Pages 18-21.

and/or ease or risk of implementation than their V1G counterparts. Among the 80 V2G use cases, there were two that scored highly: one is indirect-controlled, unified and aligned resources for customer backup/resiliency at residential-single family homes and the second is direct-controlled, unified and aligned resources for customer backup/resiliency at residential-single family homes (the main difference being the method of control –indirect versus direct). The use case – direct-controlled, unified and aligned resources for customer backup/resiliency at residential-single family homes – will be tested in this pilot.

In evaluating all 320 use cases, most VGI WG participants agreed upon ten (10) priority sectors and applications because of their potential to provide value to customers in the short-term.[2] Of the ten priority sectors and applications, those that will be addressed by this pilot include: the residential sector broadly for LDV use cases, customer bill management, home backup power (V2H), V2G that can provide value now, including V2G use cases encompassed by the forementioned line items (i.e., V2G in the residential sector or V2G to support customer bill management), system applications easily implementable for vehicle locations with daytime charging ability and all system and customer applications that defer charging away from peak periods (i.e., system renewable integration, system real-time energy).

This pilot will also address some of the next steps/further analysis recommended by the VGI WG, including:

- Assessing customer interest, acceptance, and retention, and what is required (and associated costs) to get customers to participate in VGI programs (e.g., incentives, marketing, dealership education); and
- Identifying and obtaining publicly available data on VGI costs, as well as baseline data on driving and charging patterns relevant to different use cases.[3]

Market Barriers

This pilot will address barriers currently inhibiting the growth of the bidirectional charging market and thus, preventing customers from earning revenue from grid services and preventing the electricity grid from benefitting from bidirectional charging technology that can provide valuable grid services. For example, bidirectional EVs cannot obtain value for their services by participating in the NEM program or receiving SGIP incentives, and there are disincentives to participate in CBP. While these pathways may not be appropriate for participation by bidirectional electric vehicles, this pilot will explore the options and make recommendations so that maximum value is captured from bidirectional charging technology for both customers and the electricity grid.

In the following paragraph, processes and/or methods to address these barriers within this pilot will be described. The first step will be to review current rules and requirements for existing utility programs (NEM, SGIP, CBP) and determine whether a bidirectional EV can meet the

[2] *Final Report of the California Joint Agencies Vehicle-Grid Integration Working Group*. June 30, 2020. Pages 27-28.
[3] *Final Report of the California Joint Agencies Vehicle-Grid Integration Working Group*. June 30, 2020. Pages 54.

needs and fulfill requirements of the utility program. This data will be evaluated through testing of bidirectional EVs in the pilot. The pilot will also evaluate the benefits bidirectional EVs provide to the electricity grid. As a result of these analyses, an outcome of the pilot will be to either recommend adaption of existing utility program rules or to recommend the creation of a new utility program based on the benefits bidirectional EVs can provide to the electricity grid. Any changes to allow bidirectional EVs to participate in existing programs would require regulatory approval and are beyond the scope of this pilot.

Technology Selection

This pilot will focus on exploring large-scale adoption of the DC bidirectional charging because the market for the DC bidirectional charging is more mature than AC charging. There are more EV and EVSE products available for DC bidirectional charging, the communication standards between EV-EVSE are more readily available, and the electrical interconnection process is clearly defined (adopted by Rule 21). As the AC bidirectional charging market matures, the pilot may adapt to include AC bidirectional charging EVs and EVSEs. However, in the near-term, while the pilot explores the testing of value-stream applications for DC bidirectional charging and associated technologies, any learnings can be leveraged for facilitating future testing of AC bidirectional charging technologies. The applications explored in this pilot are not hindered by the use of the AC versus DC bidirectional charging and implementation strategies and/or best practices discovered by this pilot can be utilized (albeit with some modifications) for execution of the use cases with AC bidirectional charging technology in the future. However, it should be noted, that any cost-effectiveness evaluations done by this pilot with the use of DC bidirectional charging technology will not be applicable to AC bidirectional charging technology because of the differences in cost and potential benefit due to differences in technical attributes (efficiency, maximum power, etc.).

Previous Demonstrations

Lastly, previous demonstrations of bidirectional light-duty vehicles using the DC bidirectional charging approach include, but are not limited to, the following projects: UCSD INVENT and Nuvve's joint Light-Duty V2G Demonstration, Roanoke Electric Coop's 2020 Roanoke Electric Coop Pilot (Aulander, NC), NYSERDA and Nuvve's joint V2G, V1G Demonstration, Fermata Energy's Roanoke Electric Cooperative Vehicle-to-Building & Vehicle-to-Grid Utility Pilot, Fermata Energy's City of Boulder, Colorado Vehicle-to-Building Pilot and EVSA and Nuvve's joint California, USA technology demonstration, among others noted in the Joint Utilities stocktake.[4] None of these demonstrations involved large-scale adoption and/or contemplation of modification to existing rules based on long-term participation of bidirectional EVs in electricity grid services.

B. Compliance with CPUC Decisions and relevant statute.

[4] *3/12/21 Joint Utilities Amended Stocktake. Pilots and Programs Related to VGI.* March 12, 2021.

i. *What VGI Strategy(s) and/or Near-Term Policy Action(s) established in D.20-12-029 will be addressed?*
ii. *Describe the pilot objectives and how they align with the guidelines adopted in D.20-12-029, and with any other relevant CPUC policies.*
iii. *What VGI strategies and use case(s) are addressed in the pilot and how will they help IOUs achieve the goals of D.20-12-029?*
iv. *Show how the pursuit of these activities will advance VGI, as defined by this decision, by ensuring that proven VGI technologies can be scaled and by expanding the technology required to advance VGI.*
v. *Show how the pilot does not overlap with scope of the EPIC program or other programs including those administered by the Energy Commission.*
vi. *Show why a pilot is needed before implementing an IOU program.*
vii. *How will the proposed project(s) support other state legislation and policies relate to Transportation Electrification, including any update to the VGI Roadmap, the state's Zero-Emissions Vehicle Action Plan, the Air Resources Board's Scoping Plan and Mobile Source Strategy, the Commissions Environmental and Social Justice Action Plan, and any relevant local or regional policies? Will any existing state policy help facilitate the success of the VGI pilot?*

Pilot Scope Versus Energy Commission Programs

PG&E's V2X Residential Pilot Program is focused on spurring adoption of commercially ready V2X (bidirectional technologies) for single-family residential customers with light-duty electric vehicles. The V2X Residential Pilot's goals are to demonstrate the value of V2X/bidirectional LD EVs for customers and the electricity grid and reduce the total cost of EV ownership by understanding potential revenue streams for the services provided and identifying potential barriers that inhibit access to these revenue streams. In discussion with the California Energy Commission (CEC), this pilot will not overlap with the CEC's Electric Program Investment Charge (EPIC) program because this pilot has a focus on commercially-ready technology, whereas the EPIC program is focused on facilitating commercialization of technology not yet ready for at-scale market deployment through funding of lab testing and/or small-scale research that ensures technologies meet existing communication protocols and safety standards.

Need for Pilot

It is important to conduct this pilot before implementing a full-scale utility program for bidirectional technologies because there are several challenges that face bidirectional EVs from immediately providing grid services to PG&E. That is, a robust platform for communication and control needs to be set up for the bidirectional EVs and equipment to connect with utility systems and costs and benefits need to be evaluated at large-scale to determine appropriate levels of investment for a sustainable, long-term program. Bidirectional EVs are currently excluded from participating in PG&E's NEM and SGIP programs and are unable to capture the value and/or generate revenue from energy export beyond the customer's household

electricity meter (in such programs as CBP). Through this pilot, PG&E will explore adapting existing utility programs and/or creating alternative market pathways by opening new programs to accommodate the benefits provided by bidirectional EVs. Furthermore, this pilot will aim to develop a sustainable distributed energy resource (DER) platform that will aggregate utility signals and communicate via standardized protocols to multiple EV and EVSE brands. Lastly, this pilot will require a certain level of data transparency from participants to accurately capture the costs and benefits of deploying bidirectional technologies. By capturing accurate cost and benefit information, an evaluation can be made to accurately value the services provided and develop performance metrics for a robust, and long-term sustainable utility program which would capture the benefits of bidirectional technologies.

Compliance with CPUC Decision D. 20-12-29

SB 676 mandated the California Public Utilities Commission (CPUC) to "...adopt strategies that promote VGI...". Commission Decision D.20-12-029 implementing SB 676 set to "establish strategies and quantifiable metrics to maximize the use of feasible and cost-effective electric vehicle grid integration by January 1, 2030..."[5] In the Decision, the CPUC asserted five objectives to facilitate the adoption of VGI. Three (3) of the five objectives noted below will be addressed by this pilot:

- Market signals to create market demand;
- Overcome capital costs, infrastructure, information, and other barriers to scaling VGI services; and
- Continue agency coordination.

The CPUC also adopted VGI strategies to advance the market in the VGI decision, D. 20-12-029. Those listed below will be addressed by this pilot:[6]

- The strategy of reforming retail rates applicable to EVs, with a particular focus on optional dynamic pricing structures;
- The strategy of VGI pilots, demonstrations, emerging technologies and studies to ensure that proven VGI technologies can be scaled, and that technology required to advance VGI is expanded;
- Accelerate the use of EVs for bidirectional non-grid-export power and PSPS resiliency and backup; and
- Promote the use of EVs to provide bidirectional grid-export power, to support grid-facing use cases such as system renewable energy integration, system resource adequacy, and system ancillary services like frequency regulation by developing necessary interconnection rules.
- Developing and implementing strategies to prioritize ESJ communities in siting and benefits of SB 676 pilots including working with community-based organizations (CBOs) and providing increased incentive levels for ESJ communities.

[5] D. 20-12-029. Pgs. 7, 15.
[6] D. 20-12-029. Pgs. 16, 19, 21-22, 45-47.

The Commission adopted near-term policy actions in the VGI decision, D. 20-12-029. Policy actions should be pursued as soon as possible to advance the above VGI strategies. Those policy actions that will be addressed by this pilot include:

- Pursuit of exploration of credit-for-export compensation schemes for bidirectional EVs;
- Addressing in all future TE program applications how TE programs will maximize the potential use of VGI for on-site backup power where practical; and
- The requirement to identify the use cases or categories of use cases addressed by each VGI policy action identified in this decision while filing any applications or advice letters.[7]

This pilot will address VGI strategies and near-term policy actions established in D.20-12-029 by exploring how bidirectional EVs can provide value to customers and the grid and be compensated for those services, and accelerate the adoption of bidirectional EVs and equipment. The pilot will provide incentives for program participants, with increased incentive levels to participants in environmental and social justice (ESJ) communities addressing a near-term policy action adopted by the VGI decision. Additionally, the pilot will have a focus on testing bidirectional EVs for non-grid export power and PSPS resiliency and backup in the first phase (2022) which is a key strategy adopted by the decision and a near-term policy action. Furthermore, the pilot will focus in the later phases on testing bidirectional EVs for grid-export power to support grid-facing use cases such as system resource adequacy, both strategic policy actions adopted by the VGI decision. Lastly, through the course of value-stream application testing, the pilot will consider the structures that need to be adopted on a permanent basis to enable long-term participation of bidirectional EVs in grid services, such as reforming retail rates, providing credit-for-export and adapting interconnection rules among other solutions.

C. Environmental/Social Justice Communities: **How will the pilot increase access for, or provide benefits to, Environmental/Social Justice Communities (ESJ), as defined by SB 350?**

i. Do ESJ areas face any unique participation barriers, and if so, how will this pilot address those barriers?

ii. Describe input sought and received from Community-Based Organizations (CBOs) regarding the pilot development. How will CBOs be involved in pilot implementation, and/or evaluation?

Environmental and social justice (ESJ) communities face unique barriers to adoption of bidirectional EVs and equipment, including lack of information on VGI technology and its benefits, reduced income potential and flexible spending to adopt bidirectional EVSEs which are currently more costly than non-bidirectional EVSEs. To address this inequity, the pilot will provide an increased upfront incentive (20% more than the upfront incentive offered in non-ESJ communities) to spur adoption of bidirectional technologies in ESJ communities. Additionally, the pilot team will work closely with local CBOs to help in educating ESJ communities on the

[7] D. 20-12-029. Pgs. 31-32, 41-42, 44.

benefits of bidirectional technologies and the opportunities for incentives to support technology adoption. Qualification and eligibility for the ESJ incentive adder will follow guidelines established in Assembly Bill 841.

PG&E plans to consult with CBOs for pilot implementation and evaluation through a holistic CBO effort currently underway at PG&E. CBOs are currently engaged by many teams within PG&E in a one-off piecemeal approach which tends to utilize more resources than a coordinated approach. Therefore, PG&E is building a holistic effort and plans to issue an RFP at a later date but prior to the expected launch of this pilot to establish strong CBO partnerships that will allow for input on an ongoing basis from CBOs on a variety of topics. Through this process, the teams anticipate stronger outputs and reportable data. As part of this larger PG&E effort, the pilot team will engage the selected CBOs on an ongoing basis (monthly) to inform pilot efforts in reaching ESJ communities, developing appropriate incentive levels, engaging customers, sharing unique needs & challenges and measuring impact in ESJ communities.

D. **VGI applications/value streams**:

i. *Which of the multiple VGI applications (i.e., value streams) listed in the VGI Working Group final report will the pilot address and why? Could the potential VGI value streams potentially overlap or conflict, and if so, how would the pilot resolve how to prioritize different value streams? Which VGI value streams will be excluded and why?*

This pilot will address the following VGI applications (i.e., value streams): backup power, customer bill management, system-real-time energy and system-renewable integration and EV export to support grid services (such as system RA, system capacity). The pilot will focus primarily in phase 1 (2022) on customer-backup and resiliency because both the VGI WG Final Report and VGI Decision prioritized this application as strategic in advancing VGI and in providing high total benefits to customers (in this case, consumers at single-family homes). In phase 2 of the pilot (2023), the VGI applications that will be tested are broader and include customer-bill management, system-real-time energy, system-renewable integration and possibly other system-level grid services, such as resource adequacy. The reason that the pilot will study these VGI applications is because some of them, such as customer bill management and system applications that defer charging away from peak periods such as system-real-time energy and/or system-renewable integration, were prioritized by the VGI WG as having a “high” total benefit. System-renewable integration was added as an application later in pilot development as a direct result from stakeholder feedback following the Second VGI Workshop on June 4, 2021.

The VGI applications will not be stacked in phase 1 (2022), that is, only a single application will be tested at one time. However, in phase 2, the goal of the pilot is to test stacking and optimizing applications based on specified criteria. In this scenario, there could be potential conflicts between the signals. However, if the optimization criteria are clear, the signals will prioritize one application for a specified period over another in cases where a conflict might

arise. It is always an option for the customer to "opt-out" of participation to ensure transportation needs are always met and of highest priority.

The pilot will not address customer-upgrade deferral or many of the other system-level applications, such as ancillary services due to current market limitations for individual single-family residences to participate. Some of the system-level applications are more appropriately suited for the PG&E V2X Commercial Pilot Program where participating vehicles will have larger batteries, more than one vehicle will reside behind a single customer meter (i.e., with large delivery fleets) and in some cases, the vehicles will have more operational flexibility in their duty cycles to participate in grid services. Additionally, in the case where market barriers exist for bidirectional EVs to participate and/or are disincentivized to participate in system-level use cases, the PG&E Exploring V2X Export Value Pilot will address these barriers.

E. **Stakeholder engagement**:

i. *How did the IOU address stakeholder feedback - both publicly available comments and any non-public feedback that is not confidential?*

ii. *How will the utility provide periodic updates to interested stakeholders?*

iii. *Will any pilot milestones require stakeholder input/engagement to determine the potential need for mid-course corrections? If so, how will the utility obtain and implement stakeholder recommendations?*

The Joint Utilities (PG&E, SDG&E and SCE) hosted two VGI Workshops[8] seeking stakeholder feedback on proposed pilot ideas. The Joint Utilities received comments after both workshops and specifically hosted a feedback survey after the second workshop. PG&E addressed stakeholder feedback in a variety of ways. One method included analyzing survey feedback and comments submitted to the Joint Utilities and making adjustments to pilot ideas accordingly. Another method included meeting bilaterally with stakeholders to solicit feedback on the pilot. PG&E held over fifteen (15) individual meetings with technology providers (automotive manufacturers, EVSE suppliers and software providers) to gather input for designing the pilot structure.

PG&E plans to provide regular updates to stakeholders by hosting quarterly meetings with interested stakeholders to provide status of the pilot, progress towards meeting pilot objectives and solicit feedback on data evaluation and outcomes to date. This pilot does not plan to require stakeholder input to determine potential mid-course corrections, however, stakeholder input will be crucial in evaluating cost/benefit analyses and calculations resulting from VGI value-stream application testing. This feedback will help inform PG&E's final documentation and recommendations provided to the CPUC for future long-term program adoption.

F. ***Partnerships****: What partner(s) will collaborate with the utility to complete the pilot?*

[8] The first VGI Workshop was held on March 16, 2021 and the second VGI Workshop was held on June 4, 2021.

i. *How will the project partners maximize the scope and value of the applications and use cases that would be developed?*

ii. *What sources of private or public investment (or customer contribution) will be leveraged for the project and how much, and what will that funding be used for?"*

iii. *What, if any, other public funding resources will be leveraged to fund the project(s)?*

Seven (7) partners have been identified to collaborate with PG&E to complete the pilot. Those partners include: four to five automotive manufacturers (including BMW of North America, LLC and Nissan North America, Inc.), one EVSE supplier (dcbel) and one system integrator (Nuvve). All of the participating technology providers are committed to accelerating VGI adoption and as a commitment to the pilot and in pursuit of market adoption of bidirectional charging technologies have agreed to contribute by providing in-kind development work.

For example, participating technology providers will support some or all of the following activities for customers[9]: (1) host customer enrollment processes within their customer communication channels (such as posting an application form and frequently asked questions (FAQs) about the pilot on their website and/or other social media platforms), (2) assist PG&E in recruiting participants for the pilot & ensure participants maintain compliance with the pilot program rules, (3) provide education and outreach, (4) integrate their backend systems with a central software platform (to be determined via RFP) for communication signaling of PG&E grid conditions and application testing and (5) communicate application testing notifications (either via SMS or phone application, depending on the technology providers' preference) to the end customers.

The pilot will leverage a significant amount of private investment and in-kind support to accomplish its goals. The exact quantity of private investment that will be leveraged by this pilot is difficult to quantify given the difficulty in separating private industry investment for strategic development goals and specific investment in accomplishing this pilot and this pilot only. Therefore, an exact dollar amount of private investment is excluded from this document.

The end customers will also contribute to the pilot by financing a portion of the capital cost to acquire a bidirectional-capable electric vehicle, equipment and installation. While this pilot will help bring bidirectional-capable electric vehicles and equipment in cost-parity with non-bidirectional capable electric vehicles and equipment, full cost-parity will not be feasible. Therefore, customers will be required to finance a portion of the costs of hardware to participate in the pilot.

G. IOU ownership of customer-side resources

[9] Partner commitment for program support activities will depend on final pilot design.

i. *Would the IOU own any customer-side resources? If so:*
    a. *What resources would the IOU own, and why is IOU ownership essential for the success of this pilot?*
    b. *Can any market actor provide this product or service, and if so, why is the IOU not utilizing market actors?*
    c. *What is the cost differential due to IOU-ownership of customer-side resources including rate of return requirements, differences in capital and/or labor costs or IOU requirements?*
    d. *How can the IOU develop the availability of market actors to provide products or services?*

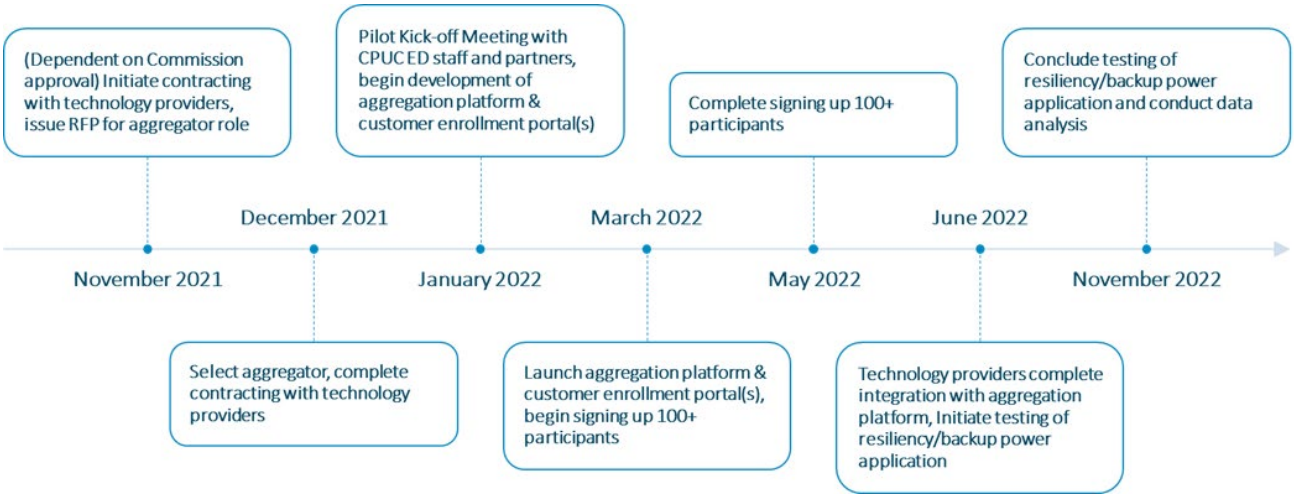
This pilot will not involve any utility ownership of customer-side resources. All charging infrastructure that is installed as part of the pilot will be owned, operated and maintained by the residential customer participants.

