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Pacific Gas and Electric Company comments on Vehicle Grid Integration Roadmap Update

Additional submitted attachment is included below.

Pacific Gas and Electric Company
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November 21, 2018

California Energy Commission
California Public Utilities Commission
California Air Resources Board
California Independent System Operator

Docket Office, MS-4
1516 Ninth Street
Sacramento, CA 95814
Docket No: 18-MISC-04
Project Title: Vehicle Grid Integration Roadmap Update

Submitted via online docket

Re: Staff Workshop on the California Vehicle-Grid Integration Roadmap Update Oct 29-30

Pacific Gas and Electric Company (PG&E) appreciates the opportunity to provide feedback to the California Energy Commission (CEC), California Public Utilities Commission (CPUC), California Air Resources Board (CARB), and California Independent System Operator (CAISO), on the recent Staff Workshop on the California Vehicle-Grid Integration (VGI) Roadmap Update.

In addition to our attached detailed comments on the California Vehicle-Grid Integration Roadmap Matrix (Attachment 1), we submit for your consideration the following brief high-level comments on the VGI Roadmap Update:

- We believe that identifying and quantifying the value (benefits and costs) of VGI is a priority.
- We support collaboration and data-sharing on EV load shapes, and we encourage better leveraging of existing efforts that incorporate EV forecasting and load-profile modeling, including those within the CEC's IEPR and CPUC's IRP processes.
- We emphasize the importance of coordinating VGI efforts with those addressing other distributed energy resources (DERs), including on topics related to value quantification, planning, and policy.
- We support the emphasis on end-to-end cybersecurity solutions for VGI.
- We support close coordination, as well as clear mapping and sequencing of roles and responsibilities, for the various state agencies in the VGI space.
- It is not clear to us how the Policy, Planning, and Market Interaction Framework is relevant to and will be used in the context of the VGI Roadmap Update, so we refrain from providing detailed comments on this Framework until its structure and purpose are further clarified.

Thank you for your consideration of our comments.

Sincerely,

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Stephanie Greene
Director, Clean Transportation
Pacific Gas and Electric Company

Attachment 1 – PG&E Comments on Vehicle Grid Integration Roadmap Update: Matrix of Goals, Issues, Action, Responsible Organization(s), and Priority

11/21/2018

PG&E Comments on Vehicle Grid Integration Roadmap Update: Matrix of Goals, Issues, Action, Responsible Organization(s), and Priority

Number	Goal	PG&E comments on Goals
E1.1	Estimate the economic potential for Vehicle-Grid Integration under medium (2030) and long term (2050) scenarios.	PG&E believes that VGI is potentially an important factor for mass EV adoption. Given California's ambitious goal of reaching 5 million zero-emission vehicles (ZEV) by 2030, we recommend that this VGI Roadmap focuses the assessment of economic and market potential on that more near-term period. If time and resources allow, the assessment of economic potential can be extended to 2050. In addition, PG&E strongly recommends that both costs and benefits be accounted for in the assessment of economic potential. Furthermore, PG&E strongly recommends that the economic assessment covers a collectively exhaustive list of the various use-cases of VGI, consistent with the recommendations from the 2014 VGI Roadmap. This includes, but is not limited to, the costs and benefits of VGI associated with all: - User sectors: residential, commercial (i.e. fleet, workplace, and public), and ride-share - Types: V1G, and V2G including V2B - Applications: customer load management, distribution and transmission reliability services, wholesale energy and resource adequacy services. Here, PG&E recommends that the VGI applications be framed and categorized based on CPUC's ongoing effort addressing Multi Use Applications (MUA) for battery storage. For a full list of these applications, we refer to "Table 1: CPUC's MUA Decision's List of Domains and Services" on page 3 of Appendix A; Multiple-Use Applications for Energy Storage: Final Working Group Report (R.15-03-011). - Approaches: indirect control (price signaling), direct control (dispatching) - Vehicle classes: LDV, MDV, and HDV, including non-road classes - Charging types: AC (L1 and L2) and DC Therefore, we recommend that this goal be updated to: "Assess and quantify the costs and benefits for the various Vehicle-Grid Integration use-cases under short- (2022), medium- (2025), and long-term (2030) scenarios."
E1.2		
E1.3 (unchanged)		
E1.4		
E1.5		
E2.1	Identify promising business models for self-sustaining private development of infrastructure and markets for VGI	
E2.2		
E2.3		
E3.1	Reduce cost of electrification by measuring how emerging opportunities can utilize vehicle-grid integration technologies	
E3.2		
E3.3 (unchanged)		
C1.1	Prioritize and track the benefits of managed PEV charging to low-income consumers and disadvantaged communities.	
C1.2 (unchanged)		

PG&E Comments on Vehicle Grid Integration Roadmap Update: Matrix of Goals, Issues, Action, Responsible Organization(s), and Priority

Number	Goal	PG&E comments on Goals
C2.1	Enhance the consumer experience.	
C2.2 (unchanged)		
C2.3 (unchanged)		
C2.4		
C2.5		
C3.1	Increase the potential number of and readiness of future EVSE site hosts.	
C3.2		
~~C3.3~~		
~~C3.4~~		
~~C3.5~~		
T1.1.1	Improve cybersecurity	PG&E agrees with this goal, and emphasizes its importance. To add more clarity, PG&E suggests rephrasing this goal to: "Ensure proper cybersecurity measures along the full chain of VGI assets"
T2.1.1 (unchanged)	Advance communication and hardware technology standardization and interoperability	PG&E believes that the goals related to VGI communication hardware, software, standards, and solutions should be consistent with and based on the findings of the Interagency VGI Communication Protocol Working Group, as documented and made publicly available in the draft final report. Similarly, PG&E believes that advancing interoperability should be consistent with current regulatory efforts in that domain, including CARB's rulemaking on SB 454. Therefore, PG&E recommends rephrasing this goal to: "Advance VGI communications and interoperability hardware, software, standards, and solutions based on and consistent with previous and ongoing interagency efforts."
T2.2.1		
T2.3.1		
T2.4.1		
T3.1.1	Develop advanced battery and charging technologies	
T3.2.1		
T3.3.1		
T3.3.2		
T4.1.1	Improve technology transfer between stakeholders	
T4.1.2		
T5.1.1* (unchanged)	Identify scenarios and cost targets for future technology research and development	PG&E notes that the targets need not be limited to "cost" targets. Therefore, we recommend rephrasing this Goal to: "Identify scenarios and targets for future technology research and development."