H. Timeline

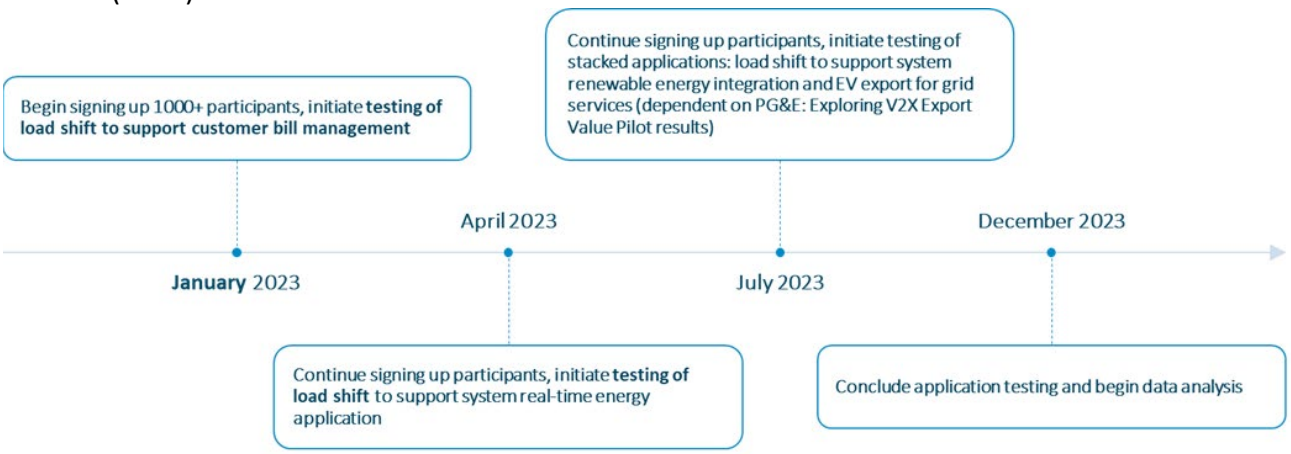
i. *Provide a flow chart describing the major stages of the pilot with milestones including (but not necessarily limited to) project initiation; key agency/partner meetings; initiation and completion of contracting (if necessary); education & outreach; installation of equipment; implementation; data collection; and evaluation.*
ii. *Also include milestones for key sub-tasks for each of the major stages of the project so that Energy Division staff can track progress against the pilot schedule.*
iii. *Identify tasks that are contingent on the completion of a preceding task; and potential options if a preceding task is delayed.*

This pilot has three major stages: phase 1 (2022), phase 2 (2023) and phase 3 (2024). Phases 1 and 2 will be focused on customer enrollment and application testing, whereas phase 3 will be focused on data analysis of results and final reporting. Below are flow charts describing the major milestones in each of the three phases. The milestones for each sub-task and contingencies will be developed and shared with CPUC Energy Division staff once the pilot is approved.

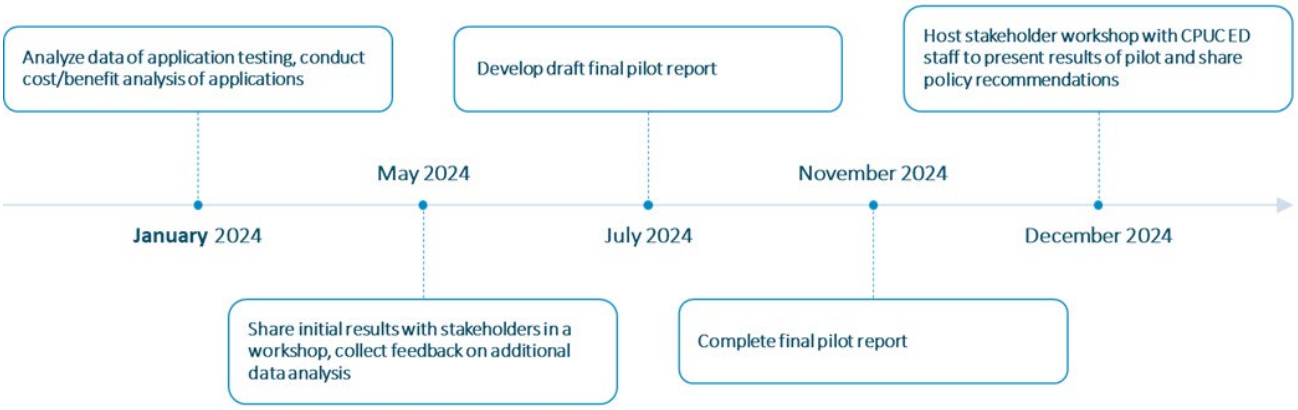
Phase 1 (2022) Timeline



Phase 2 (2023) Timeline



Phase 3 (2024) Timeline



I. Budget detail

i. *Proposed budget for the following types of expenses – equipment, materials, contracted goods and service, internal labor, and other (describe):*
ii. *Provide the estimated budget in nominal dollars and for the full project with escalators over its expected term.*
iii. *Estimate expense for each of the major budget categories listed below if required for this project. (This information will help the Commission and stakeholders understand the utility's expectation of the level of effort needed to support each type of activity)*
iv. *outreach;*
v. *customer participation incentives;*
vi. *electrical infrastructure make-ready (specify);*
vii. *EVSE;*
viii. *other technology and/or hardware expenses;*
ix. *technical services;*
x. *evaluation, including a proposed budget for data collection; and*
xi. *any other category of budget expense that would account for 10% or more of the total budget.*

The Joint Utilities have defined each budget category as follows:

- **Equipment:** Utility-owned instruments, data loggers, computers, networking, tools, batteries, vehicles, etc.
- **Materials:** Raw building materials such as wood, concrete, steel; signage materials, office consumables, etc.
- **Contracted Goods & Services:** External services to augment utility labor for: pilot management, marketing, customer services, web development, analysis, software aggregation, etc.
- **Internal Labor:** Utility Personnel labor for: pilot management, marketing, customer services, web development, analysis, etc.
- **Outreach:** Marketing, education and outreach to acquire customers, present to external parties, etc.
- **Incentives:** VGI service payments to customers or aggregators in lieu of payments to customers
- **Infrastructure:** Electrical equipment and labor to provide electrical services to EV charging equipment and other supporting equipment such as local storage, etc.
- **Technology Expenses:** Any technology expenses that are not covered under technical services such as labor to repair equipment, equipment replacement.
- **EVSE:** Utility-owned EV charging equipment
- **Miscellaneous Hardware:** Hardware not covered in Equipment, Materials or Infrastructure category

- **Technical Services:** Services not covered under Contracted Goods & Services or Technology Expenses such as subscription services (i.e., EVSE networking services, data services, parts warranty, etc.)
- **Data Collection/Evaluation:** Costs for acquiring data, 3rd party analysis of results of the pilot and developing report(s) on the effort

Table 1 below details the total pilot budget broken down by the budget categories as defined above. Where funds are available, LCFS revenue will be used in favor of ratepayer dollars to cover pilot costs. Funding for some of the pilot activities will be provided in-kind by the technology providers (i.e., product research & development, software development, electric vehicle (EV) to electric vehicle supply equipment (EVSE) compatibility testing and customer enrollment), however, this in-kind funding being leveraged by the pilot is separate and not captured in the table below.

Table 1: Total Pilot Budget

Budget Category	Total Amount ($)
Contracted Goods & Services	$1,875,000
Internal Labor	$200,000
Incentives	$5,175,000
Data Collection/Evaluation	$250,000
Total	**$7,500,000**

J. Risk mitigation

i. Explain potential risks or uncertainties for key elements of the pilot (i.e., technology performance, lack of customer uptake, integration challenges, etc.), whether they can be mitigated, and if so, how? If not, what are the potential consequences for the pilot? Can the pilot identify potential risks for future programs and/or mitigation options?

PG&E has identified four potential risks to the pilot's success: availability of commercially-ready technology, supply of hardware (vehicle &/or EVSE) to meet pilot demand, lack of customer interest and/or uptake and lack of partner coordination and alignment. Currently, there are very few commercially-ready electric vehicles and no commercially-ready EVSEs capable of bidirectional charging in the U.S. residential market. By the start of the pilot, more electric vehicles and a few EVSEs capable of bidirectional charging will be market-ready.[10] Throughout the course of the pilot, more commercially-ready bidirectional charging technology will become available. However, given the lack of existing commercially-ready technology and pilot timelines that are dependent on the private sector meeting their development and product launch

[10] The Truck of the Future Is Here: All-Electric Ford F-150 Lightning | Ford Media Center, Power Day: Volkswagen presents technology roadmap for batteries and charging up to 2030 | Volkswagen Newsroom (volkswagen-newsroom.com), 2021 california launch - dcbel

timelines, potential risks are posed to the overall timeline and objectives of the pilot. If private sector timelines slip or they are unable to produce products in the quantities needed for this pilot, the pilot timeline may be delayed or the pilot may not be able to meet its target of enrolling 1,000 customers due to limited quantities of available bidirectional charging equipment. PG&E recognizes this risk, and will monitor industry trends as well as align closely with technology providers to identify earlier impacts to the pilot objectives.

If there is a lack of customer interest or uptake of bidirectional technology, the first step will be to evaluate the pilot's outreach and marketing methods to understand if they are sufficient. The second step will be to conduct a survey to evaluate the reasons for lack of interest or uptake. Based on the outcomes of the survey, the pilot may adapt where feasible. For example, if cost is still a prohibiting factor to adoption, PG&E may elect to increase the value of the upfront incentive while decreasing the number of targeted participants. If concerns over the prioritization or importance of transportation needs are the underlying reason, then PG&E may elect to modify the pilot applications that are tested and/or increase educational efforts in collaboration with the technology providers to ensure customers are aware of how the technology prioritizes customer preferences and manages vehicle (dis)charging accordingly and are aware of their ability to opt-out of events/participation when needed.

Lastly, this pilot requires a high degree of coordination and close alignment between all partners – the utility (PG&E), technology providers (both automotive manufacturers and EVSE suppliers), the party developing the centralized software platform and the program implementer (these roles may be done by the same party). The pilot's success is dependent on the ability to align all entities around common goals, set clear expectations for partners and have strong project management and coordination efforts. To mitigate this risk, PG&E will assign an internal project manager, ensure agreements are in place with all partners and host regular meetings to ensure the pilot is on track and continuing to meet major milestones.

K. Safety

i. *What safety requirements are included in the proposed pilot?*
ii. *Does the project(s) align with the Safety Requirements Checklist adopted in D.18-01-024, D.18-05-040, and D.18-09-034?*
iii. *Are any additional safety requirements needed for the pilot, and if so, what are these requirements and how will the pilot meet them?*
iv. *Will the pilot incur cybersecurity risks and how can they be mitigated through the pilot and/or the SCE cybersecurity workplan required by D.20-12-029 (at 85)? Will the pilot help identify cybersecurity gaps and/or develop potential solutions that could be addressed in the cybersecurity workplan?*

Safety Requirements

The pilot will follow all safety requirements listed in the Safety Requirements Checklist adopted in D.18-01-024, D.18-05-040, and D.18-09-034. As an example, all participating EVSEs must

meet the safety requirements, such as compliance with CHAdeMo and CCS for DC EVSEs and UL certification from a Nationally Recognized Testing Lab (NRTL). The EVSE installation must also follow such safety requirements as compliance with California Electrical Code Article 625, the Americans with Disabilities Act (ADA) and California Building Code Chapter 11B (where applicable). Installers must be fully licensed electricians and EVTTP certified and provide proof of a performance of a full site assessment. The EVSE installation must have overcurrent protection, bollard equipment protection and concrete parking stops. Additionally, any electric vehicles that are not commercially-ready (i.e., they are modified for bidirectional charging after production) will need to go through proper safety certifications by the regulating authorities (i.e., the National Highway Traffic Safety Administration (NHTSA)).

Cybersecurity

The pilot may incur cybersecurity risks in such that grid signals are sent via the Internet to technology providers. These cybersecurity risks will be mitigated by utilizing industry-approved and adopted open standards to relay grid signals and conditions. If all possible, no proprietary standards will be used between the utility grid and the technology providers. Additionally, the technology providers will have no direct connection to utility systems and/or hardware reducing vulnerability. All messaging and communications between the utility and the technology providers will go through a single-entry point (i.e., centralized software platform). Likewise, the centralized software provider/program implementer will not have direct control over customer end-devices (such as the electric vehicles and/or EVSE hardware).

V. Scale Up: Analyze potential to scale to a full utility program. (approximately 15% of narrative)

- **A. *What additional barrier(s), if any, would need to be overcome to scale the pilot into a full program?***
- **B. *How would the pilot be scaled if it is successful and on what timeframe?***
- **C. *Will the pilot encourage the development of new business opportunities for third-party market participants providing products and/or services?***
  - *i. How does the proposed SB 676 VGI pilot design ensure this proposal will avoid or mitigate any potential unfair competition with nonutility enterprises?*
    1. How will the pilot lead to policies and programs that enable a variety of market actors to compete to offer services?

The pilot is designed to mitigate any unfair competition between nonutility enterprises. For example, all incentives in this pilot will be paid directly to end-users and not provided to any one of the technology providers (i.e., automotive manufacturers or EVSE suppliers). There is a 40% cap on the number of incentives allowed for each technology provider. For example, any single automotive manufacturer cannot have more than 40% of the incentives going to adopters of their bidirectional charging electric vehicles. This manufacturer cap will ensure that no unfair advantage is gained by any one technology provider while at the same time

encouraging technology diversification of the market. While the pilot favors market actors that are “first-to-market", that is, those technology providers that have available products at the time of the pilot launch (2022), this demand-side signal will encourage the market and industry to continue developing bidirectional charging technologies. The goal of the pilot is to partner with as many technology providers as possible. Therefore, any programs that develop from the pilot will be robust and broad to enable participation by a variety of market actors as they mature.

Pilot success will be measured by the ability to meet stated pilot objectives and to develop proposals for the creation of long-term modifications in existing programs or the creation of new utility programs that define clear market pathways for capturing the value of bidirectional electric vehicles and equipment for customers and the electricity grid. If these metrics are met, then the next step before the pilot can be scaled would be to adopt the proposed policy recommendations reported by the pilot’s final documentation. These policy recommendations would need to be approved by the applicable regulating agencies such as California Public Utilities Commission (CPUC), California Independent System Operator (CAISO) or California Air Resources Board (CARB), where applicable. Depending on the process for review and approval, the policy recommendations could take anywhere from 3-12 months for adoption. Therefore, the earliest a scaled program could be implemented following pilot completion would be 3-12 months, with a more likely timeframe to launch a subsequent program being 6-18 months following pilot completion.

VI. Evaluation (approximately 15% of narrative)

A. ***Evaluation Plan****: As noted in D.20-12-029 “Each advice letter for a VGI pilot must contain an evaluation plan that identifies a process to determine the success of each pilot and the feasibility and desirability of scaling the pilot to a full-scale program or utilize the results to revise an existing program.”*

i. Describe an evaluation plan that includes assessment of the need for ratepayer funding, effectiveness of the project for achieving the planned results, timeliness and efficiency of pilot execution, lessons learned and opportunities for improvement, and appropriateness to scale to a full utility program. Include a schedule for 1) drafting a request for proposals (RFP), 2) providing Energy Division staff time to review RFP (including draft scope of work), 3) releasing the RFP and scope of work, and 4) giving ED staff time to review RFP responses consistent with ordering paragraph 23 of D.20-12-029.

B. ***Success Indicators:*** *What criteria will the IOU use to evaluate if the pilot has been successful?*

C. ***Metrics****: What metrics from D.20-12-029 would the IOU propose to add to the SB 676 data reporting template, after receiving the concurrence of Energy Division staff, to measure the pilot’s success in overcoming barriers and the program’s impact on DACs and other priority populations?*

i. *For example, what technical, cost, and customer engagement metrics will the IOU track, and how? What other types of data will be collected, and how? How will this data be used to determine whether to scale the pilot to a full utility program? How do the proposed metrics and data align with the metrics in the final Scorecard adopted within the TEF, if finalized by the time the VGI pilot advice letter is filed?*

This pilot has two main objectives. They are: to demonstrate the value of V2X/bidirectional LD EVs for customers and the electricity grid and reduce the total cost of EV ownership by understanding potential revenue streams for the services provided and identifying potential barriers that inhibit access to these revenue streams.

The first objective can be measured by the following metrics:

- Number of customers that enroll in the pilot;
- Level of influence the pilot incentive had in V2X purchase decision; and
- Number of customers that initially enroll in the pilot and continue participating throughout the entirety of the pilot (attrition rate).

The second objective can be measured by the following metrics:

- Costs of V2X deployments (incremental hardware and/or software costs);
- Value (revenue) of V2X to customers;
- Value of V2X to the electricity grid;
- Benefits of each V2X application tested in the pilot (i.e., backup power, customer bill management, system-level real-time energy, system-level renewable integration and EV export for grid services (such as system-RA, system capacity);
- Total cost of ownership (TCO) savings due to V2X functionality; and
- Pathways (existing rules and regulations) that currently inhibit positive or increased value of V2X to customers and/or the electricity grid.

A successful pilot will be measured by achieving the above-mentioned metrics. The goal is to enroll 1,000 customers, demonstrate that the pilot incentive influenced & accelerated bidirectional technology adoption, demonstrate that the bidirectional functionality offered positive value (revenue) to customers and benefits to the electricity grid and lastly, demonstrate that bidirectional capabilities and participation of bidirectional electric vehicles in grid services reduces the total cost of ownership of electric vehicles. If the cost-benefit analysis of bidirectional electric vehicles demonstrates benefits for both customers and the electricity grid, PG&E may recommend scaling the pilot to a full-scale utility program. Whether this means adapting existing utility tariffs and rules to allow bidirectional electric vehicle participation and/or creating an entirely new program will depend on the exploration and outcomes of this pilot.

Until bidirectional electric vehicles and charging technology become ubiquitous and equal in cost to non-bidirectional electric vehicles and charging technology, incentives may be needed in

the near-term to continue accelerating market adoption and creating a sustainable, robust fleet of distributed bidirectional energy resources. Funding of incentives may need to come from ratepayer dollars. Before authorizing use of ratepayer funding to cover a long-term program of incentives, a detailed cost-effectiveness analysis is prudent in order to quantify the impact on ratepayers, utilities, customers and society.

Lastly, pursuant to VGI Decision D. 20-12-029 Ordering Paragraph 23, PG&E plans to coordinate with the other IOUs and consult with CPUC Energy Division (ED) staff on the development and issuance of a Request for Proposal (RFP) for a third-party evaluator to jointly assess the IOUs' VGI pilots. The evaluation would need to include but not be limited to the above metrics as well as complement data being collected within the IOU annual reports. PG&E will also seek clarity prior to RFP issuance on the overall timeline for evaluation completion in collaboration with the other IOUs and ED staff due to confusion with the current dates listed for final reporting in OP 23.

VII. Other (approximately 5%-10% of narrative)

Please provide any other relevant information.

N/A

VIII. Summary and conclusion (approximately 5%-10% of narrative)

PG&E's V2X Residential Pilot Program is focused on spurring adoption of V2X (bidirectional technologies) for single-family residential customers with light-duty electric vehicles. The V2X Residential Pilot Program's main objectives are to demonstrate the value of V2X/bidirectional LD EVs for customers and the electricity grid and reduce the total cost of EV ownership by understanding potential revenue streams for the services provided and identifying potential barriers that inhibit access to these revenue streams. Pilot success will be measured by: reaching the customer sign-up target of 1,000 participants, achieving ongoing performance in grid applications, achieving cost transparency of VGI technology deployments (VGI WG "next steps" recommendation), determining the value of bidirectional vehicles to customers and the electricity grid and creating sustainable pathways for bidirectional vehicles to participate in vehicle-grid integration services.

If successful, this pilot has the potential to advance Vehicle-Grid Integration (VGI) strategies, such as retail rate reform, the use of EVs for bidirectional non-grid-export power to support resiliency and developing necessary interconnection rules to allow the use of EVs for bidirectional grid-export power to support grid-facing use cases adopted by VGI Decision, D.20-12-029. VGI strategies are key in achieving California's goals of carbon-neutrality by 2045 and 5 million zero-emission vehicles and 250,000 charging ports by 2030. VGI has the potential to accelerate EV adoption, reduce costs to ratepayers, support further decarbonization, accelerate the reduction of carbon and criteria air pollutant emissions from the transportation sector and

improve grid resiliency. For these reasons, PG&E recommends approval of the V2X Residential Pilot Program by the CPUC.

PILOT 2 - V2X Commercial Pilot Program

PG&E Pilot #2 – V2X Commercial Pilot Program

I. Subject

Pacific Gas and Electric Company Proposal for Senate Bill (SB) 676 Vehicle-Grid Integration (VGI) Pilot: V2X Commercial Pilot

II. Pilot overview

Please provide an overview that addresses the topics that were included in the summaries provided to stakeholders (with updates as appropriate). Also include key partnerships, specific sources and amounts of non-ratepayer funding, and key metrics to evaluate project success.

PG&E's V2X Commercial Pilot Program is a three-year pilot focused on spurring adoption of V2X (bidirectional charging) medium- and heavy-duty (MHD) electric vehicles (EVs) that are interconnected and charge at commercial buildings. The V2X Commercial Pilot Program's goals are to demonstrate the value of V2X/bidirectional MHD EVs for customers and the electricity grid and reduce the total cost of EV ownership by understanding potential revenue streams for the services provided and identifying potential barriers that inhibit access to these revenue streams. The pilot will test five potential applications: backup power, customer bill management, system-real-time energy, system-grid upgrade deferral and EV export for grid services (such as system RA, system capacity) with an aim to sign up 200+ bidirectional medium- and heavy-duty electric vehicles and charging stations using eligible technology by the end of the second year (2023). Key partnerships include Nuvve, a V2X technology provider offering bidirectional EVSEs, software integration between EVs and EVSEs, fleet management and resource aggregation. Additional partners offering eligible technology will be qualified and onboarded over the course of the pilot pending continued availability of funding. PG&E will also coordinate with the Community Choice Aggregator (CCA) serving Alameda County and the City of Tracy, East Bay Community Energy (EBCE), on this pilot who will support pilot implementation through community outreach, technical assistance and data analysis.

The total budget for this pilot is $2.7 million. Where funds are available, LCFS revenue will be used in favor of ratepayer dollars to cover pilot costs such as customer incentives, PG&E internal costs, and software integration of utility backend systems. Funding for some of the pilot activities will be provided in-kind by the technology providers (i.e., product research and development (R&D), software development, electric vehicle (EV) to electric vehicle supply equipment (EVSE) compatibility testing and customer enrollment). Pilot success will be measured by: reaching the sign-up target of 200 participating bidirectional MHD EVs and EVSEs, achieving ongoing performance from the participating vehicles in customer and grid applications, achieving cost transparency of VGI technology deployments (one of the Vehicle-Grid Integration Working Group (VGI WG) Final Report "next steps" recommendations), determining the value to the electricity grid of bidirectional MHD vehicles and creating sustainable pathways for bidirectional MHD electric vehicles to participate in vehicle-grid integration services.

III. Need for Pilot (approximately 15% of narrative)

A. Describe the market-readiness of the technology (and/or use cases) addressed by the proposed VGI pilot; as well as practical barrier(s) to deploying at scale via an IOU program.

i. *What is the status of technology development and deployment?*

ii. *What technical standards have been established, how technically robust are existing standards, and how widely are they adopted in the marketplace? What gaps need to be filled in standards development and/or deployment?*

iii. *Are business models well-established, and if not, what barriers must be overcome to establish business models?*

iv. *Do any existing policies, rules, or tariffs create barrier(s) and if so, what are these barriers and how can they be overcome?*

v. *What customer education is necessary?*

vi. *What existing and/or ongoing pilots or research can be leveraged to provide information and/or physical resources for the pilot? How will the pilot avoid duplication of existing work?*

Over ten (10) R&D pilots across the U.S. have been conducted with bidirectional EVs and EVSEs interconnected to commercial buildings. About half of those R&D pilots have utilized and tested light-duty (LD) electric vehicles and the other half MHD electric vehicles. While these R&D pilots have explored the capabilities of bidirectional charging on a technology level, there have not been any pilots to date that explored large-scale adoption and ongoing business models of bidirectional charging either for LD or MHD electric vehicles. This pilot will leverage the technological advancements achieved in prior bidirectional R&D pilots, including compatibility testing between EV and EVSE, implementation of standard communication protocols for bidirectional charging, testing of communication protocols to enable EV and/or EVSE resources to receive grid signals and implementation strategies for testing value-stream applications.