PG&E Comments on Vehicle Grid Integration Roadmap Update: Matrix of Goals, Issues, Action, Responsible Organization(s), and Priority

Number	Goal	PG&E comments on Goals
P1.1 P1.2 P1.3 ~~P1.4~~ P1.4~~5~~	Frame the interactions between policy initiatives, market push, and demand pull factors that are required for achieving widespread deployment of managed charging and grid reliability goals and propose changes to EV deployment plans and VGI policy to address gaps.	PG&E recommends distinguishing between two distinct and important goals here: (1) "Identify, frame, and coordinate potential interactions, and resolve potential overlaps or conflicts, between the various state agencies and bodies on VGI-related policies, legislations, regulations, and programs" (2) "Ensure all stakeholders are aware of, and have the opportunity to access and engage on, mandated VGI-related policies, regulations, and programs"
P2.1 ~~P2.2~~	Identify the current and emergent needs of the electric grid and where feasible, determine the potential benefits from managed electric vehicle charging	Current and emergent grid needs go well beyond the scope of VGI. Therefore, we recommend clarifying and focusing this Goal, to address how current policy-related activities can enable EVs as a grid resource. Therefore, we recommend rephrasing this Goal to: "Continue to develop policy and regulatory frameworks that can enable EVs as a grid resource, in accordance and consistent with similar efforts on other DERs"
P3.1 P3.2	Align stakeholders' interests in robust open markets for smart infrastructure investment	PG&E recommends rephrasing this Goal to: "Align stakeholders' interests through robust market mechanisms and coordinated policy and regulatory efforts, to facilitate smart infrastructure investment"

PG&E Comments on Vehicle Grid Integration Roadmap Update: Matrix of Goals, Issues, Action, Responsible Organization(s), and Priority

Number	Problem/Issue - Initial Proposal (9/6/18)	Problem/Issue - Incorporated Comments (10/29/18)	PG&E comments on Issues (10.29.2018)	PG&E comments on Action	PG&E comments on Responsible Organization(s)	Priority
E1.1	Various scenarios of electric vehicle charging load shapes (system wide and disaggregated) are needed for effective utility resource planning. Planning frameworks must value grid integration and smart charging to minimize the costs of electrification.	Planning frameworks should account for one-way and two-way charging, yet limited data and data sharing of EV load shapes makes it challenging to characterize the various scenarios of electric vehicle charging load shapes.		(1) Encourage voluntary information- and data-sharing on EV load shapes, for various (a) EV classes (i.e. light-duty vehicles (LDV), medium-duty vehicles (MDV), and heavy-duty vehicles (HDV)), (b) charging/discharging types (e.g. unmanaged, managed/V1G, and V2G), and (c) charging modes (e.g. L1, L2, and DCFS). Such information-sharing should be encouraged especially for projects, pilots, and studies that receive public funding from the CEC. (2) Better leverage existing efforts that incorporate EV load forecasting and EV load-profile modeling, including those within the CEC's IEPR and CPUC's IRP processes. (3) Explore the need for an interagency EV Load Profile Working Group that aims to: (a) synthesize and document currently available information and efforts, (b) share best-practices on modeling and forecasting methodologies, and (c) identify gaps and recommendations, for EV load shapes associated with the various EV classes, charging types, and charging rates. In that regard, it might be also useful to explore the potential for defining and distinguishing between "existing" load shapes and "ideal/optimized" load shapes in EV forecasting. (4) Augmenting (1-3) above, we recommend that the CEC consider establishing a publicly accessible platform that includes, among other potential functionalities, a repository/catalog of existing and modeled EV load shapes Finally, PG&E notes: initiatives that do not involve commercial-scale, cost-effective utility infrastructure and services to support safety and reliability should be funded by public funds, not utility customer funds (e.g. by CEC through its non-ratepayer funded R&D budget, by U.S. Department of Energy funds, etc.).	(1) All stakeholders (2) All stakeholders (3) CEC, all stakeholders (4) CEC	High

PG&E Comments on Vehicle Grid Integration Roadmap Update: Matrix of Goals, Issues, Action, Responsible Organization(s), and Priority

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E1.2	Analyzing the supply push from solutions providers (i.e., automakers, equipment manufacturers, electric vehicle service providers, aggregators, and infrastructure installers) is needed to forecast the smart charging market and holistically assess the benefits of VGI to the state.	Resource planning does not fully reflect the technological capabilities of suppliers (automakers, equipment manufacturers, aggregators and infrastructure installers) including the potential for Vehicle-to-Grid (V2G) products. Assessments of the charging market do not yet include the demand from light, medium, heavy, and other types of transportation to allow for stakeholders to understand the scale of the problem.	PG&E notes that, in relation to VGI specifically, CPUC IRP process has factored in the modeling and integration of V1G technological capabilities (i.e. smart charging) , given their relative commercial maturity. It would be useful to include V2G technological capabilities, and it may be currently possible through sensitivity analysis that explores wide ranges of scenarios in the IRP process. However, it would be foundational to focus on V1G in the short-term, especially while the commercial viability and operational robustness of V2G continues to evolve and be validated.	Continue current efforts of progressively improving resource planning to capture new and mature technological solutions related to EV charging, consistent with the guidance in existing regulations and processes overseeing resource planning by the various state agencies. Specifically, PG&E recommends that the CPUC IRP process continue to examine the system benefits of flexible charging in the context of maintaining system reliability and meeting the state's RPS and GHG reduction goals. Ultimately, the IRP process can help estimate the system benefits of flexible charging, and these benefits should be compared against additional costs and/or benefits related to transmission, distribution, and charging infrastructure, in order to determine the full set of cost/benefit streams. In addition, future CPUC IRP cycles may also be able to consider and incorporate V2G, when proper operational models of V2G are developed.	CPUC, utility/grid operator	

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E1.3 (unchanged)	There is limited information on value to customers and ratepayers from V1G, V2G, and/or V2B. Some pilots have been completed and others are underway, however analysis is needed across user segments, across infrastructure design types, and under various policy scenarios for both direct beneficiaries and ratepayers at large.	There is limited information on value to customers and ratepayers from V1G, V2G, and/or V2B. Some pilots have been completed and others are underway, however analysis is needed across user segments, across infrastructure design types, and under various policy scenarios for both direct beneficiaries and ratepayers at large.	PG&E agrees that there is a need to quantify the value (both costs and benefits) associated with the various VGI use-cases, as well as how that value is distributed and captured by the various parties. For clarity, we recommend that this issue be split into two distinct issues: (1) "There is limited information on the value of the various VGI use-cases, each of which can be defined along multiple dimensions, including but not limited to: - User sectors: residential, commercial (i.e. fleet, workplace, and public), and ride-share - Types: V1G, and V2G including V2B - Applications: customer load management, distribution and transmission reliability services, wholesale energy and resource adequacy services - Approaches: indirect control (price signaling), direct control (dispatching) - Vehicle classes: LDV, MDV, and HDV, including non-road classes - Charging types: AC (L1 and L2) and DC" (2) "There is limited information on how the value of each VGI use-case is distributed among and captured by the various parties, including the participant, ratepayer-at-large, utility, service-provider, OEM, society, etc."	PG&E recommends the following list of actions related to VGI value: (1) Efforts aiming to quantify the value of VGI, especially those publicly funded, should account for both benefits and costs. (2) PG&E supports an interagency effort (e.g. complete Tasks 2 of the Vehicle-Grid Integration Communication Protocol Working Group (VGIWG)) focused on developing a broad framework that accounts for VGI benefits and costs. Among other considerations, it would be important for such framework to include: (a) VGI value (benefit and cost) "generation" through the various use-cases (e.g. different applications, different vehicle classes); (b) VGI value (benefit and cost) "distribution" among the various parties involved (e.g. participant/driver, utility customers, service providers, broad society, etc.). Such framework should also leverage and not contradict existing efforts, methods, and processes to quantify the value of other DERs. (3) Identify and distinguish between VGI value both at the (3a) project-level (e.g. upgrades of individual chargers to include smart-charging capabilities) as well as at the (3b) system-level (e.g. additional charging infrastructure as daytime charging increases to consume otherwise curtailed renewable energy). (3a) VGI pilots, especially those receiving public funding, should be strongly encouraged to quantify the value (benefits and costs) of VGI on the project-level. Large-scale demos can also be helpful here. (3b) Some studies have started to investigate the system-level value of VGI use-cases, but more work is needed to (i) better characterize costs and (ii) cover additional use-cases. (4) PG&E supports an initiative to compare all existing studies on VGI value (benefits and costs), and to advice on best-practices, consistent with DER methods, to account for VGI benefits and costs. Finally, PG&E notes: initiatives that do not involve commercial-scale, cost-effective utility infrastructure and services to support safety and reliability should be funded by public funds, not utility customer funds (e.g. by CEC through its non-ratepayer funded R&D budget, by U.S. Department of Energy funds, etc.).	(1) All stakeholders (2) Interagency Working Group (3a) Stakeholders managing VGI pilots (3b) All stakeholders (4) Interagency, CEC-coordinated	High

PG&E Comments on Vehicle Grid Integration Roadmap Update: Matrix of Goals, Issues, Action, Responsible Organization(s), and Priority

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E1.4	There are various valuation tools for estimating how future energy scenarios, including those with high rates of PEV adoption, achieve equity/societal and decarbonization goals, however the effectiveness of such tools require a high-level assessment of how VGI is characterized.	Valuation tools examine VGI at different scales for varying purposes including: future scenarios with high decarbonized electrification, integrated resource planning, and distribution resource planning. However effective valuation of VGI in each of those tools requires accurately characterizing how electric vehicles would act as a DER and the potential for them to offer services.		PG&E recommends a combination of actions, which, together, can help address this issue: (1) Action on E1.1: better characterization of EV load profiles (2) Action on E1.3: (a) alignment on VGI value framework; (b) documentation of and distinction between VGI value on project-level versus system-level (3) Leverage existing DER value frameworks, quantification methodologies, and processes. For example, PG&E recommends considering that the VGI applications be framed and categorized based on CPUC's ongoing effort addressing Multi Use Applications (MUA) for battery storage. For a full list of these applications, we refer to "Table 1: CPUC's MUA Decision's List of Domains and Services" on page 3 of Appendix A; Multiple-Use Applications for Energy Storage: Final Working Group Report (R.15-03-011). (4) Leverage existing regulatory framework for definition of distribution-grid services developed as part of guidance, planning and evaluation of Integrated Distributed Energy Resources. See page 8 of report R.14-10-003 "DECISION ADDRESSING COMPETITIVE SOLICITATION FRAMEWORK AND UTILITY REGULATORY INCENTIVE PILOT"	All stakeholders	High
E1.5		Utility electric tariffs are a core market signal for charging management, but may hinder electrification of various vehicle segments if design elements (e.g. non-coincident demand charges) pose uneconomic operations. Further, tariffs are not designed at sufficient locational or temporal resolution to avoid coincident loading, improve operational efficiency, or integrate renewables. Other market signals in addition to tariffs may be needed to provide stakeholders valuable opportunities to manage grid conditions.	PG&E disagrees with the statement that "tariffs are not designed at sufficient locational or temporal resolution to avoid coincident loading, improve operational efficiency, or integrate renewables." Does CEC staff have evidence to support this assertion? While we believe recent efforts focusing on testing and piloting "locational and temporal" TOUs are innovative, there is no clear evidence of a consensus among customers in California that additional "locational or temporal" resolution is preferred or needed. For example, this lack of consensus on the preference for more dynamic EV charging rate among all customers and for all use-cases was one of the main findings in EPRI's 2018 Technical Report titled "Commercial Electric Vehicle Rate Design; Stakeholder Interview Results." PG&E agrees that other market signals, including participation in DR programs for example, can complement current TOU tariffs and can be suitable to provide stakeholders additional valuable opportunities to manage grid conditions.	(1) Continue to gather, document, assess, and share customer feedback from pilots testing "locational and temporal" TOU rates. (2) Continue to explore, evaluate, and refine market signals, programs, and business models that can provide stakeholders valuable opportunities to manage grid conditions through EVs. Leveraging DR as a technology-agnostic platform to offering load curtailment, load increase, and even net-export services may be one promising way to "provide stakeholders valuable opportunities to manage grid conditions" in addition to and beyond tariffs.	(1) Stakeholders (utilities) currently piloting "locational and temporal" TOU rates; CPUC (2) CPUC, CAISO, industry stakeholders	

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E2.1	A lack of seamless grid integration of mobile resources across utility service territories and their different rate structures and policies may hinder the interoperability of PEVs and the large scale adoption of PEVs. Analysis of this seamless integration is needed including the range of cost for the different ways of communicating utility schedules with vehicle charging schedules.	A lack of interoperable smart charging does not ensure that technologies employed in plug-in hybrid and electric vehicles work in a harmonious manner and across service territories. This may inhibit the large scale mobility of PEVs, which travel between charging networks and service areas. The cost impacts on vehicle and equipment manufacturing design for multiple ways of communicating between utilities, charging stations, and vehicles is unknown.	PG&E agrees that interoperability of smart inverter and smart charging is an important issue. That said, the lack of interoperable smart inverter and smart charging infrastructure is a challenge that extends beyond the utilities' service territories in California, and even beyond the State's borders, which makes it hard to address in this VGI Roadmap. PG&E recommends focusing the scope of this Issue, and rephrasing as follows: (1) "Lack of certification standards for interoperability that are widely accepted and adopted by the industry" (2) "Lack of demonstration projects to understand and quantify the cost and benefit impacts of multiple ways of communicating between utilities, charging stations, and vehicles"	PG&E makes three recommendations related to interoperability: (1) Consensus is needed among EV and EVSE makers/stakeholders on interoperability and communication standards. Ideally, EV and EVSE providers would align and provide certainty on interoperability and communication standards for all EV classes (e.g. LDV, MDV, HDV), charging modes (e.g. L1, L2, DCFS, wired, wireless), and charging/discharging types (e.g. V1G, V2G, V2B) (2) If (1) above is not yet possible, large-scale demonstrations (demos) are needed to test, validate, evaluate, and quantify the cost and benefit impacts of: (2a) implementing the different EV-EVSE interoperability and communication standards; and (2b) integrating the different EV and/or EVSE interoperability standards with existing standards "upstream" from the EVSE; i.e. to ensure proper communication and integration with EVSP and the grid. PG&E emphasizes three considerations related to these large-scale demos: - First, both (2a) and (2b) above are necessary and required. Limiting the scope of the proposed large-scale demos to (2a) is not sufficient. - Second, the large-scale demos should cover multiple potential interoperability and communication standards, especially those short-listed as favorable in the VGIWG draft final report as well as those required for compliance with Rule 21. - Third, in the absence of consensus on interoperability and communication standards, stakeholders should at least align on a list of criteria that interoperability and communication standards should meet, and be tested and validated against. Such criteria should include end-to-end cybersecurity and grid reliability. (3) Need for stronger coordination between state agencies to align and streamline rulemaking on issues related to interoperability and communication standards, in order to avoid added costs and duplicated or contradictory efforts. Importantly, (2) and (3) are needed and can help inform and accelerate the fulfillment of (1). Finally, PG&E notes: initiatives that do not involve commercial-scale, cost-effective utility infrastructure and services to support safety and reliability should be funded by public funds, not utility customer funds (e.g. by CEC through its non-ratepayer funded R&D budget, by U.S. Department of Energy funds, etc.).	(1) EV and EVSE makers/ stakeholders (2) All industry stakeholders (3) State agencies	