The market has not yet seen mass adoption of either MHD electric vehicles or MHD electric vehicles with bidirectional capabilities. Growth in the MHD bidirectional electric vehicle space is emerging more from the specifically MHD vehicle manufacturers, such as Lion Electric Co., which was founded in 2011, and Proterra which was founded in 2004 and less from the traditional LD automotive manufacturers (such as Ford, Daimler, etc.). Interestingly, the commercial bidirectional charger market is more mature than the residential bidirectional charger market. This is likely because most of the existing unidirectional DC charger equipment almost always interconnects to a 3-phase power grid (commercial buildings), and not at a single-family residence (single-phase power grid). It is likely easier to modify existing unidirectional DC charger products for bidirectionality than to modify them for interconnecting to a 1-phase power grid. While the bidirectional charging market for vehicles and charging equipment is still evolving, we hope that by the end of this pilot program to see more bidirectional MHD electric vehicles and charging stations available.

There are two approaches to bidirectional charging: direct current (DC) and alternating current (AC). DC bidirectional charging is where the power conversion equipment resides offboard the electric vehicle in the EVSE and AC bidirectional charging is where the power conversion equipment resides onboard the electric vehicle. This pilot will focus on exploring large-scale adoption of the DC bidirectional charging approach in the near-term because the market for the DC bidirectional charging approach is more mature – there are more EV and EVSE products available using the DC approach, the communication standards between EV and EVSE are more readily available, and the electrical interconnection process is clearly defined (adopted by Rule 21). As the AC bidirectional charging market matures, the pilot may adapt to include AC bidirectional charging EVs and EVSEs, pending available funding.

There are a limited number of available bidirectional charging standards enabling communication between the EV and EVSE. For vehicles that use the CHAdeMO standard already for DC charging, there is a fully enabled communication protocol for bidirectional charging. For vehicles that use the Combined Charging Standard (CCS) for DC charging, there are two existing pathways to enable bidirectional charging. One is through the DIN 70121 specification, and one is through the ISO 15118-20 specification. The DIN 70121 specification has been finalized and is therefore, currently more mature in functionality than the ISO 15118-20 specification, which is targeted to be formalized sometime at the beginning of 2022.

The business model for bidirectional charging is not fully mature. One goal of the pilot is to help the business model evolve by creating market mechanisms for MHD electric vehicles to earn additional revenue through the bidirectional charging services they provide to customers and the electricity grid. There is currently an incremental cost to consumers to procure a bidirectional charging EVSE over a non-bidirectional EVSE due to the additional power electronics components in bidirectional EVSEs. The incremental cost for bidirectional EVSEs is expected to decline over time, but to what extent is unknown. Therefore, by creating market pathways for bidirectional vehicles to earn additional revenue, consumers (i.e., fleet managers) will have an incentive to procure bidirectional vehicles and associated EVSE equipment which may have a higher upfront capital cost than non-bidirectional EVSE equipment.

Not only will these market mechanisms need to be defined and adopted by the pilot, but customer education may be necessary to create awareness of the benefits both for owning and/or leasing bidirectional charging vehicles and equipment in order to create a long-term, robust and sustainable market. To date, there have not been clear market incentives and/or mechanisms for owning and/or leasing bidirectional charging vehicles and equipment, even though there have been several MHD electric vehicle companies with production-ready vehicles. Consumers have not been incentivized to pay the incremental cost(s) on the EVSE equipment to enable the use of bidirectional charging at commercial facilities. Therefore, this pilot will aim to overcome these market barriers and create a long-term, sustainable business case for consumers (i.e., fleet managers).

To fully enable the customer business model and market, there will likely need to be modifications in either existing utility tariffs and programs and/or the establishment of new

utility programs specifically for bidirectional charging vehicles and equipment. For example, PG&E's existing Net Energy Metering (NEM) tariff and the Self-Generation Incentive Program (SGIP) exclude bidirectional-capable electric vehicles from participating and/or receiving incentives. While bidirectional electric vehicles can technically provide the same benefits and services as stationary battery storage, the main difference is that bidirectional electric vehicles are mobile and there is not a process to guarantee they have only charged from renewable sources (in the case of NEM qualification). Customers with bidirectional electric vehicles could technically participate under PG&E's Capacity Bidding Program (CBP) and utilize their bidirectional capable vehicles to reduce onsite load during events, however, the vehicles would not receive any incremental compensation for reducing load beyond the site premise. Therefore, bidirectional vehicles under this program would be limited in the compensation they can receive for their unique ability to export energy onto the electricity grid. Through the course of this pilot, the aim is to find the most appropriate pathway(s) to enable the incentivization of bidirectional charging vehicles, similar to other more mature technology solutions, such as battery storage or battery paired with solar.

IV. Pilot Proposal (approximately 40% of narrative)

Describe how the proposed pilot will contribute to development of IOU programs that will achieve the goals of D.20-12-029.

A. ***Description**:*

i. *Describe the proposed pilot, including customer segments served and number of customers served, program delivery mechanism, etc.*

ii. *What recommendation(s) from the June 2020 VGI Working Group Final Report the pilot will address and how? How will the pilot address the specific barriers identified above under section III?*

iii. *What technologies will be used and why were they selected? Do the technologies enable, facilitate, or hinder other VGI use cases even if not the focus of the proposed pilot?*

iv. *How was the pilot project technology(s) previously demonstrated?*

Pilot Description

PG&E's V2X Commercial Pilot Program is a three-year pilot focused on spurring adoption of V2X (bidirectional charging) medium- and heavy-duty (MHD) electric vehicles that are interconnected at commercial buildings. The V2X Commercial Pilot Program's goals are to demonstrate the value of V2X/bidirectional MHD EVs for customers and the electricity grid and reduce the total cost of EV ownership by understanding potential revenue streams for the services provided and identifying potential barriers that inhibit access to these revenue streams. The pilot will test five potential applications: backup power, customer bill management, system-real-time energy, system-grid upgrade deferral and EV export for grid services (such as system RA, system capacity) with an aim to sign up 200+ bidirectional medium- and heavy-duty electric vehicles and charging stations using participating provider technology by the end of the second year (2023). PG&E will administer the pilot program with

support from East Bay Community Energy and technology providers (automotive companies, EVSE suppliers and system integrators). Upfront and ongoing performance-based incentives will be paid directly to the owners/operators of the MHD vehicle fleets. The upfront incentive will be paid upon completion of the necessary requirements for pilot participation – those are, purchase of eligible bidirectional-capable electric vehicles and EVSEs and installation of the EVSEs at the commercial facility and/or depot for the fleet.

Recommendations Considered from VGIWG

The June 2020 Vehicle-Grid Integration Working Group (VGI WG) Final Report contemplated the question, "What VGI use cases can provide value now, and how can that value be captured?" To address this question, the VGI WG created a framework to classify and define use cases. The framework identified six dimensions by which a use case can be described. The six dimensions include (1) sector (where the vehicle is used and charged/discharged), (2) application(s) (services the vehicle aims to provide), (3) type (determines the power flow to and/or from the vehicle), (4) approach (mechanism through which the vehicle's charge and/or discharge is controlled), (5) resource alignment (specifies whether the "EV actor" and the "EVSE actor" are controlled by the same actor and have coinciding intentions/incentives), and (6) technology (hardware and software utilized, including standards, communication protocols, vehicle type, etc.).[1] This pilot will focus on use case(s) defined by the following dimensions:

- **Sector(s):** Commercial-Fleet, Small Truck (class 3-5) and Commercial-Fleet, Large Truck (class 6-8)
- **Application(s):** Customer-Bill Management; Customer-Backup, Resiliency; System-Grid Upgrade Deferral; System-Real-Time Energy and potentially System-RA, System Capacity
- **Type:** V2G
- **Approach:** Direct (active)
- **Resource Alignment:** unified and aligned
- **Technology:** Charging type (DC with stationary inverter)

Utilizing the use case classification framework described above along with a process for quantifying the "benefits" (i.e. the revenue potential per EV per year for each particular use case), a total of 320 use cases were identified and subsequently, ranked by the VGI WG. In evaluating all 320 use cases, most VGI WG participants agreed upon ten (10) priority sectors and applications because of their potential to provide value to customers in the short-term.[2] Of the ten priority sectors and applications, those that will be addressed by this pilot include: customer bill management, distribution upgrade deferral, building backup power (V2B), commercial sector demand-charge management (customer bill management), V2G that can provide value now, including V2G use cases encompassed by the forementioned line items (i.e., V2G to support customer bill management or distribution upgrade deferral), system applications easily implementable for vehicle locations with daytime charging ability and all

[1] *Final Report of the California Joint Agencies Vehicle-Grid Integration Working Group*. June 30, 2020. Pages 18-21.
[2] *Final Report of the California Joint Agencies Vehicle-Grid Integration Working Group*. June 30, 2020. Pages 27-28.

system and customer applications that defer charging away from peak periods (i.e., system real-time energy).

This pilot will also address some of the next steps/further analysis recommended by the VGI WG, including:

- Assessing customer interest, acceptance, and retention, and what is required (and associated costs) to get customers to participate in VGI programs (e.g., incentives, marketing, dealership education); and
- Identifying and obtaining publicly available data on VGI costs, as well as baseline data on driving and charging patterns relevant to different use cases.[3]

Market Barriers

This pilot will address barriers currently inhibiting the growth of the bidirectional charging market which are both preventing customers from earning revenue from grid services and preventing the electricity grid from benefiting from bidirectional charging technology that can provide valuable grid services. Those barriers include: exclusion of bidirectional EVs from participating in the NEM program, exclusion of bidirectional EVs from receiving SGIP incentives and disincentives to participate in CBP. While these pathways may not be appropriate for participation by bidirectional electric vehicles, this pilot will explore the options and make recommendations so that maximum value is captured from bidirectional charging technology for both customers and the electricity grid.

In the following paragraph, processes and/or methods to address these barriers within this pilot will be described. The first step will be to review current rules and requirements for existing utility programs (NEM, SGIP, CBP) and determine potential hurdles for inclusion of bidirectional EVs in them. If additional data is needed to verify that a bidirectional EV can meet the needs and fulfill requirements of the program, then this data will be evaluated through testing of bidirectional EVs in the pilot. The pilot will also evaluate the benefits bidirectional EVs provide to the electricity grid. As a result of these analyses, an outcome of the pilot will be to either recommend adaption of existing rules, such as in the case of SGIP, or to recommend the creation of a new utility program based on the benefits bidirectional EVs can provide to the electricity grid. Any changes to allow bidirectional EVs to participate in existing programs would require regulatory approval and are out of the scope of this pilot.

Technology Selection

This pilot will focus on exploring large-scale adoption of the DC bidirectional charging approach because the market for the DC bidirectional charging approach is more mature – there are more EV and EVSE products available using the DC bidirectional charging approach, the communication standards between EV-EVSE are more readily available and the electrical interconnection process is clearly defined (adopted by Rule 21). As the AC bidirectional charging

[3] *Final Report of the California Joint Agencies Vehicle-Grid Integration Working Group*. June 30, 2020. Pages 54.

market matures, the pilot may adapt to include AC bidirectional charging EVs and EVSEs. However, in the near-term, while the pilot explores the testing of value-stream applications using the DC bidirectional charging approach and associated technologies, any learnings can be leveraged for facilitating future testing of AC bidirectional charging technologies. The applications explored in this pilot are not hindered by the use of the AC versus DC bidirectional charging approach and implementation strategies and/or best practices discovered by this pilot can be utilized (albeit with some modifications) for execution of the use cases with AC bidirectional charging technology in the future. However, it should be noted, that any cost-effectiveness evaluations done by this pilot on the use of DC bidirectional charging technology will not be applicable to AC bidirectional charging technology because of the differences in cost and potential benefit due to differences in technical attributes (efficiency, maximum power, etc.).

Previous Demonstrations

Lastly, previous demonstrations of medium- and heavy-duty vehicles using the DC bidirectional charging approach include, but are not limited to, the following projects: California Air Resources Board's Clean Mobility in Schools Pilot Project – Low Carbon Transportation Incentives FY 18/19, ConEdison's Electric School Bus V2G, Rialto Unified School District and Nuvve's joint V2G School Bus Project, Torrance School District and Nuvve's joint V2G School Bus Project, among others noted in the Joint Utilities stocktake[4]. None of these demonstrations involved large-scale adoption and/or contemplation of modification to existing rules based on long-term participation of bidirectional EVs in electricity grid services.

B. Compliance with CPUC Decisions and relevant statute.

i. *What VGI Strategy(s) and/or Near-Term Policy Action(s) established in D.20-12-029 will be addressed?*
ii. *Describe the pilot objectives and how they align with the guidelines adopted in D.20-12-029, and with any other relevant CPUC policies.*
iii. *What VGI strategies and use case(s) are addressed in the pilot and how will they help IOUs achieve the goals of D.20-12-029?*
iv. *Show how the pursuit of these activities will advance VGI, as defined by this decision, by ensuring that proven VGI technologies can be scaled and by expanding the technology required to advance VGI.*
v. *Show how the pilot does not overlap with scope of the EPIC program or other programs including those administered by the Energy Commission.*
vi. *Show why a pilot is needed before implementing an IOU program.*
vii. *How will the proposed project(s) support other state legislation and policies relate to Transportation Electrification, including any update to the VGI Roadmap, the state's Zero-Emissions Vehicle Action Plan, the Air Resources Board's Scoping Plan and Mobile Source Strategy, the Commissions*

[4] *3/12/21 Joint Utilities Amended Stocktake. Pilots and Programs Related to VGI.* March 12, 2021.

Environmental and Social Justice Action Plan, and any relevant local or regional policies? Will any existing state policy help facilitate the success of the VGI pilot?

Pilot Scope Versus Energy Commission Programs

PG&E's V2X Commercial Pilot Program is focused on spurring adoption of commercially-ready V2X (bidirectional technologies) medium- and heavy-duty (MHD) electric vehicles (EVs) that are interconnected at commercial buildings. The V2X Commercial Pilot Program's goals are to demonstrate the value of V2X/bidirectional MHD EVs for customers and the electricity grid and reduce the total cost of EV ownership by understanding potential revenue streams for the services provided and identifying potential barriers that inhibit access to these revenue streams. In discussion with the California Energy Commission (CEC), this pilot will not overlap with the CEC's Electric Program Investment Charge (EPIC) program because this pilot has a focus on commercially-ready technology, whereas the EPIC program is focused on facilitating commercialization of technology not yet ready for at-scale market deployment through funding of lab testing or small-scale research that ensures technologies meet existing communication protocols and safety standards.

Need for Pilot

It is important to conduct this pilot before implementing a full-scale utility program for bidirectional technologies because there are several challenges that face bidirectional EVs from immediately providing grid services to PG&E. That is, a robust platform for communication and control needs to be set up for the bidirectional EVs and equipment to connect with utility systems and costs and benefits need to be evaluated at large-scale to determine appropriate incentive levels for a sustainable, long-term program. Bidirectional EVs are currently excluded from participating in PG&E's NEM and SGIP programs and are unable to capture value and/or generate revenue from energy export beyond the commercial building's electricity meter (in such programs as CBP). Through this pilot, PG&E will explore adapting existing utility programs and/or creating alternative market pathways by opening new programs to accommodate the benefits provided by bidirectional EVs. Furthermore, this pilot will aim to develop a sustainable distributed energy resource (DER) platform that will aggregate utility signals and communicate via standardized protocols to multiple EV and EVSE brands. Lastly, this pilot will require a certain level of data transparency from participants in order to capture accurately the costs and benefits of deploying bidirectional technologies. By capturing accurate cost and benefit information, an evaluation can be made to accurately create performance metrics for a robust, and long-term sustainable utility program which would capture the benefits of bidirectional technologies.

Compliance with CPUC Decision D. 20-12-029

Commission Decision D.20-12-029 implementing SB 676 set to "establish strategies and quantifiable metrics to maximize the use of feasible and cost-effective electric vehicle grid

integration by January 1, 2030…"[1] In that Decision, the CPUC asserted five objectives to facilitate the adoption of VGI,[5] three (3) of which will be addressed by this pilot:

- Market signals to create market demand;
- Overcome capital costs, infrastructure, information, and other barriers to scaling VGI services; and
- Continue agency coordination.

The CPUC also adopted VGI strategies to advance the market in the VGI Decision D. 20-12-029. Those listed below will be addressed by this pilot:[6]

- The strategy of reforming retail rates applicable to EVs, with a particular focus on optional dynamic pricing structures;
- The strategy of VGI pilots, demonstrations, emerging technologies and studies to ensure that proven VGI technologies can be scaled and that technology required to advance VGI is expanded;
- Accelerate the use of EVs for bidirectional non-grid-export power and PSPS resiliency and backup;
- Promote the use of EVs to provide bidirectional grid-export power, to support grid-facing use cases such as system renewable energy integration, system resource adequacy, and system ancillary services like frequency regulation by developing necessary interconnection rules; and
- Developing and implementing strategies to prioritize ESJ communities in siting and benefits of SB 676 pilots including working with community-based organizations (CBOs) and providing increased incentive levels for ESJ communities.

The Commission adopted near-term policy actions in the VGI Decision D. 20-12-029. Policy actions should be pursued as soon as possible to advance the above VGI strategies. Those policy actions that will be addressed by this pilot include:[7]

- The requirement to consider opportunities to advance distribution deferral in any pilots or other policy actions under this decision, as well as other venues related to distribution infrastructure planning such as distribution resource plans (DRPs);
- Pursuit of exploration of credit-for-export compensation schemes for bidirectional EVs.
- Addressing in all future TE program applications how TE programs will maximize the potential use of VGI for on-site backup power where practical; and
- The requirement to identify the use cases or categories of use cases addressed by each VGI policy action identified in this decision while filing any applications or advice letters.

This pilot will promote & accelerate the use of EVs for bidirectional non-grid-export power, PSPS resiliency and backup and bidirectional grid-export power, to support grid-facing use cases. The pilot will have a focus on testing & evaluating bidirectional EVs for non-grid export power and PSPS resiliency and backup in the first phase (2022) and testing & evaluating

[5] D. 20-12-029. Pg. 14.
[6] D. 20-12-029. Pgs. 16, 19, 21-22, 45-47.
[7] D. 20-12-029. Pgs. 31-32, 41-42, 44.

bidirectional EVs for grid-export power to support grid-facing use cases such as system resource adequacy and system distribution upgrade deferral in the later phases, both key VGI strategies adopted by the VGI decision, D. 20-12-029. The pilot will study the benefits & cost-effectiveness of using EVs in these applications to understand the long-term potential of scaling up bidirectional technologies for customer- and grid-side benefits.

Furthermore, the pilot will study the effect of market signals (such as incentives) necessary to promote adoption & increase demand of bidirectional EVs for both customer- and grid-facing use cases. An outcome of this study will be to recommend either modifications to existing utility programs or the creation of new programs that capture the value bidirectional EVs provide to customers and the electricity grid. While this pilot will spur adoption of bidirectional technology with upfront & performance-based incentives, the pilot will need to evaluate the long-term use of incentives. Through the course of value-stream application testing, the pilot will consider the structures that need to be adopted on a permanent basis to enable long-term participation of bidirectional EVs in grid services, such as reforming retail rates, providing credit-for-export and adapting interconnection rules among other solutions. The goal of the pilot will be to understand the options to scaling VGI technologies on a long-term basis and the cost-effectiveness of each method.

Lastly, the pilot will seek input from community-based organizations (CBOs) to better understand the specific needs of environmental and social justice (ESJ) communities and more effectively engage with and spur adoption of bidirectional technologies in those communities. The pilot will provide increased incentive levels to vehicles and/or fleets operating in ESJ communities.

C. Environmental/Social Justice Communities: **How will the pilot increase access for, or provide benefits to, Environmental/Social Justice Communities (ESJ), as defined by SB 350?**

i. *Do ESJ areas face any unique participation barriers, and if so, how will this pilot address those barriers?*

ii. *Describe input sought and received from Community-Based Organizations (CBOs) regarding the pilot development. How will CBOs be involved in pilot implementation, and/or evaluation?*

Environmental and social justice (ESJ) communities face unique barriers to adoption of bidirectional EVs and equipment, including lack of information on VGI technology and its benefits, reduced income potential and flexible spending to adopt bidirectional EVSEs which are currently more costly than non-bidirectional EVSEs. To address this inequity, the pilot will provide an increased upfront incentive (20% more than the upfront incentive offered in non-ESJ communities) to spur adoption of bidirectional technologies in ESJ communities. Additionally, the pilot team will work closely with local CBOs and East Bay Community Energy to help in educating ESJ communities on the benefits of bidirectional technologies and the opportunities for incentives to support technology adoption.

PG&E plans to consult with CBOs for pilot implementation and evaluation through a holistic CBO effort currently underway at PG&E. CBOs are currently engaged by many teams within PG&E in a one-off piecemeal approach which tends to utilize more resources than a coordinated approach. Therefore, PG&E is building a holistic effort and plans to issue an RFP at a later date but prior to the expected launch of this pilot to establish strong CBO partnerships that will allow for input on an ongoing basis from CBOs on a variety of topics. Through this process, the teams anticipate stronger outputs and reportable data. As part of this larger PG&E effort, the pilot team will engage the selected CBOs on an ongoing basis (monthly) to inform pilot efforts in reaching ESJ communities, developing appropriate incentive levels, engaging customers, sharing unique needs & challenges and measuring impact in ESJ communities.

D. **VGI applications/value streams**:

i. Which of the multiple VGI applications (i.e., value streams) listed in the VGI Working Group final report will the pilot address and why? Could the potential VGI value streams potentially overlap or conflict, and if so, how would the pilot resolve how to prioritize different value streams? Which VGI value streams will be excluded and why?

This pilot will address the following VGI applications (i.e., value streams): backup power, customer bill management, system-real-time energy, system-upgrade deferral and EV export to support grid services (such as system RA, system capacity). The pilot will focus primarily in phase 1 (2022) on customer-backup and resiliency because both the VGI WG Final Report and VGI Decision prioritized this application as strategic in advancing VGI and in providing high total benefits to customers (in this case, fleet managers). In phase 2 of the pilot (2023), the VGI applications that will be tested are broader and include customer-bill management, system-real-time energy, system-upgrade deferral and possibly other system-level grid services, such as resource adequacy. The reason that the pilot will study these VGI applications is because some of them, such as customer bill management and system applications that defer charging away from peak periods such as system-real-time energy were prioritized by the VGI WG as having a "high" total benefit. System-upgrade deferral was prioritized as a high-priority application later in pilot development as a direct result from stakeholder feedback following the Second VGI Workshop on June 4, 2021.

The VGI applications will not be stacked in phase 1 (2022), that is, only a single application will be tested at one time. However, in phase 2, the goal of the pilot is to test stacking and optimizing applications based on specified criteria. In this scenario, there could be potential conflicts between the signals. However, if the optimization criteria are clear, the signals will prioritize one application for a specified period over another in cases where a conflict might arise. It is always an option for the customer to "opt-out" of participation to ensure transportation needs are always met and of highest priority.

The pilot will not address all of the customer-side applications or many of the system-level applications, such as customer-upgrade deferral, customer-renewable self-consumption and

system-ancillary services due to current market limitations and/or prioritization of high-value use cases under a limited-duration pilot. Customer-backup, resiliency, system-real-time energy and system-upgrade deferral were prioritized as some of the highest value applications by the VGI WG and will be the focus of this pilot. Additionally, in the case where market barriers exist for bidirectional EVs to participate and/or are disincentivized to participate in system-level use cases, the PG&E Exploring V2X Export Value Pilot will address these barriers.

E. **Stakeholder engagement**:

i. *How did the IOU address stakeholder feedback - both publicly available comments and any non-public feedback that is not confidential?*

ii. *How will the utility provide periodic updates to interested stakeholders?*

iii. *Will any pilot milestones require stakeholder input/engagement to determine the potential need for mid-course corrections? If so, how will the utility obtain and implement stakeholder recommendations?*

The Joint Utilities (PG&E, SDG&E and SCE) hosted two VGI Workshops[8] seeking stakeholder feedback on proposed pilot ideas. The Joint Utilities received comments after both workshops and specifically hosted a feedback survey after the second workshop. PG&E addressed stakeholder feedback in a variety of ways. One method included analyzing survey feedback and comments submitted to the Joint Utilities and making adjustments to pilot ideas accordingly. Another method included meeting bilaterally with stakeholders to solicit feedback on the pilot. PG&E held over fifteen (15) individual meetings with technology providers (automotive manufacturers, EVSE suppliers and software providers) to gather input for designing the pilot structure.

PG&E plans to provide regular updates to stakeholders by hosting quarterly meetings with interested stakeholders to provide status of the pilot, progress towards meeting pilot objectives and solicit feedback on data evaluation and outcomes to date. This pilot does not plan to require stakeholder input to determine potential mid-course corrections, however, stakeholder input will be crucial in evaluating cost/benefit analyses and calculations resulting from VGI value-stream application testing. This feedback will help inform PG&E's final documentation and recommendations provided to the CPUC for future long-term program adoption.

F. **Partnerships**: What partner(s) will collaborate with the utility to complete the pilot?

[8] The first VGI Workshop was held on March 16, 2021 and the second VGI Workshop was held on June 4, 2021.

i. *How will the project partners maximize the scope and value of the applications and use cases that would be developed?*
ii. *What sources of private or public investment (or customer contribution) will be leveraged for the project and how much, and what will that funding be used for?"*
iii. *What, if any, other public funding resources will be leveraged to fund the project(s)?*

There are six (6) main roles/parties that will collaborate to complete this pilot: PG&E, CCA, centralized software provider, program implementer, technology providers (medium- and heavy-duty electric vehicle manufacturers and/or EVSE suppliers) and end customers (fleet owners/operators).

PG&E: PG&E will act as the project manager and administrator of the pilot. PG&E will be in charge of distributing incentive funds, verifying that the incentive funds are distributed to qualifying participants with support of the pilot partners, tracking pilot progress and reporting final data analysis and documentation to the CPUC.

CCA: PG&E will coordinate with East Bay Community Energy on this pilot who will support pilot implementation through community outreach, technical assistance and data analysis. The CCA will leverage their existing medium- and heavy-duty fleet electrification programs to help PG&E identify fleet owners/operators that are a good technical fit for participation in this bidirectional charging pilot. Additionally, the CCA will assist PG&E in recruiting participants for the pilot, ensuring participants maintain compliance with the program rules and providing education and outreach to the end customers (fleet managers).

Centralized software provider: The centralized software provider will be responsible for developing a centralized software platform that can aggregate utility signals and communicate via standardized protocols to multiple EV and EVSE brands. The centralized software provider may (on behalf of the technology providers) communicate application testing notifications (either via SMS or app) to the end customers (fleet managers).

Program implementer: The program implementor (possibly the CCA) will host and manage the customer enrollment process by collecting the necessary information from customers to verify program eligibility and work closely with PG&E to distribute the incentives to eligible participants. The program implementer will also host an online landing page for the pilot that contains details about customer eligibility and frequently asked questions (FAQs). Lastly, the program implementer will assist PG&E in measurement and verification of customer performance in the value-stream applications and distribution of ongoing incentives.

Technology providers (such as electric vehicle manufacturers, EVSE suppliers or system integrators): One technology provider has been identified to collaborate with PG&E on this pilot – Nuvve. Additional technology providers will be qualified and onboarded over the course

of the pilot. To be eligible to participate, technology providers must demonstrate commitment to accelerating VGI adoption and as a commitment to the pilot and in pursuit of market adoption of bidirectional charging technologies agree to contribute by providing some level of in-kind development work. For example, participating technology providers must be capable of receiving signals (for example, via OpenADR or IEEE 2030.5) from the central software platform (to be developed via RFP) for communication of PG&E grid conditions and value-stream application testing.

Fleet owners/operators: The fleet owners/operators will need to adopt participating technology provider vehicles and EVSEs. The end customers (i.e., fleet managers) will also contribute to the pilot by financing a portion of the capital cost to acquire a bidirectional-capable electric vehicle, equipment and installation. While this pilot will help bring bidirectional-capable electric vehicles and equipment in cost-parity with non-bidirectional capable electric vehicles and equipment, full cost-parity will not be feasible. Therefore, customers will be required to finance a portion of the costs of hardware to participate in the pilot.

The pilot will leverage a significant amount of private investment and in-kind support to accomplish its goals. The exact quantity of private investment that will be leveraged by this pilot is difficult to quantify given the difficulty in separating private industry investment for strategic development goals and specific investment in accomplishing this pilot and this pilot only. Therefore, an exact dollar amount of private investment is excluded from this document.

G. IOU ownership of customer-side resources

i. Would the IOU own any customer-side resources? If so:

a. What resources would the IOU own, and why is IOU ownership essential for the success of this pilot?

b. Can any market actor provide this product or service, and if so, why is the IOU not utilizing market actors?

c. What is the cost differential due to IOU-ownership of customer-side resources including rate of return requirements, differences in capital and/or labor costs or IOU requirements?

d. How can the IOU develop the availability of market actors to provide products or services?

This pilot will not involve any utility ownership of customer-side resources. All charging infrastructure that is installed as part of the pilot will be owned, operated and maintained by the fleet owners/operators and/or commercial building owners where the fleet owners/operators (dis)charge their bidirectional electric vehicles.

H. Timeline

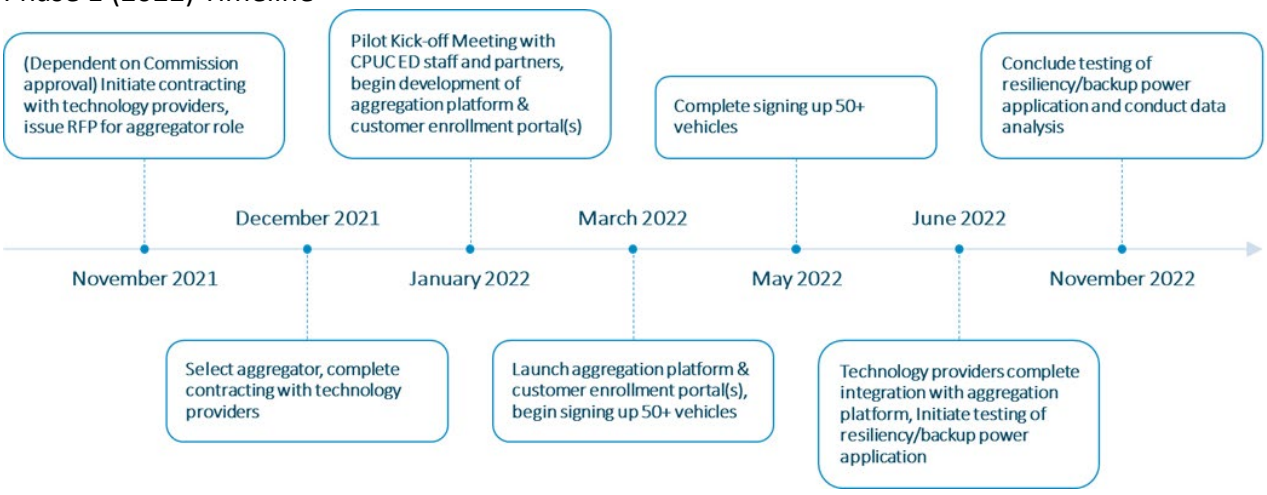
i. *Provide a flow chart describing the major stages of the pilot with milestones including (but not necessarily limited to) project initiation; key agency/partner meetings; initiation and completion of contracting (if necessary); education & outreach; installation of equipment; implementation; data collection; and evaluation.*

ii. *Also include milestones for key sub-tasks for each of the major stages of the project so that Energy Division staff can track progress against the pilot schedule.*

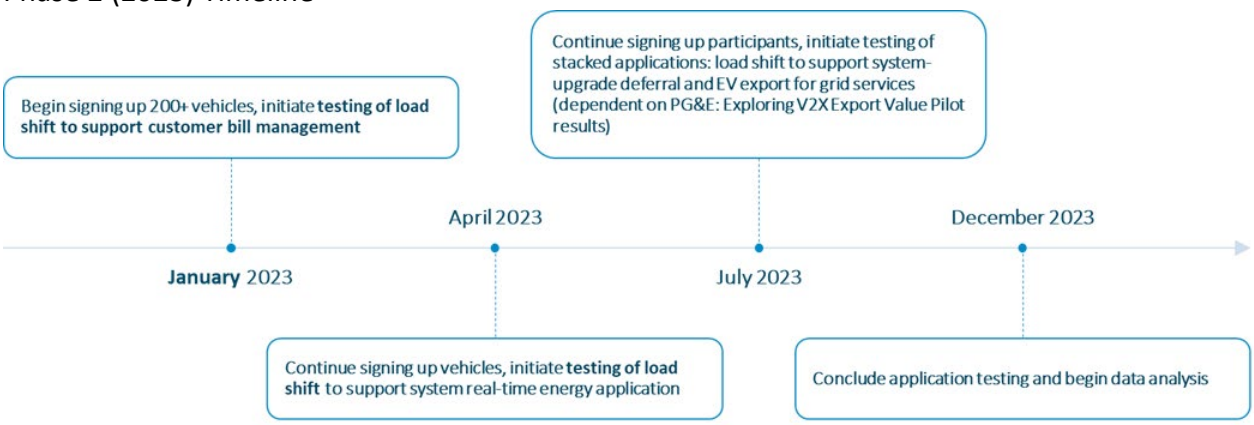
iii. *Identify tasks that are contingent on the completion of a preceding task; and potential options if a preceding task is delayed.*

This pilot has three major stages: phase 1 (2022), phase 2 (2023) and phase 3 (2024). Phases 1 and 2 will be focused on customer enrollment and application testing, whereas phase 3 will be focused on data analysis of results and final reporting. Below are flow charts describing the major milestones in each of the three phases. The milestones for each sub-task and contingencies will be developed and shared with CPUC Energy Division staff once the pilot is approved.

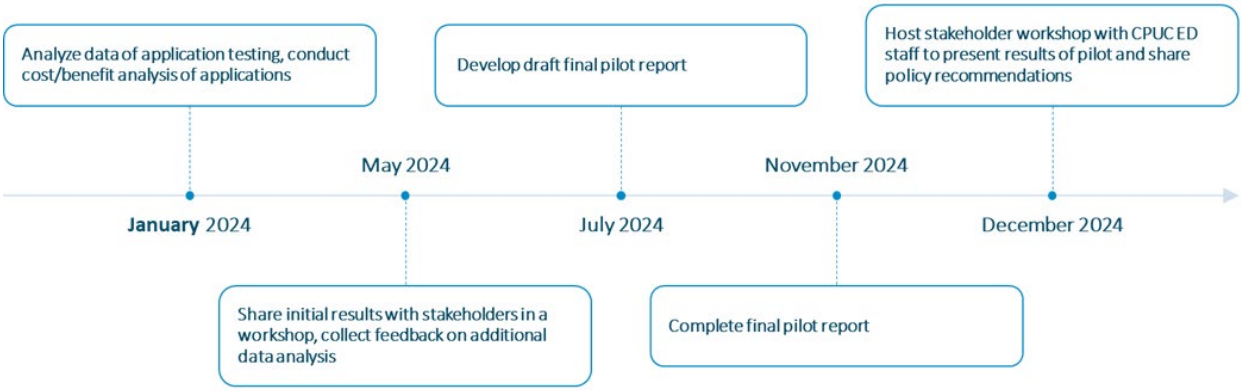
Phase 1 (2022) Timeline



Phase 2 (2023) Timeline



Phase 3 (2024) Timeline



I. Budget detail

i. *Proposed budget for the following types of expenses – equipment, materials, contracted goods and service, internal labor, and other (describe):*
ii. *Provide the estimated budget in nominal dollars and for the full project with escalators over its expected term.*
iii. *Estimate expense for each of the major budget categories listed below if required for this project. (This information will help the Commission and stakeholders understand the utility's expectation of the level of effort needed to support each type of activity)*
iv. *outreach;*
v. *customer participation incentives;*
vi. *electrical infrastructure make-ready (specify);*
vii. *EVSE;*
viii. *other technology and/or hardware expenses;*
ix. *technical services;*
x. *evaluation, including a proposed budget for data collection; and*
xi. *any other category of budget expense that would account for 10% or more of the total budget.*

The Joint Utilities have defined each budget category as follows:

- **Equipment:** Utility-owned instruments, data loggers, computers, networking, tools, batteries, vehicles, etc.
- **Materials:** Raw building materials such as wood, concrete, steel; signage materials, office consumables, etc.
- **Contracted Goods & Services:** External services to augment utility labor for: pilot management, marketing, customer services, web development, analysis, software aggregation, etc.
- **Internal Labor:** Utility Personnel labor for: pilot management, marketing, customer services, web development, analysis, etc.
- **Outreach:** Marketing, education and outreach to acquire customers, present to external parties, etc.
- **Incentives:** VGI services payments to customers or aggregators in lieu of payments to customers
- **Infrastructure:** Electrical equipment and labor to provide electrical services to EV charging equipment and other supporting equipment such as local storage, etc.
- **Technology Expenses:** Any tech expenses that are not covered under tech services such as labor to repair equipment, equipment replacement.
- **EVSE:** Utility-owned EV charging equipment
- **Miscellaneous Hardware:** Hardware not covered in Equipment, Materials or Infrastructure category

- **Technical Services:** Services not covered under Contracted Goods & Services or Technology Expenses such as subscription services (i.e., EVSE networking services, data services, parts warranty, etc.)
- **Data Collection/Evaluation:** Costs for acquiring data, 3rd party analysis of results of the pilot and developing report(s) on the effort

Table 1 below details the total pilot budget broken down by the budget categories. Where funds are available, LCFS revenue will be used in favor of ratepayer dollars to cover the below mentioned pilot costs. Funding for some of the pilot activities will be provided in-kind by the technology providers (i.e., product research & development, software development, electric vehicle (EV) to electric vehicle supply equipment (EVSE) compatibility testing and customer enrollment), however, this in-kind funding being leveraged by the pilot is separate and not captured in the table below.

Table 1: Total Pilot Budget

Budget Category	Total Amount ($)
Contracted Goods & Services	$1,035,000
Internal Labor	$200,000
Incentives	$1,325,000
Data Collection/Evaluation	$140,000
Total	**$2,700,000**

J. Risk mitigation

i. Explain potential risks or uncertainties for key elements of the pilot (i.e., technology performance, lack of customer uptake, integration challenges, etc.), whether they can be mitigated, and if so, how? If not, what are the potential consequences for the pilot? Can the pilot identify potential risks for future programs and/or mitigation options?

PG&E has identified four potential risks to the pilot's success: availability of commercially-ready technology, supply of hardware (vehicle &/or EVSE) to meet pilot demand, lack of customer interest and/or uptake and lack of partner coordination and alignment. Currently, there are very few commercially-ready medium- and heavy-duty electric vehicles and EVSEs capable of bidirectional charging in the U.S. commercial market. Throughout the course of the pilot, more commercially-ready bidirectional charging technology will become available. However, given the lack of commercially-ready technology and pilot timelines that are dependent on the private sector meeting their timelines, potential risks are posed to the overall timeline and objectives of the pilot.

If there is either a lack of commercially-ready technology or commercially-ready technology in the quantities needed to meet the needs of the pilot, the fallback plan would be to reduce the

target number of enrolled vehicles/participants from 200 vehicles and charging stations to 100 vehicles and charging stations. While this will reduce the pilot scope of "large-scale" adoption, it will still be a significant quantity of participating vehicles (larger than any previous U.S. pilot) to test and evaluate the pilot objectives and evaluate the potential for a long-term sustainable utility program for bidirectional technology.

If there is a lack of customer interest and/or uptake, the first step will be to evaluate the pilot's outreach and marketing methods to understand if they are sufficient. The second step will be to conduct an informal and/or formal survey to evaluate the reasons for lack of interest/uptake. Based on the outcomes of the survey, the pilot may adapt where feasible. For example, if cost is still a prohibiting factor to adoption, PG&E may elect to increase the value of the incentive while decreasing the number of participants. If concerns over prioritization or the importance of transportation needs are the underlying reason for lack of interest, then PG&E may elect to modify the pilot value-stream applications that are tested and/or increase educational efforts in collaboration with the pilot partners to ensure customers are aware of how the technology prioritizes customer preferences, manages vehicle (dis)charging and allows customers to "opt-out" of events/participation when needed.

Lastly, this pilot requires a high degree of coordination and close alignment between all partners – the utility (PG&E), CCA, centralized software provider, technology providers (both automotive manufacturers and EVSE suppliers) and the program implementer. The pilot's success is dependent on the ability to align all entities around common goals, set clear expectations for partners and have strong project management and coordination efforts. To mitigate this risk, PG&E will assign an internal project manager, ensure agreements are in place with all partners and host regular meetings to ensure the pilot is on track and continuing to meet major milestones.

K. Safety

i. *What safety requirements are included in the proposed pilot?*

ii. *Does the project(s) align with the Safety Requirements Checklist adopted in D.18-01-024, D.18-05-040, and D.18-09-034?*

iii. *Are any additional safety requirements needed for the pilot, and if so, what are these requirements and how will the pilot meet them?*

iv. *Will the pilot incur cybersecurity risks and how can they be mitigated through the pilot and/or the SCE cybersecurity workplan required by D.20-12-029 (at 85)? Will the pilot help identify cybersecurity gaps and/or develop potential solutions that could be addressed in the cybersecurity workplan?*

Safety Requirements

The pilot will follow all safety requirements listed in the Safety Requirements Checklist adopted in D.18-01-024, D.18-05-040, and D.18-09-034. As an example, all participating EVSE hardware must meet the noted safety requirements, such as (1) safety testing by a Nationally Recognized

Testing Lab (NRTL), (2) be designed to prevent direct contact with any live components when not plugged into an EV, (3) have no sharp edges on the EVSE connector plug and (4) the coupler between the EVSE and EV must prevent any hazardous conditions. The EVSE installation must also follow such safety requirements as compliance with California Electrical Code Article 625, the Americans with Disabilities Act (ADA) and California Building Code Chapter 11B (where applicable). Installers must be fully licensed electricians and EVTTP certified and provide proof of a performance of a full site assessment. The EVSE installation must have overcurrent protection, bollard equipment protection and concrete parking stops. Additionally, any electric vehicles that are not commercially-ready (i.e., they are modified for bidirectional charging after production) will need to go through proper safety certifications by the regulating authorities (i.e., the National Highway Traffic Safety Administration (NHTSA)).

Cybersecurity

Furthermore, the pilot may incur cybersecurity risks in such that grid signals are sent via the Internet to technology providers. These cybersecurity risks will be mitigated by utilizing industry-approved and adopted open standards to relay grid signals and conditions. If all possible, no proprietary standards will be used between the utility grid and the technology providers. Additionally, the technology providers will have no direct connection to utility systems and/or hardware reducing vulnerability. All messaging and communications between the utility and the technology providers will go through a single-entry point (i.e., centralized software platform). Likewise, the centralized software provider/program implementer will not have direct control over customer end-devices (such as the electric vehicles and/or EVSE hardware).

V. Scale Up: Analyze potential to scale to a full utility program. (approximately 15% of narrative)

- **A. *What additional barrier(s), if any, would need to be overcome to scale the pilot into a full program?***
- **B. *How would the pilot be scaled if it is successful and on what timeframe?***
- **C. *Will the pilot encourage the development of new business opportunities for third-party market participants providing products and/or services?***
  - *i. How does the proposed SB 676 VGI pilot design ensure this proposal will avoid or mitigate any potential unfair competition with nonutility enterprises?*
    1. *How will the pilot lead to policies and programs that enable a variety of market actors to compete to offer services?*

The pilot is designed to mitigate any unfair competition between nonutility enterprises. For example, all incentives in this pilot will be paid directly to end-users (i.e., fleet managers) and not provided to any one of the technology providers (i.e., vehicle manufacturers or EVSE suppliers). There is a 40% cap on the number of incentives allowed for each technology provider. For example, any single vehicle manufacturer cannot have more than 40% of the

incentives going to adopters of their bidirectional charging electric vehicles. This manufacturer cap will ensure that no unfair advantage is gained by any one technology provider, while at the same time working to achieve a ubiquitous market. While the pilot favors market actors that are "first-to-market", that is, those technology providers that have available products at the time of the pilot launch (2022), this demand-side signal will encourage the market and industry to continue developing bidirectional charging technologies. The goal of the pilot is to partner with as many technology providers as possible, so that any programs that develop from the pilot will be robust and broad to enable participation by a variety of market actors as they mature.

Pilot success will be measured by the ability to meet stated pilot objectives and to develop proposals for the creation of long-term modifications in existing programs or the creation of new utility programs that define clear market pathways for capturing the value of bidirectional electric vehicles and equipment for customers and the electricity grid. If these metrics are met, then the next step before the pilot can be scaled would be to adopt the proposed policy recommendations reported by the pilot. These policy recommendations would need to be approved by the applicable regulating agencies such as California Public Utilities Commission (CPUC), California Independent System Operator (CAISO) or California Air Resources Board (CARB), where applicable. Depending on the process for review & approval, the policy recommendations could take anywhere from 3-12 months for adoption. Therefore, the earliest a scaled program is likely to be implemented following the pilot's completion would be 3-12 months, with a more likely timeframe to launch a subsequent program being 6-18 months following pilot completion.