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E2.2	Limited aggregation models available to third-parties across the load serving entities (IOU, CCE, POUs) have inhibited the scale-up of managed charging.	Third parties do not have access to scalable managed charging models across the load serving entities. The creation or refinement of aggregation models (regarding baseline calculations, multiple program and use participation, resource scheduling) is needed.	PG&E does not completely agree with the statement that "Third parties do not have access to scalable managed charging models across load serving entities." Specifically, it is not clear what level of scalability is addressed here. As an example, within PG&E service territory, it is possible to aggregate EVs to provide DR service from both bundled (i.e. PG&E) as well as unbundled customers. In fact, third-party EVSPs have taken advantage of existing programs such as the Demand Response Auction Mechanism (DRAM). PG&E broadly agrees that work is still needed to further refine aggregation opportunities and solutions based on specific grid needs, consistent with current undergoing efforts guided by the CPUC and the CAISO.	PG&E makes two recommendations for action: (1) There is a wide range of active DR proceedings/workshops at the CPUC and CAISO regarding enhancing existing aggregation models to easily integrate DERs such as EVs. For example, the recently approved CAISO's ESDER phase 3 is enhancing the current CAISO PDR model to capture the unique characteristics of EVs, which results in EV specific options (e.g. energy baselines). More work is needed on that front, and PG&E recommends continuing these efforts, including CAISO's new ESDER phase 4 starting in Q1 2019. (2) More broadly, looking into the future, PG&E recommends continuing the efforts on aggregation models that focus on the distribution grid. Aggregation models focused on granular and local areas (e.g. bank/circuit level aggregation) may become increasingly important for grid needs, given the distinct topology and resource composition.	CPUC, CAISO, EVSE, EVSP, utility/grid operator	

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E2.3	There is limited understanding of "unbundling" (or the separate-purchase of) charging equipment and charging services, and the impact unbundling may have on the grid and market.	There is limited understanding of "unbundling" (or the separate-purchase of) charging equipment and charging services, and the impact unbundling may have on the grid and market and how unbundling charging aligns with unbundling other DERs."	For clarity, PG&E recommends rephrasing this problem/issue to: "There is limited understanding of "unbundling" (or the separate-purchase of) charging equipment and charging services, and the impact unbundling may have on the grid and market. There is also limited understanding of how unbundling for EV charging impacts other DERs."	PG&E believes that the market will ultimately dictate what the composition of "unbundling" will look like, based on innovative and evolving business models and shaped by current and potentially new players. The involvement of utilities/grid operators will continue to be necessary, both to (1) coordinate and advise on unbundling impact on other DERs and to (2) ensure grid reliability.	All stakeholders	
E3.1	Autonomous, Connected, Electric, Shared (ACES) vehicles have unverified impacts on future electricity demand, traffic flow, and greenhouse gas emissions.	Traffic and driving pattern information could be utilized to improve the predictability of load planning and reliability of aggregation, bridging the divide between metropolitan transportation planning and utility planning and operations. Further, Autonomous, Connected, Electric, Shared (ACES) vehicles have unverified impacts on future electricity demand, traffic flow, and greenhouse gas emissions.		(1) Leverage traffic and driving-pattern data, especially that available from public agencies, to further inform the modeling of EV load profiles for smart/managed charging as well as V2G. One venue to coordinate this effort is through the proposed EV Load Profile Working Group in E1.1. The involvement of rideshare stakeholders (e.g. Transportation Network Companies) and public transit agencies that use or plan on using electric vehicles would be important and useful. PG&E also encourages the involvement of Metropolitan Transportation Planning agencies in this effort, as they may have access to local level driving patterns that would be useful. (2) Encourage and fund efforts (e.g. studies, pilots, and programs) to characterize, evaluate, and commercialize VGI solutions for rideshare applications. (3) Fund efforts (e.g. studies and pilots) to assess and quantify the value of VGI opportunities for ACES. In addition, evaluate ACES potential impact on the grid under various assumptions on ACES and VGI adoption. It may be more efficient to focus on (1) and (2) above in the short-term with plans to focus on (3) in the longer term. Finally, PG&E notes: initiatives that do not involve commercial-scale, cost-effective utility infrastructure and services to support safety and reliability should be funded by public funds, not utility customer funds (e.g. by CEC through its non-ratepayer funded R&D budget, by U.S. Department of Energy funds, etc.).	(1) Public transit, rideshare, metropolitan transportation planning agencies and other relevant state agencies (2) Rideshare, utility/grid operator, other industry stakeholders, state agencies (3) ACES industry stakeholders, academia, state agencies	

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E3.2	Electrification and charging infrastructure operations can positively impact the development of sustainable communities and smart cities, but viable models are unproven or developing.	Electrification and charging infrastructure operations can positively impact the development of sustainable communities and smart cities. For example, an aggregation of V2G vehicles connected to an electrified garage could provide cost management and resiliency services to a microgrid of surrounding buildings while reducing real estate allocated for stationary storage. However, viable models are unproven or developing given strong stakeholder interest.	While PG&E broadly agrees with the example presented in this section on the potential ability of aggregated V2G-enabled EVs to provide cost-management and resiliency services, it is not clear what the VGI problem/issue here is. The statement "However, viable models are unproven or developing given strong stakeholder interest" is not clear.			
E3.3 (unchanged)	Characterizing the grid impacts of large scale transportation electrification for medium-duty and heavy-duty vehicles is needed to provide reliable service and minimize grid upgrade costs.	Characterizing the grid impacts of large scale transportation electrification for medium-duty and heavy-duty vehicles is needed to provide reliable service and minimize grid upgrade costs.	While PG&E broadly agrees with this statement, it's not clear what the VGI problem/issue here is. Some efforts have already started addressing this topic, including pilots (e.g. PG&E's Priority Review Project with the San Joaquin Regional Transit District) and studies (e.g. California Transportation Electrification Assessment Phase 3-Part A: Commercial and Non-Road Grid Impacts – Final Report).	PG&E recommends the continuation and update of efforts aiming to characterize the grid impacts of large scale transportation electrification for medium-duty and heavy-duty. In that regard, we reiterate our recommendations for actions (1) and (2) proposed in E1.1 to better characterize the load shapes of medium- and heavy-duty vehicles.	All stakeholders	
C1.1	Current utility resource planning does not take into account the environmental and air quality outcomes from shifting how power plants operate (in response to managed PEV charging) near low-income and disadvantaged communities.	A lack of data and analytical methods in current utility resource planning prohibits accounting for the environmental and air quality outcomes from electrifying transportation and changes to electric generator operations resulting from smarter PEV charging, particularly in and near low-income and disadvantaged communities.	PG&E agrees that existing IRP guidelines did not provide sufficient methodologies to allow all LSEs to calculate air quality emissions, particularly in relation to smart PEV charging. Future cycles of the CPUC IRP process should expand the clean-net-short GHG accounting tool to consider air quality emissions as well. Further methods will need to be developed before a judgement can be made on how local shifts in electric load shapes from VGI may impact local air emissions. PG&E encourages the CEC and other agencies to focus on the avoided emissions from transportation electrification, which we expect will generally be significantly larger than the potential impact of VGI solutions on electric sector emissions.	PG&E recommends that the CPUC IRP process continue to develop methods for estimating LSE-level air pollution emissions associated with LSE generation portfolios. Once developed, these models would likely be able to help estimate how different EV charging profiles impact power plant emissions.	State agencies (including CPUC IRP process and CARB)	