VI. Evaluation (approximately 15% of narrative)

A. ***Evaluation Plan****: As noted in D.20-12-029 "Each advice letter for a VGI pilot must contain an evaluation plan that identifies a process to determine the success of each pilot and the feasibility and desirability of scaling the pilot to a full-scale program or utilize the results to revise an existing program."*

i. Describe an evaluation plan that includes assessment of the need for ratepayer funding, effectiveness of the project for achieving the planned results, timeliness and efficiency of pilot execution, lessons learned and opportunities for improvement, and appropriateness to scale to a full utility program. Include a schedule for 1) drafting a request for proposals (RFP), 2) providing Energy Division staff time to review RFP (including draft scope of work), 3) releasing the RFP and scope of work, and 4) giving ED staff time to review RFP responses consistent with ordering paragraph 23 of D.20-12-029.

B. ***Success Indicators:*** *What criteria will the IOU use to evaluate if the pilot has been successful?*

C. ***Metrics****: What metrics from D.20-12-029 would the IOU propose to add to the SB 676 data reporting template, after receiving the concurrence of Energy Division*

staff, to measure the pilot's success in overcoming barriers and the program's impact on DACs and other priority populations?

i. *For example, what technical, cost, and customer engagement metrics will the IOU track, and how? What other types of data will be collected, and how? How will this data be used to determine whether to scale the pilot to a full utility program? How do the proposed metrics and data align with the metrics in the final Scorecard adopted within the TEF, if finalized by the time the VGI pilot advice letter is filed?*

This pilot has two main objectives. They are: to demonstrate the value of V2X/bidirectional MHD EVs for customers and the electricity grid and reduce the total cost of EV ownership by understanding potential revenue streams for the services provided and identifying potential barriers that inhibit access to these revenue streams.

The first objective can be measured by the following metrics:

- Number of vehicles that enroll in the pilot;
- Level of influence the pilot incentive had in V2X purchase decision; and
- Number of vehicles that initially enroll in the pilot and continue participating throughout the entirety of the pilot (attrition rate).

The second objective can be measured by the following metrics:

- Costs of V2X deployments (incremental hardware and/or software costs);
- Value (revenue) of V2X to customers (i.e., fleet managers);
- Value of V2X to the electricity grid;
- Benefits of each V2X application tested in the pilot (i.e., backup power, customer bill management, system-real-time energy, system-grid upgrade deferral and EV export for grid services, such as system-RA, system capacity);
- Total cost of ownership (TCO) savings due to V2X functionality; and
- Pathways (existing rules & regulations) that currently inhibit positive or increased value of V2X to customers and/or the electricity grid.

A successful pilot will be measured by achieving the above-mentioned metrics. The goal is to enroll 200 vehicles and charging stations, demonstrate that the pilot incentive influenced & accelerated bidirectional technology adoption, demonstrate that the bidirectional functionality offered positive value (revenue) to customers and benefits to the electricity grid and lastly, demonstrate that bidirectional capabilities and participation of bidirectional electric vehicles in grid services reduces the total cost of ownership of electric vehicles. If the cost-benefit analysis of bidirectional electric vehicles demonstrates benefits for both customers and the electricity grid, PG&E may recommend scaling of the pilot to a full-scale utility program. Whether this means adapting existing utility tariffs and rules to allow bidirectional electric vehicle participation and/or creating an entirely new program will depend on the exploration and outcomes of this pilot.

Until bidirectional electric vehicles and charging technology becomes ubiquitous and equal in cost to non-bidirectional electric vehicles and charging technology, incentives may be needed in the near-term to continue accelerating market adoption and creating a sustainable, robust fleet of distributed bidirectional energy resources. Funding of incentives may need to come from ratepayer dollars. Before authorizing use of ratepayer funding to cover a long-term program of incentives, a detailed cost-effectiveness analysis is prudent in order to quantify the impact on ratepayers, utilities, customers and society.

Lastly, pursuant to VGI Decision D. 20-12-029 Ordering Paragraph 23, PG&E plans to coordinate with the other IOUs and consult with CPUC Energy Division (ED) staff on the development and issuance of a Request for Proposal (RFP) for a third-party evaluator to jointly assess the IOUs' VGI pilots. The evaluation would need to include but not be limited to the above metrics as well as complement data being collected within the IOU annual reports. PG&E will also seek clarity prior to RFP issuance on the overall timeline for evaluation completion in collaboration with the other IOUs and ED staff due to confusion with the current dates listed for final reporting in OP 23.

VII. Other (approximately 5%-10% of narrative)

Please provide any other relevant information.

N/A

VIII. Summary and conclusion (approximately 5%-10% of narrative)

PG&E's V2X Commercial Pilot is focused on spurring adoption of V2X (bidirectional technologies) medium- and heavy-duty (MHD) electric vehicles (EVs) that are interconnected at commercial buildings. The V2X Commercial Pilot Program's main objectives are to demonstrate the value of V2X/bidirectional MHD EVs for customers and the electricity grid and reduce the total cost of EV ownership by understanding potential revenue streams for the services provided and identifying potential barriers that inhibit access to these revenue streams. Pilot success will be measured by: reaching the sign-up target of 200 vehicles and charging stations, achieving ongoing performance in customer and grid applications, determining the value of bidirectional vehicles to customers and the electricity grid, achieving cost transparency of VGI technology deployments (VGI WG "next steps" recommendation) and creating sustainable pathways for bidirectional vehicles to participate in vehicle-grid integration services.

If successful, this pilot has the potential to advance Vehicle-Grid Integration (VGI) strategies, such as retail rate reform, the use of EVs for bidirectional non-grid-export power to support resiliency and developing necessary interconnection rules to allow the use of EVs for bidirectional grid-export power to support grid-facing use cases adopted by VGI Decision, D.20-12-029. VGI strategies are key in achieving California's goals of carbon-neutrality by 2045 and 5 million zero-emission vehicles and 250,000 charging ports by 2030. VGI has the potential to accelerate EV adoption, reduce costs to ratepayers, support further decarbonization, accelerate

the reduction of carbon and criteria air pollutant emissions from the transportation sector and improve grid resiliency. For these reasons, PG&E recommends approval of the V2X Commercial Pilot Program by the CPUC.

PILOT 3 - V2M PSPS Microgrid Pilot

Pilot #3 – V2M PSPS Microgrid Pilot

I. Subject

Pacific Gas and Electric Company Proposal for Senate Bill (SB) 676 Vehicle to Grid Integration (VGI) Pilot: Vehicle-to-Microgrid (V2M) Public Safety Power Shutoff (PSPS) Microgrid Pilot

II. Pilot overview

Please provide an overview that addresses the topics that were included in the summaries provided to stakeholders (with updates as appropriate). Also include key partnerships, specific sources and amounts of non-ratepayer funding, and key metrics to evaluate project success.

PG&E's V2M PSPS Microgrid Pilot is focused on enabling V2X (bidirectional) electric vehicles to charge/discharge in a microgrid to support community resiliency during a PSPS event with the goal of operational integration for multi-customer microgrids (front of the meter (FTM) microgrids with behind the meter (BTM) support). The V2M Microgrid Pilot will expand the existing EPIC 3.11B program (which is validating BTM real time resiliency controls for solar and storage) to include electric vehicles and will leverage the V2X Residential and V2X Commercial pilot programs and sites where applicable. Through this pilot a set of roughly 5 to 10 BTM bi-directional electric vehicles will be tested in coordination with a FTM generator (or generator plus battery) to manage the balance of generation and load in a community microgrid during a PSPS event. Once tested, a program with an incentive (maximum 200 vehicles estimated) will be available for customers sited in locations that are within the boundaries of PSPS microgrid locations with a target of system use during 2023 PSPS operations (provided the necessary regulatory approvals are obtained).

Funding for validating the majority of capability in the pilot will be provided by the EPIC 3.11B project (i.e., FTM generator management and testing, SCADA and switching controls, operational processes, etc.). A portion of VGI pilot funds will be used to validate the incremental capabilities specific to the electric vehicle such as establishing inverter configurations, testing performance of the vehicle, and consideration of customer preferences towards community resilience, site resilience, and mobility. Pilot success will be measured by: developing operational processes for multi-customer microgrids to utilize BTM electric vehicles to support the balance of generation/load in a multi-customer microgrid, demonstrating 5 to 10 BTM bi-directional electric vehicles in PSPS, launching a program with incentives for maximum of 200 vehicles with the follow on ability for future vehicles to participate (regardless of incentive availability).

III. Need for Pilot (approximately 15% of narrative)

A. Describe the market-readiness of the technology (and/or use cases) addressed by the proposed VGI pilot; as well as practical barrier(s) to deploying at scale via an IOU program.

i. *What is the status of technology development and deployment?*
ii. *What technical standards have been established, how technically robust are existing standards, and how widely are they adopted in the marketplace? What gaps need to be filled in standards development and/or deployment?*
iii. *Are business models well-established, and if not, what barriers must be overcome to establish business models?*
iv. *Do any existing policies, rules, or tariffs create barrier(s) and if so, what are these barriers and how can they be overcome?*
v. *What customer education is necessary?*
vi. *What existing and/or ongoing pilots or research can be leveraged to provide information and/or physical resources for the pilot? How will the pilot avoid duplication of existing work?*

There are three driving forces behind the need for resiliency support from BTM Distributed Energy Resources (DERs), including electric vehicles, within multi-customer microgrids:

1. PSPS Formed Microgrids: PG&E has implemented temporary, and is exploring permanent, generation solutions for PSPS events whereby sections of the distribution grid are isolated and energized utilizing front-of-the-meter generation. In these scenarios, typically BTM DERs continue to operate as if they are connected to the bulk electric system with no consideration of resiliency support for the islanded microgrid. Two immediate opportunities to improve BTM DER participation exist:
    a. By leveraging BTM DERs for resiliency, and through coordinated charging/discharging of storage and electric vehicles (EVs), the run-time of fossil fuel-based generation can be reduced.
    b. For sites with an excess of generation within the multi-customer microgrid boundaries (i.e. generation is greater than load) an over generation mitigation solution is needed. Many of the solutions today involve load banks or other options that may not lead to the lowest emissions within the microgrid. This pilot would enable the ability for vehicles to charge during times of overgeneration as an alternative to curtailment.
2. Multi-Customer Microgrids: The Community Microgrid Enablement Program (CMEP), as well as other programs, will scale microgrids that span multiple customers across utility distribution lines. In this type of network, existing BTM DERs in communities would be included in such microgrids by the nature of their location on the system. Unlike single customer campus microgrids, the BTM DERs in these communities would not be designed with localized high-speed communication and controls capabilities. A need for control of BTM DER assets, including EVs, to support generation and load balancing exists (for the same reason as PSPS microgrids) and it is anticipated that this will happen more commonly across the network as CMEP and BTM DERs scale in their prevalence.
3. BTM Electric Vehicle Growth: An increase in BTM DER output leads to a reduction of real time FTM controlled generation output within a microgrid. As BTM DER prevalence increases we expect the capability to include control of BTM DERs to move from “nice to

have" to "must have". EVs are a powerful tool (both in kW capacity as well as kWh storage) to help balance generation and load within microgrids. This large capacity leads V2G-capable EVs to be one of the greatest opportunities to provide meaningful kWh of storage into a neighborhood microgrid.

The primary technical challenges yet to be validated to including bi-directional DERs in multi-customer microgrid operations include:

- Scalable real time controls for managing the balance of generation and load within a multi-customer microgrid;
- Protection schemes that support high penetration distributed generation;
- Validation of the bi-directional inverter hardware, in combination with vehicles, to support such a use case; and
- Integration to operations and planning to effectively include BTM DER capacity when operating a multi-customer microgrid.

Scale challenges, which effect the implementation of the technology exist as well:

- BTM DERs must be able to detect a utility formed microgrid;
- BTM DERs must be able to respond in real time to generation and load balance within the microgrid;
- Direct connectivity to each individual DER, replacement of hardware or additional communication equipment, and other site level device upgrades are impractical to implement across the entirety of the network;
- The solution must be low cost, require low to no customer involvement, and should be universally applicable; and
- Customer performance logging and renumeration for participation should be considered.

The EPIC 3.11B project will develop these capabilities with a focus on solar and solar plus storage type DERs. At the launch of that project, budget for exploring bi-directional EVs was not included due to a lack of such EV DERs on the network. To include bi-directional EVs in the EPIC 3.11B project, additional funding would be needed from the VGI Decision (D. 20-12-029) to consider customer preferences for vehicle resiliency vs. mobility use, validate the vehicle hardware in this use case, and to provide an incentive to customers to adopt the capability and hardware required to participate.

IV. Pilot Proposal (approximately 40% of narrative)

Describe how the proposed pilot will contribute to development of IOU programs that will achieve the goals of D.20-12-029.

A. ***Description**:*

i. *Describe the proposed pilot, including customer segments served and number of customers served, program delivery mechanism, etc.*
ii. *What recommendation(s) from the June 2020 VGI Working Group Final Report the pilot will address and how? How will the pilot address the specific barriers identified above under section III?*
iii. *What technologies will be used and why were they selected? Do the technologies enable, facilitate, or hinder other VGI use cases even if not the focus of the proposed pilot?*
iv. *How was the pilot project technology(s) previously demonstrated?*

We propose to demonstrate the capability for electric vehicles to participate in multi-customer microgrid generation and load balancing support utilizing the EPIC 3.11B control scheme:

- Real time frequency-based controls of BTM DERs (electric vehicles)
    - FTM generator varies frequency output to induce charging or discharging of BTM assets
    - BTM assets utilize their IEEE 1547 compliant frequency-droop programming, with potentially updated set points, to respond to the frequency of the island
- Frequency is a common parameter anywhere within a microgrid, such that all DERs immediately will recognize and respond to the signal with only the requirement of a connection to their standard electrical service and the correct firmware on the inverter-based resources
    - Firmware requirements in Rule 21 have included frequency-droop capability since ~2018 or so
    - Prior versions of DERs would be compatible in a limited fashion, V2G vehicles will be fully compatible from the first interconnection onward
- A secondary "best effort" web connected communication pathway is possible utilizing IEEE 2030.5 for the purposes of reading BTM DER state of charge, sending updated frequency set points, and/or for reading out performance during an event (e.g. how many kWh were discharged to, or imported from, the grid).

With the proposed approach, Rule 21 compliant inverter-based resources (IBR) that support advanced inverter functions could be controlled to support a multi-customer microgrid. EPIC 3.11B will be validating that capability for solar and solar plus storage; this pilot seeks to expand that project to consider bi-directional EV specific capabilities:

- Customer preferences for community resilience, site resilience, and mobility;
- Real time control validation for EV specific DERs;
- Identification of a set of V2G electrical configurations with testing and support for at least one such configuration; and
- Exploration of customer renumeration for grid charging and/or export for the purposes of multi-customer resiliency.

The pilot will interact and work closely with the V2X Residential and V2X Commercial pilots utilizing a subset of the vehicle OEMs and hardware that those pilots work to make accessible to customers. We will seek to make this pilot as reasonably compatible with the largest ecosystem (vehicle plus charger brands) as possible, with a focus on first demonstrations with only a limited scope of hardware and vehicles.

Through the course of this project, the following customer programs will be made available:

- **Phase I – Limited testing cohort (first 5 to 10 vehicles)**
  - Test case of approximately 5 to 10 BTM vehicle sites paid for in whole or in part with pilot funds (excluding the vehicle cost)
  - Demonstrated at a temporary generation PSPS site with coordination to a FTM fossil fuel generator and potentially a FTM energy storage asset
  - Likely limited to 1-2 vehicle OEMs and a single charging partner
- **Phase 2 – Incentive cohort (up to 200 vehicles)**
  - Incentive for up to 200 vehicles to cover a portion or all of the costs of bi-directional charging equipment, home isolation devices, and communications
  - Customers must be in a location subject to PSPS and within the boundaries of a multi-customer microgrid (either temporary or permanent)
  - A preference towards first offering incentive towards low income or medical baseline customers will be in place
  - An incentive for per-event performance may or may not be put into place (either covered via upfront incentive, or included in a per-event incentive)
  - Target participation from the full range of vehicle OEMs and charging partners from the V2X Residential/Commercial pilots dependent on vehicle and charger interest and overlap with customer type in PSPS formed microgrids
- **Phase 3 – Post-incentive cohort (ongoing)**
  - After incentive funds have been exhausted, a program will continue to exist such that customers can participate in community resiliency with their bi-directional EV
  - Consideration of the appropriate on-going payment for charging/discharging will be included within the scope of this project including a recommendation to the Commission for a program with continued funding for resiliency performance

B. Compliance with CPUC Decisions and relevant statute.

i. What VGI Strategy(s) and/or Near-Term Policy Action(s) established in D.20-12-029 will be addressed?

ii. Describe the pilot objectives and how they align with the guidelines adopted in D.20-12-029, and with any other relevant CPUC policies.

iii. What VGI strategies and use case(s) are addressed in the pilot and how will they help IOUs achieve the goals of D.20-12-029?

iv. *Show how the pursuit of these activities will advance VGI, as defined by this decision, by ensuring that proven VGI technologies can be scaled and by expanding the technology required to advance VGI.*
v. *Show how the pilot does not overlap with scope of the EPIC program or other programs including those administered by the Energy Commission.*
vi. *Show why a pilot is needed before implementing an IOU program.*
vii. *How will the proposed project(s) support other state legislation and policies relate to Transportation Electrification, including any update to the VGI Roadmap, the state's Zero-Emissions Vehicle Action Plan, the Air Resources Board's Scoping Plan and Mobile Source Strategy, the Commissions Environmental and Social Justice Action Plan, and any relevant local or regional policies? Will any existing state policy help facilitate the success of the VGI pilot?*

The June 2020 VGI Working Group (WG) Final Report contemplated the question, "What VGI use cases can provide value now, and how can that value be captured?". To address this question, the VGI WG first created a framework to classify and define use cases. The framework identified six dimensions by which a use case can be described. The six dimensions include (1) sector (where the vehicle is used and charged/discharged), (2) application(s) (services the vehicle aims to provide), (3) type (determines the power flow to and/or from the vehicle), (4) approach (mechanism through which the vehicle's charge and/or discharge is controlled), (5) resource alignment (specifies whether the "EV actor" and the "EVSE actor" are controlled by the same actor and have coinciding intentions/incentives) and (6) technology. This pilot will focus on use case(s) defined by the following attributes:

Dimension	Attributes
Sector	Any
Applications	System-Backup, Resiliency
Type	V2G
Approach	Direct (Active)
Resource Alignment	Unified
Technology-Charging Type	DC with stationary inverter

Of the policies identified, one is well aligned with this pilot project and received strong agreement:

- *6.07* Pilot funding for V1G and V2G for microgrid and V2M solutions, including a state-wide near-term goal; and utilities' PSPS plans and microgrid frameworks should consider EVs for FTM grid services.

Policy 6.07 includes: (1) Set a state goal (floor) of having 10 MW of EVs providing grid services to microgrids, including energy supply, capacity, or other services, in the near term. One area of consideration would be to test an EV-powered microgrid at community centers in vulnerable

communities. (2) Utilities should consider the feasibility of EVs for FTM grid services as part of their PSPS plans and microgrid frameworks.

Through this pilot, VGI will be advanced in a few key ways:

- Operational processes for use of EVs for multi-customer microgrids
- Program for enrollment of vehicles
- Processes and analysis to identify barriers and solutions for vehicle participation (e.g. how should a customer be renumerated when grid charging to absorb overgeneration in a microgrid?)
- Validation of advanced inverter functions as they relate to EVs

By aligning this pilot with EPIC 3.11B we ensure coordination on the effort, and avoid the duplication of work, but also gain the opportunity to build upon existing work at the least cost to ratepayers. Longer term the project will advance VGI and participation of DERs broadly in resiliency by providing the foundation for microgrids that are distributed and "self-regulating" via frequency. In a future state these microgrids could potentially be networked into macrogrids and eventually resynchronized with the greater transmission system.

C. Environmental/Social Justice Communities: **How will the pilot increase access for, or provide benefits to, Environmental/Social Justice Communities (ESJ), as defined by SB 350?**

i. *Do ESJ areas face any unique participation barriers, and if so, how will this pilot address those barriers?*

ii. *Describe input sought and received from Community-Based Organizations (CBOs) regarding the pilot development. How will CBOs be involved in pilot implementation, and/or evaluation?*

This pilot will focus on disadvantaged communities (DACs) that overlapwith established PSPS microgrids, where possible,, and will create air quality benefits in DACs from avoiding diesel emissions typically associated with temporary generation used in PSPS events.

PG&E plans to consult with CBOs for pilot implementation and evaluation through a holistic CBO effort currently underway at PG&E. CBOs are currently engaged by many teams within PG&E in a one-off piecemeal approach which tends to utilize more resources than a coordinated approach. Therefore, PG&E is building a holistic effort and plans to issue an RFP later to establish strong CBO partnerships that will allow for input on an ongoing basis from CBOs on a variety of topics. Through this process, the teams anticipate stronger outputs and reportable data. As part of this larger PG&E effort, the pilot team will engage the selected CBOs on an ongoing basis (monthly) to inform pilot efforts in reaching ESJ communities, developing appropriate incentive levels, engaging customers, sharing unique needs & challenges and measuring impact in ESJ communities.

D. **VGI applications/value streams**:

i. *Which of the multiple VGI applications (i.e., value streams) listed in the VGI Working Group final report will the pilot address and why? Could the potential VGI value streams potentially overlap or conflict, and if so, how would the pilot resolve how to prioritize different value streams? Which VGI value streams will be excluded and why?*

The following value streams will be served by this pilot:

Application	Use in Pilot
Customer-Backup, Resiliency	Home backup at customer SOC reserve set point
System-Backup, Resiliency	Support for local area EPS, multi-customer microgrid
System-Real-Time Energy	
System-Frequency Regulation	
System-Renewable Integration	Use of vehicle for storage and dispatch of overgeneration
System-GHG Reduction	Increased use of BTM solar, or stored grid electricity, as an alternative to diesel or fossil-based generation

There is potential for overlap with single site customer backup (at the home) as well as broader renewable integration and GHG reduction efforts. What makes this pilot unique is it's focus on those use cases within multi-customer microgrids. The siting of these devices within multi-customer microgrids presents unique technical challenges which, while they only apply to a small fraction of the population today, are expected to scale as BTM DERs become increasingly prevalent on the network.

E. **Stakeholder engagement**:

i. *How did the IOU address stakeholder feedback - both publicly available comments and any non-public feedback that is not confidential?*

ii. *How will the utility provide periodic updates to interested stakeholders?*

iii. *Will any pilot milestones require stakeholder input/engagement to determine the potential need for mid-course corrections? If so, how will the utility obtain and implement stakeholder recommendations?*

Based on feedback from the VGI Pilot working groups, we have added:

- Consideration of an incentive preference for medical baseline customers; and
- Preference for an incentive that covers both the cost of installed hardware, as well as performance of the system during PSPS.

We will work with the industry stakeholders through the V2X Residential and Commercial pilots to find overlap with this V2M PSPS Microgrid pilot. We will leverage those groups and stakeholders to inform this pilot both in terms of hardware and vehicles, but also in terms of cost analysis and compensation. The incentive schemes and renumeration for performance will

be socialized with relevant stakeholders (vehicle OEMs, charger manufacturers, and customers).

F. **Partnerships**: What partner(s) will collaborate with the utility to complete the pilot?
   i. *How will the project partners maximize the scope and value of the applications and use cases that would be developed?*
   ii. *What sources of private or public investment (or customer contribution) will be leveraged for the project and how much, and what will that funding be used for?*
   iii. *What, if any, other public funding resources will be leveraged to fund the project(s)?*

The vehicle and charger partnerships formed with industry stakeholders in the V2X Residential and Commercial pilots will be leveraged for this pilot.[1] Our intent is to work closely with a single vehicle OEM and charging vendor for the first test with an expanded group beyond the first 5 to 10 sites.

The EPIC 3.11B project will bring funding to develop the core capabilities of this project and will result in significant additional value (inclusion of vehicles) for an incremental ratepayer investment from this VGI Decision.

The remainder of the cost will be paid for out of the VGI Decision (D. 20-12-029) funding request of $1.5M for this project.

G. IOU ownership of customer-side resources
   i. *Would the IOU own any customer-side resources? If so:*
      a. *What resources would the IOU own, and why is IOU ownership essential for the success of this pilot?*
      b. *Can any market actor provide this product or service, and if so, why is the IOU not utilizing market actors?*
      c. *What is the cost differential due to IOU-ownership of customer-side resources including rate of return requirements, differences in capital and/or labor costs or IOU requirements?*
      d. *How can the IOU develop the availability of market actors to provide products or services?*

This pilot will not include any IOU ownership of customer-side resources.

H. Timeline

[1] List the partners here.

i. *Provide a flow chart describing the major stages of the pilot with milestones including (but not necessarily limited to) project initiation; key agency/partner meetings; initiation and completion of contracting (if necessary); education & outreach; installation of equipment; implementation; data collection; and evaluation.*

ii. *Also include milestones for key sub-tasks for each of the major stages of the project so that Energy Division staff can track progress against the pilot schedule.*

iii. *Identify tasks that are contingent on the completion of a preceding task; and potential options if a preceding task is delayed.*

Testing & Site Preparation (January to June 2022)

- Selection of the OEM and charging partner for the first 5 to 10 unit demonstration for target of 2022 PSPS
- Lab testing of hardware as part of the EPIC 3.11B program
- Site selection with a preference towards a site with high BTM solar penetration and an FTM battery if possible
- Enrollment of first 5 to 10 customers with installation of charger on site premise
- Deployment of the EPIC 3.11B control system at the site

Demonstration of Phase I (July to December 2022)

- PSPS performance during 2022 with 5 to 10 vehicles
- Learnings on customer preferences, impacts, and behaviors via survey
- Create a report document containing learnings to inform Phase II

Phase II Enrollment and Operational Use (January to December 2023)

- Open incentive for a variety of vehicle and charger combinations
- Potential selection of a set of follow-on sites allowing for greater accessibility
- Enroll up to 200 participants with a preference towards low income and medical baseline customers
- PSPS performance during 2023 with up to 200 vehicles
- Learnings on customer preferences, impacts, and behaviors via survey
- Create a final report document containing learnings

Phase III Enrollment and Operational Use (January 2024 onward)

- Pathways in place for customers to continuously participate in community V2G

The sub-tasks (bulleted above) are contingent on the previous task completion. There may be opportunity for parallel work in the Testing & Preparation task.

I. Budget detail

i. *Proposed budget for the following types of expenses – equipment, materials, contracted goods and service, internal labor, and other (describe):*
ii. *Provide the estimated budget in nominal dollars and for the full project with escalators over its expected term.*
iii. *Estimate expense for each of the major budget categories listed below if required for this project. (This information will help the Commission and stakeholders understand the utility's expectation of the level of effort needed to support each type of activity)*
iv. *outreach;*
v. *customer participation incentives;*
vi. *electrical infrastructure make-ready (specify);*
vii. *EVSE;*
viii. *other technology and/or hardware expenses;*
ix. *technical services;*
x. *evaluation, including a proposed budget for data collection; and*
xi. *any other category of budget expense that would account for 10% or more of the total budget.*

A budget of $1.5M from the ratepayers is requested for this pilot, which would operate alongside the EPIC 3.11B project which already has obtained funding of roughly $2.9M. Of the $1.5M funds requested, approximately $500,000 to $750,000 would be used towards project activities:

- Hardware and vehicle testing;
- Program setup and management; and
- Project management, site selection, and demonstration.

The remaining funds would be used for customer incentive purposes, implying a $3,750 to $5,000 per customer potential incentive.

We may find through the course of the project that the incentive is either too high or too low, which could result in the number of participants ranging from 100 to 400 based on customer feedback and our own cost analysis.

J. Risk mitigation

i. *Explain potential risks or uncertainties for key elements of the pilot (i.e., technology performance, lack of customer uptake, integration challenges, etc.), whether they can be mitigated, and if so, how? If not, what are the potential consequences for the pilot? Can the pilot identify potential risks for future programs and/or mitigation options?*

#	Risk	Impact	Mitigation
1	Low overlap between customers in PSPS and availability of qualified vehicles	Phase I demonstration of 5 to 10 units in PSPS is not feasible	Move demonstration to lab or demonstrate in 2022 or 2023 during PSPS off season
2	Readiness of charger and vehicle hardware	Delay to the project, broadly	Begin partnership with vehicle and charger immediately, move demonstration into 2023 if necessary
3	EPIC 3.11B delays	Delay to the project, broadly	Work ahead of VGI pilot approval to consider EV within the EPIC 3.11B program
4	Low customer adoption	Insufficient participation	Increase incentive or target alternative communities where possible

PG&E is unable to determine whether the pilot will be able to identify potential risks for future programs and/or mitigation options at this time.

K. Safety

i. What safety requirements are included in the proposed pilot?

ii. Does the project(s) align with the Safety Requirements Checklist adopted in D.18-01-024, D.18-05-040, and D.18-09-034?

iii. Are any additional safety requirements needed for the pilot, and if so, what are these requirements and how will the pilot meet them?

iv. Will the pilot incur cybersecurity risks and how can they be mitigated through the pilot and/or the SCE cybersecurity workplan required by D.20-12-029 (at 85)? Will the pilot help identify cybersecurity gaps and/or develop potential solutions that could be addressed in the cybersecurity workplan?

This pilot will require all participating EVSE hardware to have all applicable safety certifications and be Rule 21 compliant. Additionally, any electric vehicles that are not commercially-ready (i.e., they are modified for bidirectional charging after production) will need to go through proper safety certifications by the regulating authorities (i.e., Nation Highway Traffic Safety Administration,…). Furthermore, the pilot may incur cybersecurity risks in such that grid signals are sent via the Internet to technology providers. These cybersecurity risks will be mitigated by utilizing industry-approved and adopted open standards to relay grid signals and conditions. If all possible, no proprietary standards will be used between the utility grid and the technology providers. Additionally, the technology providers will have no direct connection to utility systems and/or hardware reducing vulnerability. All messaging and communications between the utility and the technology providers will go through a single-entry point (i.e., aggregator or program implementer). Likewise, the aggregator/program implementer will not have direct control over customer end-devices (such as the electric vehicles and/or EVSE hardware).

V. Scale Up: Analyze potential to scale to a full utility program. (approximately 15% of narrative)

A. What additional barrier(s), if any, would need to be overcome to scale the pilot into a full program?

Barriers to scale the pilot may include:

- The incentive may be insufficient to entice participants
- Customers may have economic concerns around charging from the grid at times they normally would not have, for discharging back to the grid for exports, and interactions with Net Energy Metering (NEM) tariffs
- Interconnection studies and costs for customers without NEM
- Customer concerns around mobility during a PSPS emergency

B. How would the pilot be scaled if it is successful and on what timeframe?

If successful, the pilot would be scaled during the 200-vehicle incentive cohort (Phase II) and would remain available without incentive during Phase III. At that point in time, the Commission and PG&E could work together to determine if a follow-on incentive is needed or warranted.

C. Will the pilot encourage the development of new business opportunities for third-party market participants providing products and/or services?

i. How does the proposed SB 676 VGI pilot design ensure this proposal will avoid or mitigate any potential unfair competition with nonutility enterprises?

1. *How will the pilot lead to policies and programs that enable a variety of market actors to compete to offer services?*

The intent of the project is to utilize standardized functions within all Rule 21 compliant inverter. Specifically, the advanced inverter functions within IEEE 1547 which support frequency-droop controls. By utilizing this type of scheme any Rule 21 compliant inverter could participate in these resiliency services.

VI. Evaluation (approximately 15% of narrative)

A. Evaluation Plan: As noted in D.20-12-029 "Each advice letter for a VGI pilot must contain an evaluation plan that identifies a process to determine the success of each pilot and the feasibility and desirability of scaling the pilot to a full-scale program or utilize the results to revise an existing program."

i. Describe an evaluation plan that includes assessment of the need for ratepayer funding, effectiveness of the project for achieving the planned results, timeliness and efficiency of pilot execution, lessons learned and opportunities for improvement, and appropriateness to scale to a full utility program. Include a schedule for 1) drafting a request for proposals (RFP), 2) providing Energy Division staff time to review RFP (including draft scope of work), 3) releasing the RFP and scope of work, and 4) giving ED staff time to review RFP responses consistent with ordering paragraph 23 of D.20-12-029.

B. Success Indicators: What criteria will the IOU use to evaluate if the pilot has been successful?

C. Metrics: What metrics from D.20-12-029 would the IOU propose to add to the SB 676 data reporting template, after receiving the concurrence of Energy Division staff, to measure the pilot's success in overcoming barriers and the program's impact on DACs and other priority populations?

i. For example, what technical, cost, and customer engagement metrics will the IOU track, and how? What other types of data will be collected, and how? How will this data be used to determine whether to scale the pilot to a full utility program? How do the proposed metrics and data align with the metrics in the final Scorecard adopted within the TEF, if finalized by the time the VGI pilot advice letter is filed?

The pilot's main objectives are to: 1) demonstrate customer adoption of V2G technology for community resiliency, 2) value to the PSPS microgrid, and 3) operational integration of EVs.

The first objective can be measured as follows:

- Number of customers who enroll in the pilot
- Number of customers that initially enroll in the pilot and continue participating throughout the entirety of the pilot (attrition rate)
- Incentive required (value and structure) to induce participation

The second objective can be measured as follows:

- Reduction in GHG emissions within the PSPS microgrid
- Reduction in fuel costs within the PSPS microgrid
- Reduction in equipment, or nameplate capacity, required to serve the microgrid
- Cost to serve the microgrid using conventional generation versus incentives and compensation to electric vehicle participants

The third objective can be measured as follows:

- Operational time, complexity, and cost to deploy
- Reliability and consistency of asset availability
- Potential scale of the solution on the network

A successful pilot will meet all three objectives, while also recognizing that V2G technology is in its infancy and that additional learning cycles may be needed. If the cost-benefit analysis determines that a net value is created, while remaining reasonable to integrate into operations,

then PG&E may recommend scaling the pilot to a full-scale program. Whether this means adapting existing utility tariffs and rules to allow bidirectional electric vehicle participation and/or creating an entirely new program will depend on the exploration and outcomes of this pilot.

Lastly, pursuant to VGI Decision D. 20-12-029 Ordering Paragraph 23, PG&E plans to coordinate with the other IOUs and consult with CPUC Energy Division (ED) staff on the development and issuance of a Request for Proposal (RFP) for a third-party evaluator to jointly assess the IOUs' VGI pilots. The evaluation would include but not be limited to the above metrics as well as data being collected within the IOU annual reports. PG&E will also seek clarity prior to RFP issuance on the overall timeline for evaluation completion in collaboration with the other IOUs and ED staff due to current confusion with the dates of final reporting listed in OP 23.

VII. Other (approximately 5%-10% of narrative)

Please provide any other relevant information.

N/A

VIII. Summary and conclusion (approximately 5%-10% of narrative)

By combining funding from the VGI Decision with the existing EPIC 3.11B, we believe there is a unique opportunity to significantly advance both a resilient grid architecture and V2G capabilities, while doing so at a least cost to ratepayers. While the core of this program would be in support of PSPS, the learnings from it is directly extensible to multi-customer microgrids and is in support of transitioning to a flexible, resilient, and distributed grid architecture.

PILOT 4 - Exploring V2X Export Value Pilot

Pilot #4 – Exploring V2X Export Value Pilot

I. Subject

Pacific Gas & Electric Proposal for Senate Bill (SB) 676 Vehicle to Grid Integration (VGI) Pilot: Exploring Vehicle-to-Grid (V2G) Export Value

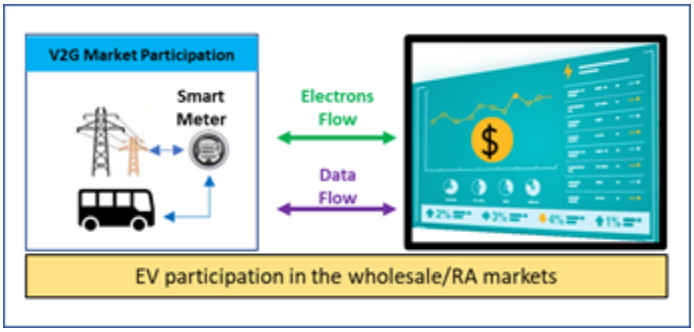
II. Pilot overview

Please provide an overview that addresses the topics that were included in the summaries provided to stakeholders (with updates as appropriate). Also include key partnerships, specific sources and amounts of non-ratepayer funding, and key metrics to evaluate project success.

Purpose: This program aims to create revenue streams to capture value from **V2X classes 2b-8 school electric buses** performing EV export to meet utility capacity shortfalls, provide grid services in the CAISO markets, and to help lower the total cost of ownership for EVs and bidirectional charging equipment. The project will test and validate the most cost-effective pathways of participation in VGI services while supporting transportation charging needs with a small pool of V2X school bus class vehicles 2b-8 located in Disadvantaged Communities (DACs). Coordination will be needed between simulated CAISO market and utility monitoring & controls systems such as Distributed Energy Resource Management System (DERMS) and Advanced Distribution Management Systems ().

Challenge Today: Today, utility tariffs and programs (Net Energy Metering (NEM), Demand Response (DR), Emergency Load Reduction Programs (ELRP)) and existing CAISO mechanisms do not consider capacity value for EV export, energy from EV batteries charged from the grid (i.e., from non-renewable sources) or any contribution beyond zero kW consumption.

What: Create pathways for capturing value of EV export for CAISO market participation and ancillary services and for capturing value of EV export to the grid in case of capacity shortfall (policy updates needed by both the investor-owned utilities (IOUs)/CPUC and CAISO). The pilot will also explore ways to synchronize EV export with the grid, study customer responsiveness and appropriate incentive levels. The pilot has a total budget of $2.3 million.



Potential additional funding and collaborations: The pilot will attempt to leverage funds from other TE programs, such as SDG&E's Vehicle to Grid Electric School Bus Pilot as described in Advice Letter 3489-E-A, matching funds and/or efforts for which partners will absorb costs and collaborate with EPIC 3.27 multipurpose meter in cases where one meter is shared between EVSE and other loads.

Funding for some of the pilot activities will be provided in-kind by the technology providers (i.e., product research and development (R&D), some software development, electric vehicle (EV) to electric vehicle supply equipment (EVSE) compatibility testing.

Pilot success will be measured by having a minimum of one site with an EV bus fleet with sufficient energy storage capacity to allow the measurement of participation in a simulated CAISO market. Depending on the final number of vehicles the amount of capacity is expected to be no less than 326 kWh and could be as great as eight (8) mWh for the largest potential fleet we may partner with. The successful collection and analysis of data showing how it would participate in the market and the revenues it would receive will help establish the level of incentive necessary to result in significant participation. We would also measure the amount of revenue that would be returned to the EV site customer as the result of such participation thus creating a sustainable pathway for bidirectional vehicles to participate in vehicle-grid integration and in the CAISO market.

Possible Partners

We have not received a final commitment to participate from all parties, below is a summary of the conversations to date:

Status of Vehicle and EVSE Manufacturer V2X Technology Deployments

Original Equipment Manufacturers (OEM)	**Status of Talks**
Bus Manufacturers	
Proterra	In conversation for two school bus fleets located in Redding and Madera. The Grant Elementary School in Redding has purchased two buses, and the Golden Valley Romeo Unified School District intends to deploy 2-6 buses. Each school is planning to have more buses than chargers and it is likely that we will need to fund additional chargers to fully enable participation. These buses typically have battery capacity of 226 kWh, so at a given site, we anticipate a minimum of 452 kWh and a maximum of 1.35 MWh in total capacity. It is expected that these buses would not be used during the summer given the added complexity of providing infrastructure to another entity. The buses would remain grid-connected and available for most of the summer season.
Lion Electric	Lion Electric buses are being used by Oakland Unified School District. See below under AutoGrid for more details about this partnership.
EVSE Manufacturers	
Proterra	Proterra offers their own charging equipment for their buses.

ABB/Lion Electric	Lion offers ABB chargers for their vehicles. We have not yet had the opportunity to discuss specifics with Lion Electric.
Nuvve/Rhombus	We have spoken with Nuvve and we anticipate working with them as partner.
Aggregators	
AutoGrid	In addition to offering aggregation services, AutoGrid is also introducing us to one of their clients, ZUM, as they are involved in the project to electrify their bus fleet. We are discussing this opportunity with a focus on the fleet used for Oakland Unified School District.
Olivine	PG&E has worked with Olivine on other pilots. We are discussion with them regarding their participation in this pilot.

III. Need for Pilot (approximately 15% of narrative)

A. *Describe the market-readiness of the technology (and/or use cases) addressed by the proposed VGI pilot; as well as practical barrier(s) to deploying at scale via an IOU program.*

i. What is the status of technology development and deployment?

Buses from Proterra, BlueBird and Lion Electric are commercially available in limited quantities. Bi-directional chargers are currently available for all companies but have not received all necessary approvals. It is expected that the required approvals will be received in time for participation in the pilot project.

The partners we are seeking to work with all have buses currently on order with deliveries expected in 2021 and 2022.

ii. What technical standards have been established, how technically robust are existing standards, and how widely are they adopted in the marketplace? What gaps need to be filled in standards development and/or deployment?

The ISO (International Standards Organisation) 15118-2018 standard for communication between EV and charging station is defined, as is the IEEE (Institute of Electrical and Electronics Engineers) 2030.5 standard for communication between grid operators and EVs. Both standards are robust but neither have been fully adopted in the marketplace. We have targeted partners who have either already adopted these standards or anticipate having them adopted in time for the start of our pilot project. In certain circumstances it may be necessary to use other standards for initial testing, such as Open Automated Demand Response (OpenADR) for utility side connectivity which if used would be supplanted by IEEE 2030.5 as soon as is feasible. Currently, there is no UL certification for an AC based bidirectional charger, but one UL 9741 is available for DC based bidirectional chargers. Given that export to grid for Electric School Buses provides much higher grid value via a DC charger, this limitation does not hinder this pilot effort. It at least one instance, it is possible that one school bus OEM will not support ISO 15118-2018 at the start of the pilot. If this is the case, then it may be necessary for the OEM to

create some custom coding to bridge this gap. Installing and configuring chargers and testing them with the vehicles is expected to be completed prior to the start of this pilot.

iii. *Are business models well-established, and if not, what barriers must be overcome to establish business models?*

The business model is not well-established; creating a business model that works for all participants is a key part of this pilot. It will be necessary to determine the value of participation by bus fleets to the site host customer and to the CAISO grid, by considering both revenues generated and received, as well as looking at external studies that seek to determine the amount of battery degradation will occur with Vehicle to Grid (V2G) usage.

iv. *Do any existing policies, rules, or tariffs create barrier(s) and if so, what are these barriers and how can they be overcome?*

The most significant barrier is the discrepancy between the cost of electricity paid at retail rates versus the revenue generated through export at wholesale rates. We will overcome these barriers for the sake of the pilot by providing the funds from our budget to create the proper level of incentive. Looking beyond our pilot, it will be necessary to work with CAISO and CPUC to create policy that supports a sufficient incentive on an ongoing basis. This incentive will likely be through a restructuring of rates to better reflect the value of such V2G services contributing to the grid and CAISO market.

v. *What customer education is necessary?*

Customers will need to ensure that their vehicles are plugged in and available to charge/discharge when not in use. This includes times during the middle of the day when the buses are off duty as well as immediately after finishing the final drop-off at the end of the school day. It will be important to coordinate changes in bus schedules with our team so that we can ensure that there will always be sufficient range available for the need as required.

vi. *What existing and/or ongoing pilots or research can be leveraged to provide information and/or physical resources for the pilot? How will the pilot avoid duplication of existing work?*

Many R&D pilots have been successfully completed utilizing bidirectional EVs and EVSEs. While these pilots have explored the capabilities of bidirectional charging on a technology level, there have not been any pilots to date that explored large-scale adoption and ongoing business models of bidirectional charging. This pilot will leverage the technological advancements achieved in prior R&D pilots, including compatibility testing between EV and EVSE and exploration of communication protocols for achieving charging/discharging optimization as well as the lessons learned by our effort in our Commercial VGI pilot.

There are a few widely accepted bidirectional charging standards enabling communication between the EV and EVSE. For vehicles that use the CHAdeMO standard already for DC charging, there is a fully enabled communication protocol for bidirectional charging. For vehicles that use the Combined Charging Standard (CCS) for DC charging, there are two existing pathways to enable bidirectional charging. One is through the DIN 70121 specification, and one is through the ISO 15118-20 specification. The DIN 70121 specification has been finalized and therefore, currently more mature in functionality than the ISO 15118-20 specification, which is targeted to be formalized sometime in the beginning of 2022.

This pilot will build on the efforts of our Residential and Commercial pilot projects to earn revenue by addressing the challenges of participating fully in the CAISO market. The ability to earn CAISO market revenues may create an additional incentive to procure bidirectional vehicles and equipment which may have a higher upfront capital cost than non-bidirectional vehicles and equipment.

Not only will market mechanisms need to be defined and adopted by the pilot, but customer education may be necessary to create awareness of the benefits of exporting energy with participation in the CAISO market to create a long-term, robust, and sustainable market. To date, there have not been clear market incentives and/or mechanisms for owning and/or leasing bidirectional charging vehicles and equipment. Further there have been significant barriers such as the discrepancy between purchasing electricity at retail prices while selling energy on the CAISO market would yield returns in much lower wholesale prices. This pilot will aim to overcome these market barriers and create a long-term, sustainable business case for such participation.

IV. Pilot Proposal (approximately 40% of narrative)

Describe how the proposed pilot will contribute to development of IOU programs that will achieve the goals of D.20-12-029.