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C1.2 (unchanged)	Current metrics, such as those in the SB 350 Equity Indicators, do not report all charging infrastructure investment or smart charging customer enrollment.	Current metrics, such as those in the SB 350 Equity Indicators, do not report all charging infrastructure investment or smart charging customer enrollment.	PG&E makes two notes here. First, it is not clear how reporting "all charging infrastructure investment" is related to VGI. Second, beyond EV-specific Time of Use (TOU) rates and VGI pilots that are limited in scope, few smart-charging programs are currently available to the public. As smart-charging programs expand, this issue might get automatically resolved. Therefore, PG&E suggests that this issue focuses on the need for expanding smart-charging programs rather than on the reporting associated with these programs.	PG&E recommends coordinating and streamlining the reporting requirements related to VGI across all state agencies, in order to avoid added costs and potential duplicated efforts	State agencies	
C2.1	Important consumer information, such as optimal times for charging and managed charging methods, incentives, and utility bill savings, is not disseminated at the scale necessary to achieve PEV goals.	While important consumer information, such as optimal times for charging and managed charging and discharging methods, incentives, and utility bill savings, are being disseminated, consumers do not always understand the benefits of managing their charging behaviors without compromising their mobility.				
C2.2 (unchanged)	All makes of PEVs and charging equipment are not interoperable.	Not all makes of PEVs and charging equipment are interoperable.	PG&E notes that, while interoperability between the EVs and EVSEs is important, it is equally important to account for 'affordability' when deciding on the scope and extent of interoperability. It might be useful to combine this problem/issue with E2.1 also focused on interoperability.	PG&E reiterates our recommendations for actions proposed in E2.1		
C2.3 (unchanged)	The charging and payment process for workplace and public charging is evolving, but needs to simplify for drivers as PEV infrastructure is deployed.	The charging and payment process for workplace and public charging is evolving, but needs to simplify for drivers as PEV infrastructure is deployed.	PG&E believes that this Problem/Issue, while relevant to the broader topic of transportation electrification and EV adoption, is not directly related to VGI. Therefore, PG&E considers this Problem/Issue out-of-scope for and recommends removing from this VGI Roadmap. This topic is better addressed through efforts and initiatives focused on the broader topic of EV adoption, including for example the ZEV Action Plan.			

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C2.4		Lack of a centralized state-wide information resource that provides relevant and up to date information on EV charging infrastructure across state agencies, regional and local governments, and other funding programs, including available smart chargers for the various customer segments.	PG&E acknowledges the potential benefit from such information resource, but notes three important considerations. First, such initiative should leverage existing, and avoid duplicating, efforts, especially in relation to creating burden of mandating additional unnecessary reporting requirements. Second, such initiative should be customer-centric, focusing on informing and enabling customers for EV charging. Third, to be relevant to this VGI Roadmap, such initiative should be focused on VGI solutions (e.g. smart charging and V2G), perhaps as a part of broader initiative that covers other aspects of transportation electrification. For clarity, PG&E recommends rephrasing this problem/issue to: "Lack of a centralized state-wide customer-centric information resource that can synthesize and streamline existing, relevant, and up to date information on VGI solutions and opportunities, across state agencies, regional and local governments, and other funding programs, including available smart charging alternatives and solutions for the various customer segments."			
C2.5		Non-conformed electrical and automotive and safety standards prohibit the interconnection of V2G technologies. Utility service planning studies needed particularly for clustered charging load or high power installations are currently a critical path to deployment, but inhibit rapid customer installation and provision of bidirectional charging services.	PG&E notes that the lack of coordinated, electrical and automotive, safety standards inhibits the interconnection of V2G technologies. V2G capabilities require compliance with Rule 21. EVs that does not backfeed into the grid are considered loads and do not need to comply with Rule 21, but they do have to comply with load interconnection requirements specified in Rule 2 and the PG&E Green Book. All inverters connected to the grid after 9/8/2017 are required to be certified to UL-1741 SA. The UL-1741 SA certification will be adequate for those off-board inverters that interface with the EVs. Currently, there are no interconnection certification standards for certifying on-board EV inverters. According to at least one major EV manufacturer, the accepted interconnection certification standard in California, UL-1741 SA, may not be suitable for V2G applications due to the tight space constraint for the on-board EV inverters. It is also PG&E's understanding that SAE is planning to develop a new standard that will adopt the new IEEE-1547.1 revision, forecasted to be issued next year. However, this standard development may be a multi-year process. PG&E also notes that utility load interconnection studies are critical, particularly for clustered charging load or high power installations, to avoid overloading existing distribution facilities and to avoid abnormal distribution voltages. The inability to predict or control installation location, mode of operation, EV battery sizes, and charging/discharging rate inevitably constrains the utilities' ability to pre-plan for EV interconnection.	(1) Ensure coordination between automakers and utilities/grid operators on interconnection requirements, including certification standards, for V2G technologies. (2) Continue existing efforts to (a) improve the interconnection process with proven VGI solutions, and (b) to improve overall customer interconnection experience and ensure the rapid adoption and deployment of EV and VGI solutions, while continuing to ensure compliance with existing rules and regulations.	(1) Industry stakeholders (2) Utility/grid operator, CPUC	

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C3.1	Standardized "make ready" infrastructure plans are not part of new construction and not all customers are aware of the possibility of EVSE integration.	Standardized "make ready" infrastructure plans are not part of new construction and load management systems are being deliberated upon for compliance for larger installations. Furthermore, not all customers are aware of the possibility of easily installing EVSE atop capable infrastructure.	PG&E makes two comments here, as a result of which PG&E recommends that this problem/issue be removed from the VGI Roadmap. First, regarding the two topics (1) "make ready" and (2) customer awareness of the easiness of "installing EVSE atop capable infrastructure": PG&E believes that these topics, while relevant to the broader theme of transportation electrification and EV adoption, are not directly related to VGI. Therefore, PG&E consider these topics out-of-scope for and recommends removing from this VGI Roadmap. Second, while PG&E broadly acknowledges that load management systems and programs are being considered and implemented within EV programs, it is not clear what problem/issue is being addressed here.			
C3.2	EVSE integration can be challenging and cost-prohibitive at existing buildings.	Dense installation of grid-connected EVSE can be challenging and cost-prohibitive at existing buildings, and DER supported or off-grid charging solutions may be necessary, particularly for vehicles with relatively lower power and energy requirements.	PG&E broadly agrees that "DER supported" solutions, including VGI capabilities of EVs, may be beneficial to address potential technical and cost challenges associated with "dense installation of grid-connected EVSE." However, this does not seem like a VGI problem/issue, bur rather a VGI solution for resolving a potential transportation-electrification problem/issue. Can the CEC staff clarify what VGI problem specifically is addressed here?	PG&E notes that several efforts are currently underway that can help address this challenge, including the integration of EVs and their VGI capabilities as a DER within the following initiatives, procedures, and processes, among others: IOU Grid Modernization Plan; Distributed Resource Planning (DRP); Integrated Distributed Energy Resources (IDER), and Distribution Deferral Opportunity Report (DDOR). PG&E supports and emphasizes the need for the continuation of these efforts.	Utility/grid operator, CPUC	

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~~C3.3~~	~~Large scale EVSE installations across the state may be challenging for installers that operate in multiple locations due to development codes that can vary across cities and counties.~~					
~~C3.4~~	~~Dense deployment of EVSE in specific locations can be challenging for utilities to integrate with the electric grid.~~					
~~C3.5~~	~~Information describing best practices for operating and maintaining EVSE from site hosts and EVSPs participating in publically funded programs is not readily available.~~					
T1.1.1	Low cost and robust cyber security measures between the PEV-charger and charger-aggregator may not be readily deployed in today's charging market, and commercialization of smart chargers must continue to ensure safe data transfers from malicious attacks.	Cost-efficient and robust cyber security measures between the PEV-charger and charger-aggregator may not be readily deployed in today's charging market, and commercialization of smart chargers must continue to ensure safe data transfers from malicious attacks. New technology solutions may not be timely integrated to maximize security and effectiveness.		(1) Ensure that cybersecurity associated with EV charging is end-to-end, extending from the EV through EVSE and EVSP all the way to the grid. Ensure clarity and alignment among the various stakeholders on cybersecurity needs and requirements. (2) Testing and validating cybersecurity requirements and solutions can be included in the large-scale demos referenced in the proposed actions for E2.1.	All stakeholders	
T2.1.1 (unchanged)	Wireless, V2G discharge, DC Fast Charging for light vehicles, and medium- and heavy-duty vehicle charging need to be prepared for advanced interoperability capabilities to enable the robust development of the charging network.	Wireless, V2G discharge, DC Fast Charging for light vehicles, and medium- and heavy-duty vehicle charging need to be prepared for advanced interoperability capabilities to enable the robust development of the charging network.	PG&E agrees that interoperability capabilities are needed to unlock the full potential of VGI. Instead of limiting this need to select vehicle classes and charging types, PG&E recommends rephrasing this Problem/Issue to: "Interoperability capabilities are needed yet are not fully developed across the various vehicle classes and charging types." It might be useful to combine this problem/issue with E2.1 also focused on interoperability.	PG&E reiterates our recommendations for actions proposed in E2.1		

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T2.2.1	The lack of communication standardization for light-, medium, and heavy duty vehicle charging may inhibit the maximization of smart charging benefits and underutilize smart chargers and PEVs as grid resources.	The lack of implemented communication standards for light-, medium, and heavy duty vehicle charging may be inhibiting the utilization of smart charging and PEVs as grid resources. New services to manage power levels an innovations may be unnecessarily withheld from the market without readily available data enabled with communications standards.	PG&E makes three comments here. First, we emphasize the importance of implementation, and having national and industry recognized certification standards. Concrete next-steps, including large-scale programs and demos, are needed to evaluate the applicability and favorability of VGI communication standards, especially those short-listed in the Interagency VGI Communication Protocol Working Group draft final report and those required in CA Rule 21 (e.g. IEEE-2030.5 and DNP 3.0+F30). Second, another challenge is the lack of industry consensus on uniform VGI communication standards associated with different vehicle classes and charging types. Third, PG&E agrees that in addition to communication standards, unavailability of data is also a challenge. That said, PG&E recommends separating out the data unavailability challenge as follows: "Data scarcity and uncertainty around the electric vehicle charging load shapes (system wide and disaggregated), which are needed for effective utility resource planning and enabling new services for managing power levels."	PG&E reiterates our recommendations for actions proposed in E2.1		

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T2.3.1	PEVs are unable to participate in charging-specific tariffs and/or monetary compensation programs without highly accurate metering and communications necessary to provide accurate reporting and settlement and knowledge about the availability of integrated low-cost metering and communication solutions is incomplete.	PEVs are unable to participate in charging-specific tariffs and/or monetary compensation programs without highly accurate metering and communications necessary to provide accurate reporting and settlement and knowledge about the availability of integrated low-cost metering and communication solutions is incomplete. EVSE-embedded submeters may be necessary to advance the state of the art beyond current implementations of whole-house TOU rates and separate electrical service specific to one or multiple EV chargers.	PG&E notes that EV metering data accuracy and communication requirements are use-case specific. For example, demand response settlements do not require data integration with existing utility billing systems, while charging-specific retail tariffs do. Technologies related to EV submetering should take into account the ultimate usage of the EV consumption data, the related accuracy and communications needs, and the lowest-cost solution to meeting those needs. Furthermore, it is not clear that “EVSE-embedded submeters” are necessary to implement charging-specific tariffs or monetary compensation programs for PEV participation. A submeter could be located upstream of an EVSE, or of a bank of EVSEs. Separate meters for EVs could be implemented without requiring a separate electrical service (a single service can serve multiple, separately billed meters). As stated previously, any technology solution should be targeted to the use case and optimized for cost-effectiveness. Therefore, PG&E recommends rephrasing this problem/issue to: "PEVs are able to participate in charging-specific tariffs and/or monetary compensation programs. However, more advanced tariffs and programs may require greater customer demand for more accurate metering and communications necessary to provide accurate reporting and settlement, and knowledge about the availability of integrated low-cost metering and communication solutions is incomplete. EVSE-embedded submeters, if feasible, cost-effective and justified by customer demand and needs, may help advance the state of the art beyond current implementations of whole-house TOU rates and separate electrical service specific to one or multiple EV chargers."	In relation to sub-metering: PG&E recommends the continuation of current efforts and thinking aimed at clarifying and distinguishing between the technology requirements for utility submetering and billing versus VGI-related compensation for behind-the-meter retail customer energy management services. Such efforts are already underway, guided by the CPUC.	CPUC, utility/grid operator, other industry stakeholders	
T2.4.1	Integrated solutions providing advanced communication and control functions that connect the PEV and/or charger with grid operators are needed to reduce implementation costs.	Integrated solutions providing advanced communication and control functions that connect the PEV and/or charger with grid operators are needed to reduce implementation costs. Certainty in the use of integrated charging solutions are needed to achieve economies of scale cost savings.	It is not clear what "certainty in the use of integrated charging solutions" exactly refers to. PG&E believes that more certainty will be realized once clear and successful business models are developed by the market.			