A. ***Description**:*

i. *Describe the proposed pilot, including customer segments served and number of customers served, program delivery mechanism, etc.*

ii. *What recommendation(s) from the June 2020 VGI Working Group Final Report the pilot will address and how? How will the pilot address the specific barriers identified above under section III?*

iii. *What technologies will be used and why were they selected? Do the technologies enable, facilitate, or hinder other VGI use cases even if not the focus of the proposed pilot?*

iv. *How was the pilot project technology(s) previously demonstrated?*

Pilot Description

PG&E's Exploring V2X Export Value Pilot is focused on determining the value of the export of energy from electric vehicles in the CAISO market during peak demand times and events. This intends to build on the learnings from our residential and commercial pilot projects by adding CAISO revenues to will cover the cost of investment in bidirectional charging equipment, vehicles capable of bidirectional charging and the accelerated wear and tear of these batteries given the additional usage. These learnings are intended to inform audiences serviced by other pilots thus furthering accelerating V2X adoption.

The pilot will test two use cases and a final phase which will combine them in a live production pilot:

1. A simulated in-market use case which will focus on calculating the value of service and identifying barriers to adoption while using a simulated CAISO market.
2. A simulated market-informed case in which distribution needs as relates to PG&E and CAISO will be analyzed. In this case, we will also determine the value of participation in events that benefit PG&E, including frequency and voltage support
3. A production program in which PG&E will focus on enabling interconnection, providing measurement and valuation (M&V) support and energy exports.

In the initial use cases, the pilot budget will be used in part to provide incentives to participants to cover the additional costs attributed to use of bidirectional charging equipment and additional chargers if deemed necessary. At the end of the pilot, PG&E will report on the amount needed to incentivize participation.

Recommendations Considered from VGIWG

The June 2020 VGI Working Group (WG) Final Report contemplated the question, "What VGI use cases can provide value now, and how can that value be captured?". To address this question, the VGI WG first created a framework to classify and define use cases. The framework identified six dimensions by which a use case can be described. The six dimensions include: (1) sector (where the vehicle is used and charged/discharged), (2) application(s) (services the vehicle aims to provide), (3) type (determines the power flow to and/or from the vehicle), (4) approach (mechanism through which the vehicle's charge and/or discharge is controlled), (5) resource alignment (specifies whether the "EV actor" and the "EVSE actor" are controlled by the same actor and have coinciding intentions/incentives) and (6) technology. This pilot will focus on use case(s) defined by the following attributes:

Dimension	Attributes
Sector	Fleet
Applications	System Grid Applications (FTM) Voltage Support, Ancillary Services

Type	V2G
Approach	Direct (Active)
Resource Alignment	Unified
Technology-Charging Type	DC with stationary inverter

Market Barriers

This pilot will address barriers currently inhibiting the growth of the bidirectional charging market which are both preventing customers from earning revenue from grid services and preventing the electricity grid from benefiting from bidirectional charging technology that can provide valuable grid services. Those barriers include exclusion of bidirectional EVs from participating in the NEM program, exclusion of bidirectional EVs from receiving SGIP incentives and disincentives to participate in CBP. While these pathways may not be appropriate for participation by bidirectional electric vehicles, this pilot will explore the options and make recommendations so that maximum value is captured from bidirectional charging technology for both customers and the electricity grid.

Technology Selection

As this pilot will be depending on efforts underway to electrify existing bus fleets, technology selection will be made prior to the start of this pilot. It is likely that in some cases technology will be considered to replace or update existing unidirectional chargers and potentially to add existing charging capacity to ensure the availability of enough connected vehicles. It is expected that only DC based bidirectional chargers will be considered due to their ability to offer a greater amount of energy export to meet needs.

Previous Demonstrations

Lastly, previous demonstrations of medium- and heavy-duty vehicles using the DC bidirectional charging approach include, but are not limited to, the following projects: California Air Resources Board's Clean Mobility in Schools Pilot Project – Low Carbon Transportation Incentives FY 18/19, ConEdison's Electric School Bus V2G, Rialto Unified School District and Nuvve's joint V2G School Bus Project, Torrance School District and Nuvve's joint V2G School Bus Project, among others noted in the Joint Utilities stocktake[1]. None of these demonstrations involved large-scale adoption and/or contemplation of modification to existing rules based on long-term participation of bidirectional EVs in electricity grid services.

[1] *3/12/21 Joint Utilities Amended Stocktake. Pilots and Programs Related to VGI.* March 12, 2021.

B. *Compliance with CPUC Decisions and relevant statute.*

i. *What VGI Strategy(s) and/or Near-Term Policy Action(s) established in D.20-12-029 will be addressed?*
ii. *Describe the pilot objectives and how they align with the guidelines adopted in D.20-12-029, and with any other relevant CPUC policies.*
iii. *What VGI strategies and use case(s) are addressed in the pilot and how will they help IOUs achieve the goals of D.20-12-029?*
iv. *Show how the pursuit of these activities will advance VGI, as defined by this decision, by ensuring that proven VGI technologies can be scaled and by expanding the technology required to advance VGI.*
v. *Show how the pilot does not overlap with the scope of the EPIC program or other programs including those administered by the Energy Commission.*
vi. *Show why a pilot is needed before implementing an IOU program.*
vii. *How will the proposed project(s) support other state legislation and policies related to Transportation Electrification, including any update to the VGI Roadmap, the state's Zero-Emissions Vehicle Action Plan, the Air Resources Board's Scoping Plan and Mobile Source Strategy, the Commissions Environmental and Social Justice Action Plan, and any relevant local or regional policies? Will any existing state policy help facilitate the success of the VGI pilot?*

In addition to identifying high-priority VGI use cases in which value can be captured in the short-term, the WG also addressed a second question to identify policy recommendations, that is "What policies need to be changed or adopted to allow additional use cases to be deployed in the future?". The WG categorized all policy recommendations into 11 policy categories to help consolidate and more easily manage the scope of overall recommendations.

Of the 11 policy categories identified, there is one that aligns closely with this pilot:

- 2. Develop and fund government and LSE customer programs, incentives, and DER procurements.[2]

There were three short-term policy recommendations of those identified by the VGI WG that had either strong or good agreement among stakeholders and which will be informed by this pilot. Those policy recommendations[i], all with strong agreement include:

- 2.02 V2G systems become eligible for some form of Small Generation Incentive Program (SGIP) incentives
- 2.12 Allow Smart Unidirectional Charging (V1G) and V2G to qualify for SGIP to level the playing field with incentives for other DERs, but V1G would get less incentive compared to V2G based on permanent load shift logic, and

[2] [INSERT CITATION: WG Report page 34

- 2.17 Enable customers, via Rules 15/16 or any new EV tariff, to employ load management technologies to avoid distribution upgrades, and focus capacity assessments on the Point of Common Coupling.[3]

The VGI WG also identified policy recommendations that are achievable in the medium-term (2023-2025) or long-term (2026-2030). One recommendation that was identified as achievable in the medium-term will be informed by this pilot:

- In addition to an EV export bill credit (under NEM or another framework), a supplemental credit should be considered for environmental components, e.g., based on SGIP GHG signal to determine marginal emissions rate[4]

Most Working Group participants agreed on certain "consensus use cases" that include priority sectors and applications providing value in the short-term including:

- System applications easily implementable for vehicle locations with daytime charging ability
- Vehicle types with excess battery capacity relative to duty cycle, such as school buses; and
- All system and customer applications that defer charging away from peak periods.

There were four barriers identified in Section III above and summarized below:

- Exclusion of bidirectional EVs from participating in the NEM program
- Exclusion of bidirectional EVs from receiving SGIP incentives
- Scarcity of charging standards for bidirectional charging. and
- The lack of mechanisms that allow EV Export to participate in the CAISO market.

In Section 6.2, of the VGI Decision concerning the implementation of SB 676, Joint Commenters suggested creating a method to compensate for situations in which EVs export electricity to the grid in times of need.[5] Ideas considered include potentially expanding eligibility under the NEM program for credited exports. They believed that directly incentivizing export of energy from EV to grid would encourage deployment of technologies and programs that would allow EV drivers to sell their stored electricity to grid operators in times of need. They further asserted that this could be "considered a near-term policy action to advance the reform of retail rates" and/or to "Develop and Fund Government and Load Serving Entity Customer Programs, Incentives, and Distributed Energy Resource Procurements." While it's unclear how such policy action would be implemented given existing rules that stipulate use of NEM 2 tariffs; there has been considerable advocacy for a Commission supported program that would compensate EV drivers for electricity exports more broadly even including exports from EVs charged from the grid. The decision stopped short of finding that such "creation of any credit-for-export scheme" would be

[3] WG Report, page 38
[4] WG Report, page 39
[5] VGI Decision, page 31

reasonable but rather suggests that such a scheme should be further explored and that it would be useful for such consideration to occur in a Commission proceeding that also considers credit for exports from other types of energy storage systems.[6]

The VGI working group recommends that in so much as IOUs are not able to directly affect CAISO policy, large electrical corporations such as PG&E "shall collaborate with CAISO where beneficial and report on reforms to wholesale market rules and access that advance VGI strategies." This coordination and the efforts to determine the necessary incentive amount for encouraging EV export participation in CAISO markets are a central aspect of this pilot.

Compliance with CPUC Decision D. 20-12-029

Commission Decision D.20-12-029 implementing SB 676 set to "establish strategies and quantifiable metrics to maximize the use of feasible and cost-effective electric vehicle grid integration by January 1, 2030…"[1] In that Decision, the CPUC asserted five objectives to facilitate the adoption of VGI,7. Three (3) of which will be addressed by this pilot:

- Market signals to create market demand
- Overcome capital costs, infrastructure, information, and other barriers to scaling VGI services; and
- Continue agency coordination

Pilot Scope Versus Energy Commission Programs

PG&E's V2X Export Pilot Program is focused on spurring adoption of commercially ready V2X (bidirectional technologies) electric school buses that will be interconnected in a commercial setting. The V2X Export Pilot Program's goals are to support the bidirectional electric vehicle market through incentives, create and demonstrate V2X/bidirectional value for customers and the electricity grid and reduce the total cost of ownership of EV adoption. In discussion with the California Energy Commission (CEC), this pilot will not overlap with the CEC's Electric Program Investment Charge (EPIC) program because this pilot has a focus on commercially-ready technology, whereas the EPIC program is focused on facilitating commercialization of technology not yet ready for at-scale market deployment through funding of lab testing or small-scale research that ensures technologies meet existing communication protocols and safety standards.

Need for Pilot

It is important to conduct this pilot before implementing a full-scale utility program for bidirectional technologies because there are several challenges that face bidirectional EVs from immediately providing grid services to PG&E and in interacting with the CAISO market. That is, a robust platform for communication and control needs to be set up for the bidirectional EVs and equipment to connect with utility systems and costs and benefits need to be evaluated at large-

[6] VGI Decision, page 32

scale to determine appropriate incentive levels for a sustainable, long-term program. Bidirectional EVs are currently excluded from participating in PG&E's NEM and SGIP programs and are unable to capture value and/or generate revenue from energy export beyond the commercial building's electricity meter (in such programs as CBP). Through this pilot, PG&E will explore adapting existing utility programs and/or creating alternative market pathways by opening new programs to accommodate the benefits provided by bidirectional EVs. Furthermore, this pilot will aim to develop a sustainable distributed energy resource (DER) platform that will aggregate utility signals and communicate via standardized. Lastly, this pilot will require a certain level of data transparency from participants to capture accurately the costs and benefits of deploying bidirectional technologies. By capturing accurate cost and benefit information, an evaluation can be made to accurately create performance metrics for a robust, and long-term sustainable utility program which would capture the benefits of bidirectional technologies

C. ***Environmental/Social Justice Communities: How will the pilot increase access for, or provide benefits to, Environmental/Social Justice Communities (ESJ), as defined by SB 350?***

i. Do ESJ areas face any unique participation barriers, and if so, how will this pilot address those barriers?

ii. Describe input sought and received from Community-Based Organizations (CBOs) regarding the pilot development. How will CBOs be involved in pilot implementation, and/or evaluation?

ESJ school districts are receiving financial support for the electrification of school bus fleets. In working with schools in these districts we intend to help them economically participate by creating new revenue streams that will benefit their communities. As we finalize which district(s) will participate in this pilot project we will seek out participation from CBOs in these districts. We anticipate that such organizations will help identify opportunities for these revenue streams to benefit the local community.

Most opportunities under consideration are within DACs, these include school districts in Oakland, Madera County, and Stockton.

PG&E plans to consult with CBOs for pilot implementation and evaluation through a holistic CBO effort currently underway at PG&E. CBOs are currently engaged by many teams within PG&E in a one-off piecemeal approach which tends to utilize more resources than a coordinated approach. Therefore, PG&E is building a holistic effort and plans to issue an RFP later to establish strong CBO partnerships that will allow for input on an ongoing basis from CBOs on a variety of topics. Through this process, the teams anticipate stronger outputs and reportable data. As part of this larger PG&E effort, the pilot team will engage the selected CBOs on an ongoing basis (monthly) to inform pilot efforts in reaching ESJ communities, developing

appropriate incentive levels, engaging customers, sharing unique needs & challenges and measuring impact in ESJ communities.

D. ***VGI applications/value streams****:*

i. Which of the multiple VGI applications (i.e., value streams) listed in the VGI Working Group final report will the pilot address and why? Could the potential VGI value streams potentially overlap or conflict, and if so, how would the pilot resolve how to prioritize different value streams? Which VGI value streams will be excluded and why?

This pilot will address the following VGI applications (i.e., value streams): integration System Grid Applications (FTM), Voltage Support, Ancillary Services and EV export. This pilot has three major stages: phase 1a (2022), phase 1b (2023) and phase 2 (2024). Phase 1a will focus on setting up and evaluating results working in a simulated CAISO environment. Phase 1b, will focus on the integration of utility side signaling to initiate events, while phase 2 will focus on live interaction with CAISO. Each stage has a data analysis component within its scope. See the timelines presented in Section H below describing the major milestones in each of the three phases.

The pilot will not address all of the customer-side applications or many of the system-level applications, such as customer-upgrade deferral, customer-renewable self-consumption, customer-backup, resiliency, system-real-time energy and system-upgrade deferral services due to current market limitations and/or prioritization of high-value use cases under a limited-duration pilot along with the fact that a number of these applications are addressed in pilots 1-3. Additionally, in the case where market barriers exist for bidirectional EVs to participate and/or are disincentivized to participate in system-level use cases, the PG&E Exploring V2X Export Value Pilot will address these barriers.

E. ***Stakeholder engagement****:*

i. How did the IOU address stakeholder feedback - both publicly available comments and any non-public feedback that is not confidential?

ii. How will the utility provide periodic updates to interested stakeholders?

iii. Will any pilot milestones require stakeholder input/engagement to determine the potential need for mid-course corrections? If so, how will the utility obtain and implement stakeholder recommendations?

The Joint Utilities (PG&E, SDG&E and SCE) hosted two VGI Workshops seeking stakeholder feedback on proposed pilot ideas. The Joint Utilities received comments after both workshops and specifically hosted a feedback survey after the second workshop. PG&E addressed stakeholder feedback in a variety of ways. One method included following up with select stakeholders to dive deeper into their comments submitted to the Joint Utilities. Another

method included meeting directly with stakeholders to solicit feedback on the pilot. PG&E held over 15 individual meetings with technology providers (vehicle manufacturers, EVSE suppliers and software/service providers) to gather input for designing the pilot structure.

PG&E plans to provide regular updates to stakeholders by hosting quarterly meetings with interested stakeholders to provide status on the pilot, progress towards meetings pilot objectives and solicit feedback on data evaluation and outcomes to date. This pilot will not require stakeholder input to determine the potential need for mid-course corrections, however, stakeholder input will be crucial in evaluating cost/benefit analysis and calculations resulting from VGI application testing. This feedback will help inform our final documentation and recommendations provided to the Commission for future long-term program adoption.

F. ***Partnerships****: What partner(s) will collaborate with the utility to complete the pilot?*

   i. *How will the project partners maximize the scope and value of the applications and use cases that would be developed?*
   ii. *What sources of private or public investment (or customer contribution) will be leveraged for the project and how much, and what will that funding be used for?*
   iii. *What, if any, other public funding resources will be leveraged to fund the project(s)?*

Nine partners have been identified as potential collaborators with PG&E to complete the pilot. Those partners include: Proterra, Lion Electric, ZUM, EPRI, Olivine, AutoGrid, Rhombus and Nuvve. All the participating technology providers are committed to accelerating VGI adoption and as a commitment to the pilot and pursuit of market adoption of bidirectional charging technologies have agreed to contribute by providing in-kind development work.

PG&E: PG&E will act as the project manager and administrator of the pilot. PG&E will oversee distributing incentive funds, verifying that the incentive funds are distributed to qualifying participants with support of the pilot partners, tracking pilot progress and reporting final data analysis and documentation to the CPUC.

Centralized software provider: The centralized software provider will be responsible for developing a centralized software platform that can aggregate utility signals and communicate via standardized protocols to multiple EV and EVSE brands. The centralized software provider may (on behalf of the technology providers) communicate application testing notifications (either via SMS or app) to the end customers (fleet managers).

Technology providers (electric vehicle manufacturers and EVSE suppliers): Several technology providers have been identified to collaborate with PG&E on this pilot. Those technology

providers include: Proterra and Nuvve. For incentive eligibility, participating technology providers must demonstrate commitment to accelerating VGI adoption and as a commitment to the pilot and in pursuit of market adoption of bidirectional charging technologies agree to contribute by providing some level of in-kind development work that can be leveraged by the pilot.

Fleet owners/operators: The fleet owners/operators will need to adopt participating technology provider vehicles and EVSEs. The end customers (i.e., fleet managers) will also contribute to the pilot by financing a portion of the capital cost to acquire a bidirectional-capable electric vehicle, equipment, and installation. While this pilot will help bring bidirectional-capable electric vehicles and equipment in cost-parity with non-bidirectional capable electric vehicles and equipment, full cost-parity will not be feasible. Therefore, customers will be required to finance a portion of the costs of hardware to participate in the pilot.

The pilot will leverage a significant amount of private investment and in-kind support to accomplish its goals. The exact quantity of private investment that will be leveraged by this pilot is difficult to quantify given the difficulty in separating private industry investment for strategic development goals and specific investment in accomplishing this pilot and this pilot only. Therefore, an exact dollar amount of private investment is excluded from this document.

G. *IOU ownership of customer-side resources*

i. Would the IOU own any customer-side resources? If so:

a. What resources would the IOU own, and why is IOU ownership essential for the success of this pilot?

b. Can any market actor provide this product or service, and if so, why is the IOU not utilizing market actors?

c. What is the cost differential due to IOU-ownership of customer-side resources including rate of return requirements, differences in capital and/or labor costs or IOU requirements?

d. How can the IOU develop the availability of market actors to provide products or services?

This pilot will not involve any IOU ownership of customer-side resources. All charging infrastructure that is installed as part of the pilot will be owned, operated, and maintained by the bus fleet operators.

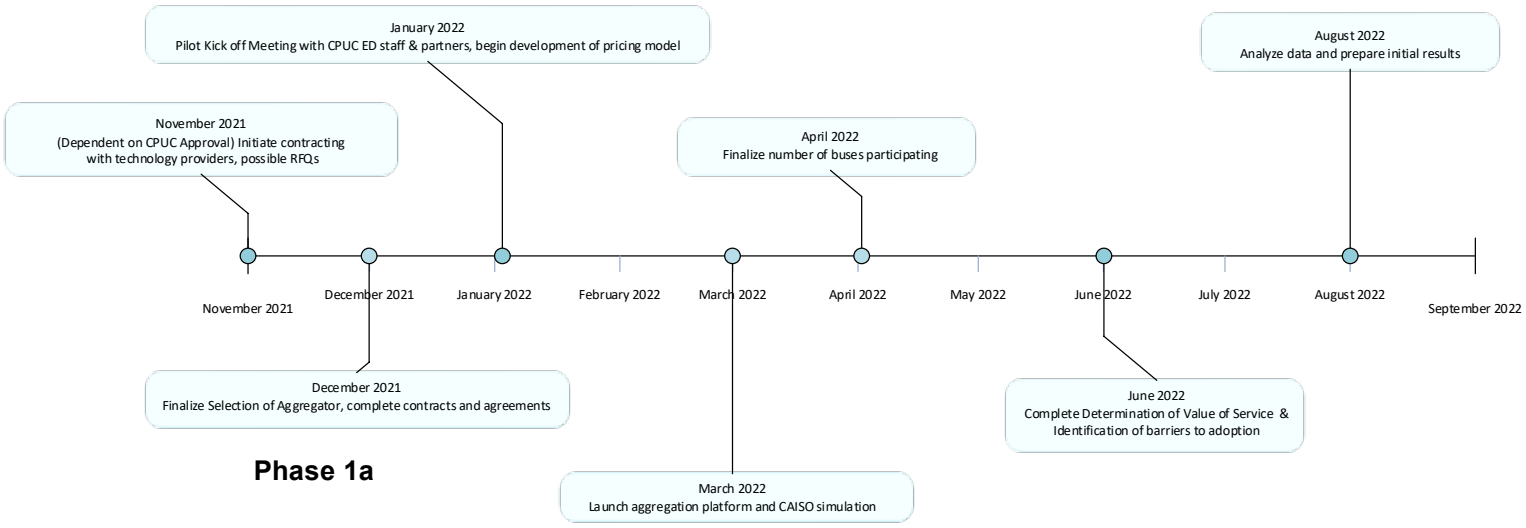
H. *Timeline*

i. Provide a flow chart describing the major stages of the pilot with milestones including (but not necessarily limited to) project initiation; key agency/partner meetings; initiation and completion of contracting (if necessary); education & outreach; installation of equipment; implementation; data collection; and evaluation.

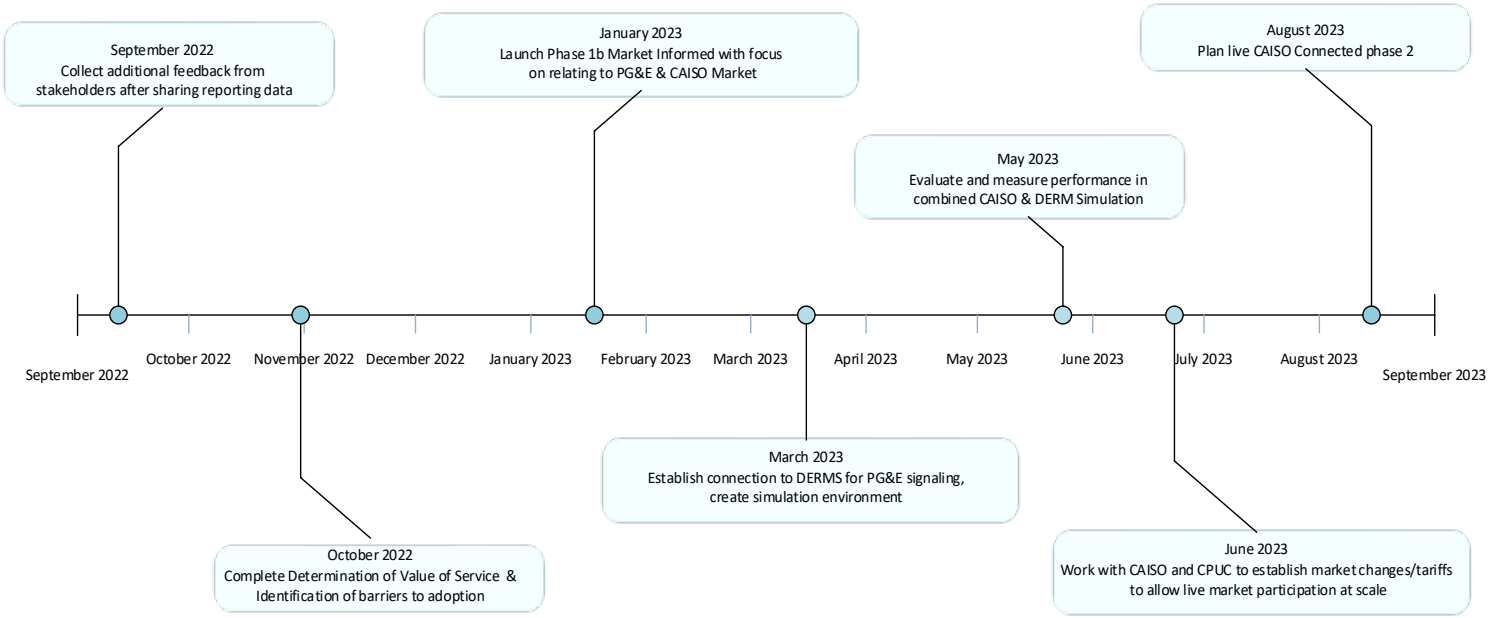
ii. Also include milestones for key sub-tasks for each of the major stages of the project so that Energy Division staff can track progress against the pilot schedule.

iii. Identify tasks that are contingent on the completion of a preceding task; and potential options if a preceding task is delayed.