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T3.1.1	Manufacturers of solutions for MD/HD EVs need to accommodate high-voltage battery and charging systems to meet applicable vocational duty cycles.	Manufacturers of solutions for MD/HD EVs need to accommodate high-voltage battery and charging systems to meet applicable vocational duty cycles and provide grid stabilization services. Without tracking progress on this issue, forecasting the potential for heavy, and off-road vehicle electrification remains uncertain.	PG&E notes that the electrification of medium-duty, heavy-duty, and off-road vehicles has several significant advantages, including GHG reduction and air-quality improvement. Although grid stabilization services can be an additional advantage, it is not the only one.			
T3.2.1	Users need to understand the relationships between battery life, range, operations and their overall impact on total cost of ownership.	Stakeholders need to understand the relationships between battery life, range, operations and their overall impact on total cost of ownership, particularly for V2G operations and the recyclability, reuse, and redeployment of batteries after their use in vehicles.				
T3.3.1	The load and grid upgrade requirements of fast charging to support long distance travel for light personal and light/medium/heavy commercial vehicles are unknown.	The load and grid upgrade requirements of fast and/or high power charging to support long distance travel for light personal and light/medium/heavy commercial vehicles must be known to provide reliable service while reducing grid upgrades.	While PG&E broadly agrees on this problem/issue, it is not clear how it is relevant to the associated Goal.	PG&E reiterates our recommendations on EV load profiles, proposed in E1.1.		
T3.3.2		Electrical and safety certifications under SAE for onboard vehicle chargers capable of off-board energy discharge are not considered by UL. Regulatory acceptance of electrical standards but not automotive standards for V2G bar the use of behind-the-meter discharging technologies.	Electrical grid safety certifications under SAE, compliant with IEEE-1547.1, for onboard EV inverters are not available yet. The current grid interconnection standard, UL-1741 SA, may not be suitable for EV on-board inverter applications. Therefore, national standards for V2G interconnections are needed. An auto- and utility-recognized and approved certification standard is needed for V2G applications in order to streamline the development and deployment of V2G solutions.	PG&E reiterates our recommendations proposed in C2.5.		

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T4.1.1	Technology and knowledge transfer between local, state, and federal stakeholders (agencies, auto OEMs, charging technology providers, utilities etc.) is not yet occurring at a comprehensive scope or frequently enough to rapidly advance EV adoption.	Technology and knowledge transfer between local, state, and federal stakeholders regulatory agencies, auto OEMs, charging technology providers, utilities etc.) is not yet occurring at a comprehensive scope or frequently enough to rapidly prototype and advance adoption of VGI solutions. Meanwhile, technology transfers need to consider opportunities to create robust, competitive markets for vehicles, equipment and services, while protecting intellectual property.				
T4.1.2		State investments lack a comprehensive data warehouse to compile R&D learnings to determine how pilots can be extrapolated for regional or market-scale impact modeling. Research portfolios do not consistently identify connections between individual investments or a broader industry technology roadmaps in order to prioritize funds to pursue cutting-edge areas of research and analysis.	PG&E supports the idea of a state-wide data warehouse to compile VGI R&D learnings and to help inform how VGI pilots can be extrapolated for commercial deployment and market-scale impact modeling. However, similar to our comment on C2.4, such initiative should leverage existing, and avoid duplicating, efforts, especially in relation to creating burden of mandating additional unnecessary reporting requirements.	(1) Explore the idea of launching an interagency effort to fund and develop an online state-wide data warehouse that (a) compiles and tracks VGI R&D learnings and (b) help inform how VGI pilots can be extrapolated for commercial deployment and market-scale impact modeling. (2) Proactively engage all VGI stakeholders on needs and wants, and explore possible options to receive support from National Labs (3) Explore and leverage previous efforts to develop data warehouses in similar or related fields (e.g. has this been done before for other purposes?) Finally, PG&E notes: initiatives that do not involve commercial-scale, cost-effective utility infrastructure and services to support safety and reliability should be funded by public funds, not utility customer funds (e.g. by CEC through its non-ratepayer funded R&D budget, by U.S. Department of Energy funds, etc.).	All stakeholders, led by state agencies	

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T5.1.1* (unchanged)	State agencies and stakeholders need a focused roadmap to direct VGI technology development, specified with technology metrics and informed by industry product roadmaps.	State agencies and stakeholders need a focused roadmap to direct VGI technology development, specified with technology metrics and informed by industry product roadmaps.	While setting broad technological goals and criteria may be useful for clarity and guidance, PG&E cautions against the risk of prematurely mandating specific technological solutions, especially given the relatively nascent nature of the VGI markets. Technology roadmaps advising on the "what" aspect of VGI goals may be useful to stimulate and track progress. However, technology roadmaps mandating the "how" aspect of VGI solutions are not favorable; technology development should be left to industry players to decide on. Therefore PG&E recommends rephrasing this Problem/Issue to: "Alignment and coordination between state agencies and other stakeholders on the technological goals, objectives, and/or criteria of VGI is needed."			
P1.1	The interactions between the objectives and timelines of state transportation electrification and vehicle-grid integration policies and programs are unclear.	The interactions between the objectives and timelines of state transportation electrification and vehicle-grid integration policies and programs are unclear. State agency units implementing VGI-related policy measures are independent, yet require improved awareness of related activities. E.g. ZEV and Infrastructure Targets (B-48-18), Utility Transportation Electrification and Integrated Resource Planning (SB 350), CA Energy Demand Forecast and Transportation Energy Demand Forecast (IEPR), CARB Climate Change Scoping Plan and Mobile Source Strategy (Medium and Heavy assessment, Sustainable Freight, Innovative Clean Transit, Advanced Clean Trucks), Research Assessments (EPIC, ARFVTP, CARB Research), Rulemakings (R.13-11-007, Title 20, Rule 21 Interconnection, Open Access, Low Carbon Fuel Standard)	PG&E recommends distinguishing between two types of interactions, both of which are consequential to the progress of VGI: (1) interaction between the state's goals and objectives for transportation-electrification on one hand and vehicle-grid integration on the other hand; (2) interactions between VGI-related policies, legislations, regulations, and programs among the various state agencies. Therefore, PG&E recommends rephrasing this Problem/Issue to two separate Problem/Issue items: (1) "Potential overlap and insufficient coordination between the various state agencies and bodies on VGI-related policies, legislations, regulations, and programs" (2) "Potential overlap in the various state agencies work between VGI-related policies, legislations, regulations, and programs on one hand, and broader transportation electrification policies, legislations, regulations, and programs on the other hand"	(1) Clear mapping of roles and responsibilities for the various state agencies in the VGI space. (2) Close coordination to ensure clear and reasonable sequencing of the agencies' activities in the VGI space. Efforts by the agencies should build on one another, to avoid potential overlap, redundancy, or contradiction. (3) Formalize the interagency coordination on VGI via an effort similar to the ZEV Action Plan, whereby the activities of state agencies are mapped out and structured around clear goals. This action plan should be updated, at least annually, to allow transparency on the actions and progress of the state agencies as they move towards the directed goals.	State agencies	High