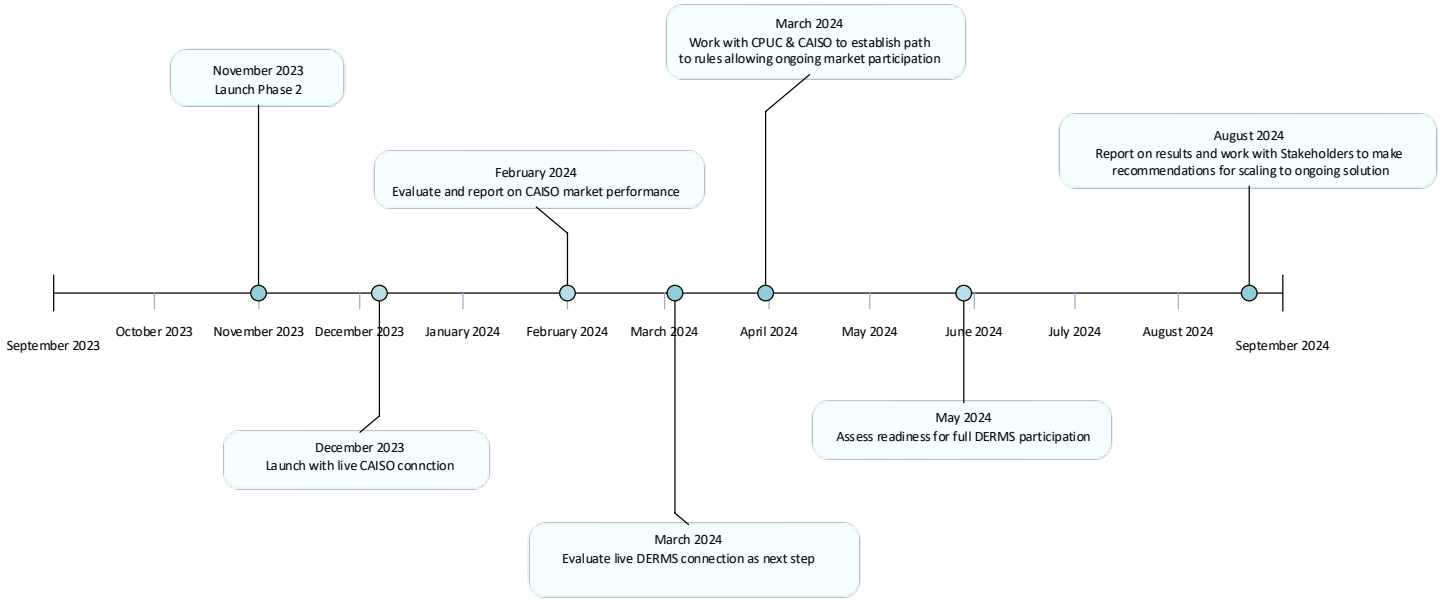
This pilot has three major stages: phase 1a (2022), phase 1b (2023) and phase 2 (2024). Phase 1a will focus on setting up and evaluated results working in a simulated CAISO environment. Phase 1b, will focus on the integration of utility side signaling to initiate events, while phase 2 will focus on live interaction with CAISO. Each stage has a data analysis component within its scope. Below are flow charts describing the major milestones in each of the three phases. The milestones for each sub-task and contingencies will be developed and shared with CPUC Energy Division staff once the pilot is approved. Any resulting changes to the major milestones will also be amended and shared at that time.



Phase 1a



Phase 1b



Phase 2

I. ***Budget detail***

i. *Proposed budget for the following types of expenses – equipment, materials, contracted goods and service, internal labor, and other (describe):*
ii. *Provide the estimated budget in nominal dollars and for the full project with escalators over its expected term.*
iii. *Estimate expense for each of the major budget categories listed below if required for this project. (This information will help the Commission and stakeholders understand the utility's expectation of the level of effort needed to support each type of activity)*
iv. *outreach;*
v. *customer participation incentives;*
vi. *electrical infrastructure make-ready (specify);*
vii. *EVSE;*
viii. *other technology and/or hardware expenses;*
ix. *technical services;*
x. *evaluation, including a proposed budget for data collection; and*
xi. *any other category of budget expense that would account for 10% or more of the total budget.*

The Joint Utilities have defined each budget category as follows:

- **Equipment:** Utility-owned instruments, data loggers, computers, networking, tools, batteries, vehicles, etc.
- **Materials:** Raw building materials such as wood, concrete, steel; signage materials, office consumables, etc.
- **Contracted Goods & Services:** External services to augment utility labor for: pilot management, marketing, customer services, web development, analysis, software aggregation, etc.
- **Internal Labor:** Utility Personnel labor for: pilot management, marketing, customer services, web development, analysis, etc.
- **Outreach:** Marketing, education, and outreach to acquire customers, present to external parties, etc.
- **Incentives:** VGI services payments to customers or aggregators in lieu of payments to customers
- **Infrastructure:** Electrical equipment and labor to provide electrical services to EV charging equipment and other supporting equipment such as local storage, etc.
- **Technology Expenses:** Any tech expenses that are not covered under tech services such as labor to repair equipment, equipment replacement.
- **EVSE:** Utility-owned EV charging equipment
- **Miscellaneous Hardware:** Hardware not covered in Equipment, Materials or Infrastructure category

- **Technical Services:** Services not covered under Contracted Goods & Services or Technology Expenses such as subscription services (i.e., EVSE networking services, data services, parts warranty, etc.)
- **Data Collection/Evaluation:** Costs for acquiring data, 3rd party analysis of results of the pilot and developing report(s) on the effort

Table 1 below details the total pilot budget broken down by the budget categories. Where funds are available, LCFS revenue will be used in favor of ratepayer dollars to cover the below mentioned pilot costs. Funding for some of the pilot activities will be provided in-kind by the technology providers (i.e., product research & development, software development, electric vehicle (EV) to electric vehicle supply equipment (EVSE) compatibility testing and customer enrollment), however, this in-kind funding being leveraged by the pilot is separate and not captured in the table below.

Table 1: Total Pilot Budget

Item	Budget	
Incentives (upfront and participation based)	$	1,210,000
PG&E Labor	$	275,000
Contracted Goods and Services	$	700,000
Data Collection/Evaluation	$	115,000
Total	**$**	**2,300,000**

This pilot has a smaller budget which is intended to support a small-scale fleet of electric school buses to focus efforts on the development of market mechanisms for capturing the value of V2G export. It is anticipated that most of the budget for this pilot will come from ratepayers.

J. Risk mitigation

i. Explain potential risks or uncertainties for key elements of the pilot (i.e., technology performance, lack of customer uptake, integration challenges, etc.), whether they can be mitigated, and if so, how? If not, what are the potential consequences for the pilot? Can the pilot identify potential risks for future programs and/or mitigation options?

PG&E has identified several risks to this pilot's success:

In each partnership opportunity being considered, buses are stated to be compatible with bidirectional chargers and vendors have built bidirectional capable chargers that are stated to be compatible with each of these vehicles. In some cases, a charger or the module that supports bidirectional charging is not yet UL certified. While we expect approvals to happen

well ahead of our timeline, there are factors out of our control that could delay such certification. It is possible that certain partners would not be able to participate based on our timeline, and in that unlikely scenario, the project start could be delayed. If this occurs, efforts to determine the incentive structure can still move forward. There will be an opportunity amend the process once the pilot is able to begin.

This pilot seeks to determine how electric vehicles can function in the CAISO market in a way that both encourages participation by EV busses at a level that meets grid needs while providing revenue and incentives sufficient to cover costs of participation. While we have reason to believe that such a mechanism will be successful there are multiple risks with our assumption:

1. The amount required to induce participation may exceed the value of that participation to the grid. While unexpected, this would require a reimagining of the pilot and may narrow the participation that can be considered.
2. There are unknowns on how such usage of electrified buses will affect the battery longevity and ultimately the warranty for these batteries. We expect our partners will move forward with the pilot project with these unknowns, but it may have some effect on the ability or timeframe to scale this to a full-service offering.
3. If this project is successful in that the resulting data shows that this is feasible and worthwhile, the ability for this to scale will depend on the ability for PG&E, CAISO and the CPUC to work together to determine and affect changes to current policy and programs to support such a solution.
4. Lastly, this pilot requires a high degree of coordination and close alignment between all partners – the utility (PG&E), technology providers (both bus manufacturers and EVSE suppliers) and the program aggregator/implementer. The pilot's success is dependent on the ability to align all entities around common goals, set clear expectations for partners and have strong project management and coordination efforts. To mitigate this risk, PG&E will assign an internal project manager, ensure agreements are in place with all partners and host regular meetings to ensure the pilot is on track and continuing to meet major milestones.

K. *Safety*

i. What safety requirements are included in the proposed pilot?

ii. Does the project(s) align with the Safety Requirements Checklist adopted in D.18-01-024, D.18-05-040, and D.18-09-034?

iii. Are any additional safety requirements needed for the pilot, and if so, what are these requirements and how will the pilot meet them?

iv. Will the pilot incur cybersecurity risks and how can they be mitigated through the pilot and/or the SCE cybersecurity workplan required by D.20-12-029 (at 85)? Will the pilot help identify cybersecurity gaps and/or develop potential solutions that could be addressed in the cybersecurity workplan?

Safety Requirements

The pilot will follow all safety requirements listed in the Safety Requirements Checklist adopted in D.18-01-024, D.18-05-040, and D.18-09-034. As an example, all participating EVSE hardware must meet the noted safety requirements, such as (1) safety testing by a Nationally Recognized Testing Lab (NRTL), (2) be designed to prevent direct contact with any live components when not plugged into an EV, (3) have no sharp edges on the EVSE connector plug and (4) the coupler between the EVSE and EV must prevent any hazardous conditions. The EVSE installation must also follow such safety requirements as compliance with California Electrical Code Article 625, the Americans with Disabilities Act (ADA) and California Building Code Chapter 11B (where applicable). Installers must be fully licensed electricians and EVTTP certified and provide proof of a performance of a full site assessment. The EVSE installation must have overcurrent protection, bollard equipment protection and concrete parking stops. Additionally, any electric vehicles that are not commercially ready (i.e., they are modified for bidirectional charging after production) will need to go through proper safety certifications by the regulating authorities (i.e., the National Highway Traffic Safety Administration (NHTSA)).

Cybersecurity

Furthermore, the pilot may incur cybersecurity risks in such that grid signals are sent via the Internet to technology providers. These cybersecurity risks will be mitigated by utilizing industry-approved and adopted open standards to relay grid signals and conditions. Our intention, barring any insurmountable hurdles, is that no proprietary standards will be used between the utility grid and the technology providers. Additionally, the technology providers will have no direct connection to utility systems and/or hardware thus reducing vulnerability. All messaging and communications between the utility and the technology providers will go through a single-entry point (i.e., centralized software platform). Likewise, the centralized software provider/program implementer will not have direct control over customer end-devices (such as the electric vehicles and/or EVSE hardware).

This pilot will require all participating EVSE hardware to have all applicable safety certifications and be Rule 21 compliant. Additionally, any electric vehicles that are not commercially ready (i.e., they are modified for bidirectional charging after production) will need to go through proper safety certifications by the regulating authorities (e.g., the National Highway Traffic Safety Administration (NHTSA)). To the degree that they apply this project, all the requirements outlined in the Safety Requirements Checklist (D.18-01-024/D.18-05-040) will be addressed. Furthermore, the pilot may incur cybersecurity risks in such that grid signals are sent via the Internet to technology providers. These cybersecurity risks will be mitigated by utilizing industry-approved and adopted open standards to relay grid signals and conditions. If all possible, no proprietary standards will be used between the utility grid and the technology providers. Additionally, the technology providers will have no direct connection to utility systems and/or hardware reducing vulnerability. All messaging and communications between the utility and the technology providers will go through a single-entry point (i.e., aggregator or

program implementer). Likewise, the aggregator/program implementer will not have direct control over customer end-devices (such as the electric vehicles and/or EVSE hardware).

V. Scale Up: Analyze potential to scale to a full utility program. *(approximately 15% of narrative)*

- **A. *What additional barrier(s), if any, would need to be overcome to scale the pilot into a full program?***
- **B. *How would the pilot be scaled if it is successful and on what timeframe?***
- **C. *Will the pilot encourage the development of new business opportunities for third-party market participants providing products and/or services?***
  - *i. How does the proposed SB 676 VGI pilot design ensure this proposal will avoid or mitigate any potential unfair competition with nonutility enterprises?*
    1. *How will the pilot lead to policies and programs that enable a variety of market actors to compete to offer services?*

Pilot success will be measured by the ability to meet stated pilot objectives and to develop proposals for the creation of long-term modifications in existing programs or the creation of new utility programs that define clear market pathways for capturing the value of bidirectional electric vehicles and equipment for customers and the electricity grid. If these metrics are met, then the next step would be to adopt the proposed policy recommendations reported by the pilot. These policy recommendations would need to be approved by the applicable regulating agencies such as California Public Utilities Commission/ (CPUC), California Independent System Operator (CAISO), California Air Resources Board (CARB), where applicable. Depending on the process for review and approval, the policy recommendations could take anywhere from 3-12 months for adoption. Therefore, the earliest a scaled program would be likely to be implemented following the pilot's completion, would be in three to twelve months, perhaps sooner if it should be possible to begin designing a program based on the preliminary data from the earlier phases of the pilot. It is PG&E's intention that a pathway to implementing such a program would be determined.

This pilot is expected to encourage the development of new business opportunities in several areas:

(1) The development of software-based solutions to enable both EV owners and fleet operators to indicate their preferences for opting-into voluntary opportunities to export energy. Such including such factors as, market price for energy, times of vehicle need/use, state of charge based on time of anticipated vehicle usage and consideration of commute distance, vehicle range, MPGe, and potentially, such factors as forecasted weather, and route topology to help determine route energy requirements.

(2) Utility programs aimed at encouraging adoption using V2G compatible equipment and commit to participation in grid events.

(3) Once sales of V2X equipment begin to scale, there may be new business opportunities for solar PV installations that include grid-forming inverters compatible with V2X vehicles, solutions that take fuller advantage of electric vehicles for resiliency use cases while allowing participation in EV-export opportunities, thus providing competition for stationary storage.

VI. Evaluation (approximately 15% of narrative)

A. ***Evaluation Plan****: As noted in D.20-12-029 "Each advice letter for a VGI pilot must contain an evaluation plan that identifies a process to determine the success of each pilot and the feasibility and desirability of scaling the pilot to a full-scale program or utilize the results to revise an existing program."*

i. Describe an evaluation plan that includes assessment of the need for ratepayer funding, effectiveness of the project for achieving the planned results, timeliness and efficiency of pilot execution, lessons learned and opportunities for improvement, and appropriateness to scale to a full utility program. Include a schedule for 1) drafting a request for proposals (RFP), 2) providing Energy Division staff time to review RFP (including draft scope of work), 3) releasing the RFP and scope of work, and 4) giving ED staff time to review RFP responses consistent with ordering paragraph 23 of D.20-12-029.

B. ***Success Indicators:*** *What criteria will the IOU use to evaluate if the pilot has been successful?*

C. ***Metrics****: What metrics from D.20-12-029 would the IOU propose to add to the SB 676 data reporting template, after receiving the concurrence of Energy Division staff, to measure the pilot's success in overcoming barriers and the program's impact on DACs and other priority populations?*

i. For example, what technical, cost, and customer engagement metrics will the IOU track, and how? What other types of data will be collected, and how? How will this data be used to determine whether to scale the pilot to a full utility program? How do the proposed metrics and data align with the metrics in the final Scorecard adopted within the TEF, if finalized by the time the VGI pilot advice letter is filed?

This main objective of this pilot is to enable revenue streams through CAISO market participation and determine pathways that would remove barriers to such participation. This pilot seeks to achieve this objective by using V2G school buses and to additionally have the generated revenue streams benefit a disadvantaged community (DAC). Additionally, this pilot seeks to perform EV export to meet capacity shortfalls at the utility level, and grid services at the CAISO level as well as to provide ancillary services and support grid reliability.

- Value (revenue) of V2G[ii] to customers;

- Value of V2G to electricity grid;
- Benefits of each V2G application tested in the pilot (i.e., customer bill management, system-level real-time energy, and EV export for grid services);
- Cost reduction in Total Cost of Ownership (TCO) due to V2G functionality with market incentives in electric vehicle ownership; and
- Creation of Pathways (existing rules & regulations) that currently inhibit positive or increased value of V2G to customers and/or the electricity grid.

A successful pilot will be measured by achieving the above-mentioned metrics. The goal is to enroll a minimum of one small to bus fleet, demonstrate that the pilot incentive influenced & accelerated an additional revenue stream, and demonstrate that bidirectional capabilities and participation of bidirectional electric vehicles in grid services reduces the total cost of ownership of electric vehicles. If the cost-benefit analysis of bidirectional electric vehicles demonstrates benefits for both customers and the electricity grid, PG&E may recommend scaling the pilot to a full-scale utility program. Whether this means adapting existing utility tariffs and rules to allow bidirectional electric vehicles participation and/or creating an entirely new program will depend on the exploration and outcomes of this and our other pilot projects.

Finally, until bidirectional electric vehicle and charging technology becomes ubiquitous and equal in cost to non-bidirectional electric vehicle and charging technology, incentives may be needed in the near-term to continue accelerating market adoption and creating a sustainable, robust fleet of distributed bidirectional energy resources. Funding of incentives may need to come from ratepayer dollars. Before authorizing use of ratepayer funding to cover a long-term program of incentives, a detailed cost-effectiveness analysis is prudent to quantify the impact on ratepayers, utilities, customers, and society.

VII. Other (approximately 5%-10% of narrative)

N/A.

VIII. Summary and conclusion (approximately 5%-10% of narrative)

PG&E's Exploring V2X Export Value Pilot is focused on creating positive revenue streams to capture value from V2X school e-buses classes 2b-8, performing EV export to meet capacity shortfalls at the utility level and grid services at the CAISO level.

Pilot success will be measured by its ability to demonstrate significant additional revenue generation through participation in energy markets and the resulting opportunities to demonstrate the case for policy changes to support the transition to a scalable implementation.

If successful, this pilot has the potential to advance Vehicle-Grid Integration (VGI) strategies, such as retail rate reform, the use of EVs for bidirectional non-grid-export power to support resiliency and developing necessary interconnection rules to allow the use of EVs for

bidirectional grid-export power to support grid-facing use cases adopted by VGI Decision, D.20-12-029. VGI strategies are key in achieving California's goals of carbon-neutrality by 2045 and 5 million zero-emission vehicles and 250,000 charging ports by 2030. VGI has the potential to accelerate EV adoption, reduce costs to ratepayers, support further decarbonization, accelerate the reduction of carbon and criteria air pollutant[iii] emissions from the transportation sector and improve grid resiliency. For these reasons, PG&E recommends approval of the Exploring V2X Export Value Pilot by the Commission.

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[i] Final Report of the Joint Agencies Vehicle-Grid Integration Working Group, June 30, 2020, Appendix A retrieved from 355243149.pdf (ca.gov)

[iii] Criteria Pollutants as defined by the Clean Air Act. See: Criteria Air Pollutants | US EPA

PG&E Gas and Electric
Advice Submittal List
General Order 96-B, Section IV

AT&T
Albion Power Company

Alta Power Group, LLC
Anderson & Poole

Atlas ReFuel
BART

Barkovich & Yap, Inc.
California Cotton Ginners & Growers Assn
California Energy Commission

California Hub for Energy Efficiency Financing

California Alternative Energy and Advanced Transportation Financing Authority
California Public Utilities Commission
Calpine

Cameron-Daniel, P.C.
Casner, Steve
Cenergy Power
Center for Biological Diversity

Chevron Pipeline and Power
City of Palo Alto

City of San Jose
Clean Power Research
Coast Economic Consulting
Commercial Energy
Crossborder Energy
Crown Road Energy, LLC
Davis Wright Tremaine LLP
Day Carter Murphy

Dept of General Services
Don Pickett & Associates, Inc.
Douglass & Liddell

East Bay Community Energy Ellison Schneider & Harris LLP Energy Management Service
Engineers and Scientists of California

GenOn Energy, Inc.
Goodin, MacBride, Squeri, Schlotz & Ritchie
Green Power Institute
Hanna & Morton
ICF
IGS Energy
International Power Technology
Intestate Gas Services, Inc.
Kelly Group
Ken Bohn Consulting
Keyes & Fox LLP
Leviton Manufacturing Co., Inc.

Los Angeles County Integrated Waste Management Task Force
MRW & Associates
Manatt Phelps Phillips
Marin Energy Authority
McKenzie & Associates

Modesto Irrigation District
NLine Energy, Inc.
NRG Solar

Office of Ratepayer Advocates
OnGrid Solar
Pacific Gas and Electric Company
Peninsula Clean Energy

Pioneer Community Energy

Redwood Coast Energy Authority
Regulatory & Cogeneration Service, Inc.
SCD Energy Solutions
San Diego Gas & Electric Company

SPURR
San Francisco Water Power and Sewer
Sempra Utilities

Sierra Telephone Company, Inc.
Southern California Edison Company
Southern California Gas Company
Spark Energy
Sun Light & Power
Sunshine Design
Tecogen, Inc.
TerraVerde Renewable Partners
Tiger Natural Gas, Inc.

TransCanada
Utility Cost Management
Utility Power Solutions
Water and Energy Consulting Wellhead Electric Company
Western Manufactured Housing Communities Association (WMA)
Yep Energy