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P1.2	Agencies or stakeholders may unknowingly develop policies, business processes, and market initiatives concerning EVs that counteract or contradict VGI resource certification efforts.	Agencies or stakeholders may unknowingly develop electric transportation policies, business processes, and market initiatives that counteract or conflict with VGI efforts.				
P1.3	Rapidly evolving renewable portfolio standards, rate designs, and infrastructure incentive policies influence the usefulness of VGI, but utilities need certainty in charging infrastructure procurement policy and private companies need certainty in charging infrastructure technical specifications to successfully co-invest in charging.	Rapidly evolving renewable portfolio standards, rate designs, and infrastructure incentive policies influence the usefulness of VGI, but utilities need certainty in charging infrastructure procurement policy and private companies need certainty in charging infrastructure technical specifications to successfully co-invest in charging, including for V2G.				
~~P1.4~~	~~State agency units implementing VGI-related policy measures are independent, yet require improved awareness of related activities. E.g. ZEV and Infrastructure Targets (B-48-18), Utility Transportation Electrification and Integrated Resource Planning (SB 350), CA Energy Demand Forecast and Transportation Energy Demand Forecast (IEPR), CARB Climate Change Scoping Plan and Mobile Source Strategy (Medium and Heavy assessment, Sustainable Freight, Innovative Clean Transit, Advanced Clean Trucks), Research Assessments (EPIC, ARFVTP, CARB Research), Rulemakings (R.13-11-007, Title 20, Rule 21 Interconnection, Open Access, Low Carbon Fuel Standard)~~					
P1.4~~5~~	Impacts of concentrated local and individual efforts related to smart EV charging (ZNE homes codes for EV and DR capability, Local Climate Action Planning, Fleet Procurements, Low-Income and Disadvantaged Community programs) are not readily transparent, which may result in poor estimates of charging demand and grid upgrades.	Impacts of concentrated local and individual efforts related to smart EV charging (ZNE homes codes for EV and DR capability, Local Climate Action Planning, Fleet Procurements, Low-Income and Disadvantaged Community programs) are not readily transparent or predictable, which results in uncertainty related to charging demand and grid upgrades.				

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P2.1	Utility programs, procurements, and tariffs could be served by the use of EVs as distributed energy and demand response resources, but requirements between utilities and service providers or participants may prevent robust participation in multiple markets.	Utility programs, procurements, and tariffs could be served by the use of EVs as distributed energy and demand response resources, but varied requirements between investor- and publicly-owned utilities, community choice aggregators, various balancing areas, and service providers or participants may prevent robust participation in one or multiple markets. Regulatory and market mechanisms need to be improved to incorporate and account for potential grid benefits, including over longer planning horizons, while considering how public expenditures on charging would enable the provision of grid services.		Among other improvements in regulatory and market mechanisms, PG&E recommends the continuation of current efforts to expand and evolve the scope of DR to become a technology-agnostic platform that can effectively integrate EVs to offer a wide range of grid services. Such DR-enabled grid services by EVs may eventually encompass: V1G, V2G, and V2B; system-wide and local-distribution-grid needs; in the form of load curtailment, load increase, and even net-export.	CPUC, CAISO, Industry stakeholders	
~~P2.2~~	~~Some of the reliability needs of Balancing Authorities could be met by the use of EVs as distributed energy and demand response resources, but uncertain market size and pricing dampens market participant interest.~~					

PG&E Comments on Vehicle Grid Integration Roadmap Update: Matrix of Goals, Issues, Action, Responsible Organization(s), and Priority

Number	Problem/Issue - Initial Proposal (9/6/18)	Problem/Issue - Incorporated Comments (10/29/18)	PG&E comments on Issues (10.29.2018)	PG&E comments on Action	PG&E comments on Responsible Organization(s)	Priority
P3.1	The wide variety of terms to qualify charging technologies into different state, local, and utility charging or EV-related programs have fragmented equipment design and can inhibit the benefits of economies-of-scale production for charging equipment.	The wide variety of terms to qualify charging technologies into different state, local, and utility charging or EV-related programs may be precluding consistent equipment design and can inhibit harmonious charging operations across territories, while delaying the benefits of economies-of-scale production for charging equipment.	It is not clear whether there is evidence to support the validity of this problem/issue. Specifically, it is not clear how "widely variable" the terms are to "qualify charging technologies into different state, local, and utility charging or EV-related programs." Therefore PG&E recommends rephrasing this Problem/Issue to: "Lack of clarity on the potential variety of terms to qualify charging technologies into different state, local, and utility charging or EV-related programs, which may preclude consistent equipment design, may constrain harmonious charging operations, and/or may delay the benefits of economies-of-scale production for charging equipment."	Commission a study to evaluate and document current status and variety of terms "to qualify charging technologies into different state, local, and utility charging or EV-related programs." If/when such assessment is available, it should be made available for all stakeholders to review. Subsequently, it would be possible to launch a multi-stakeholder effort to explore the need for potential solutions to streamline these qualification terms. Finally, PG&E notes: initiatives that do not involve commercial-scale, cost-effective utility infrastructure and services to support safety and reliability should be funded by public funds, not utility customer funds (e.g. by CEC through its non-ratepayer funded R&D budget, by U.S. Department of Energy funds, etc.).	All stakeholders, led by state agencies	
P3.2	The traditional "rate of return" regulatory designs may cause utilities to underestimate the grid impact mitigation potential from smart charging infrastructure and grid upgrade planning methodologies may need to be updated. Regulatory changes that accommodate and encourage third party aggregation of charging may be needed.	The traditional "rate of return" regulatory designs may cause utilities to underestimate the grid impact mitigation potential from smart charging infrastructure and grid upgrade planning methodologies may need to be updated. Regulatory changes that accommodate and encourage third party aggregation of charging may be needed. It may be necessary to allow utilities to consider criteria for performance-based ratemaking or other incentive mechanisms to balance the objectives of infrastructure investments, renewable integration, minimizing ratepayer impact, and encouraging marketplace competition.	PG&E disagrees with this statement. The assertion that "the traditional "rate of return" regulatory designs may cause utilities to underestimate the grid impact mitigation potential for smart charging" is inaccurate. As the record in the existing CPUC DRP, IDER (including DDOR) and other EV proceedings indicates, current ratemaking for grid upgrades include and support procurement of distribution deferral services from DERs, including EVs. The multiple programs administered by different agencies also need to be coordinated to make sure that they do not conflict with each other.	PG&E reiterates our recommendations for actions proposed in E2.1 to test, validate, evaluate, and quantify the cost and benefit of VGI grid impact. Also, PG&E reiterates our recommendations for actions proposed in E2.2 about development and evolvement of aggregation models.		