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CalETC Comments on VGI Roadmap Update Workshop and Revised Matrix

Additional submitted attachment is included below.

November 21, 2018

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

Docket Office, MS-4
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Docket No: 18-MISC-04
Project Title: Vehicle Grid Integration Roadmap Update
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Re: Staff Workshop on the California Vehicle-Grid Integration Roadmap Update Oct 29-30

The California Electric Transportation Coalition (CalETC) 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.

CalETC supports the efforts of the CEC, CPUC, CARB, and CAISO to promote the adoption of zero-emission vehicles (ZEVs) and equipment. CalETC views the CEC's efforts to coordinate with the appropriate agencies and update the California's VGI Roadmap as critical to achieving effective integration of electric vehicles (EVs) with the electrical grid, avoiding unnecessary costs to the grid, determining the value of grid services that can be offered by EVs, and promoting grid stability and reliability while meeting driver mobility needs.

In addition to our attached comments on the California Vehicle-Grid Integration Roadmap Matrix of Goals, Problems/Issues, Actions, Responsible Organization, and Priority (Attachment 1), we submit for your consideration the following comments on the VGI Roadmap Update relative to the tracks and specified issues and actions.

I. Determination of Economic Potential for VGI

The determination of the economic value of VGI is a priority. We support collaboration and data sharing to define the present and future profiles for EV-load demand, which will help inform the modeling and evaluation of VGI applications. Existing efforts that incorporate EV-load forecasting and EV-load-profile modeling can be better leveraged, including those within the CEC's Integrated Energy Policy Report (IEPR) and CPUC's Integrated Resource Planning (IRP) processes. We also strongly support efforts to quantify the need for the different types of VGI (e.g., V1G, V2G, and "passive") and the VGI net value (benefits and costs) in the different charging market segments.

Quantifying the value of VGI requires developing a framework that accounts for the costs and benefits of each of the VGI types and applications, and for the different vehicle classes and charging modes. This framework would also help articulate the value attribution to all parties involved (e.g., EV customer, service providers, automakers, utility customers, society, etc.). Additional considerations related to VGI value quantification include: (1) distinguishing between project-level and system-level value, (2) finding ways for the various stakeholders to have a value proposition, and (3) ensuring that VGI valuation methodologies are consistent and easily integrated with similar efforts for other distributed energy resources (DERs). One recommendation for facilitating on-going data sharing and analysis is to establish a voluntary working group specifically for this purpose.

Large-scale demonstrations are also necessary to validate the valuation studies. Large-scale demonstrations, especially near term, are needed to: quantify the value (benefits and costs) of VGI; accelerate the development of VGI technologies; and validate the net value, functionality, cybersecurity, and customer experience for each of the VGI use cases and technology solutions. As VGI demonstrations get implemented, they should aim to evaluate the most viable and commercially mature VGI use cases, including the cost of implementing the technology and integrating with the grid.

II. Technology Needs

The technology issues/problems identified in the matrix may be best addressed as functional needs. The issues delineate particular technology needs for:

- Robust end-to-end cybersecurity measures to enable safe data transfer protection from malicious attacks across the full VGI chain of assets (including EV, EVSE, EVSP, and grid). (See comments in Appendix A.)
- Integrated advanced communications and control solutions to ensure proper connection of the EVs and/or EVSEs with the grid operators, including through aggregators.
- Implementation of communications standards for wireless, AC conductive, and DC charging with all classes of EVs (for V1G and V2G in appropriate applications).
- Low-cost metering and communications solutions for EV charging.
- Integration of VGI solutions with other DERs.
- Electrical and safety certifications needed for V2G grid interconnection.

CEC, CAISO, CPUC, CARB and the utilities need to coordinate and collaborate on defining the functional needs for each of these technologies. An integral overarching element for determining technological requirements is the consensus from the Workshop that end-to-end (utility/grid operator to EV) solutions are critical.

Demonstrations are important to prove out VGI technology, standards, cost, and benefits and should be designed with clear questions to answer, and technologies/options to prove out, as was stated during the Workshop by multiple stakeholders. The V2G technology demonstrations need to address the determination and verification of communications and control protocols

needed to meet Rule 21 grid-interconnection requirements. This also requires coordination between automakers and utilities/grid operators for defining and adopting vehicle safety certification standards for grid interconnection.

Additionally, the Roadmap Matrix identifies issues related to the need to institute technology and knowledge information transfer, as well as make available additional data to help prioritize technology investment in cutting edge research and analysis. The implementation of VGI demonstrations can aid in addressing these issues. The demonstrations can help industry stakeholders and the California agencies better engage in dialogue about the available technologies for integrated VGI solutions. In addition, the demonstrations can further provide viable data and learnings for regional and market scale impact modeling, to help inform priorities for state investment in VGI technology research and analysis.

Finally, in relation to communication standards to enable VGI, we caution against mandating a single VGI standard prematurely. We emphasize the findings of the Interagency VGI Communication Protocol Working Group (VGIWG), whose draft final report states that "*there is not one best path to communicate between the PFE and the EV that should be required at this time*." The VGIWG performed an exhaustive year-long detailed evaluation of various communications standards and their capabilities to meet a defined set of communications requirements (based on over 70 use cases) specific to VGI, including Rule 21 functionality. The determination from that comprehensive work is that there is no distinctive reason or justification for selecting any single standard at this time. The results established the need to further verify the standards and their capability to provide end-to-end VGI solutions (see comments in Appendix A). VGI demonstrations can help establish and inform the process for testing and validating the standards and verifying their ability to support VGI interoperability requirements.

III. Customer Experience

CalETC supports the issues identified in the matrix and provided specific recommended actions to address the listed issues (see Attachment 1).

We believe that particular focus should be placed on providing consumer information to understand the value for managing charging behavior. It is noted in the issue statement that customers do not readily understand the benefits of managing their charging behavior without compromising their mobility. We think it is imperative to gain knowledge about the level of understanding customers have about EVs, charging behavior, and the relationship to the grid.

In addition, it is important to provide the customer with an understanding of the positive attributes of VGI, such as the ability to achieve a lower total cost of EV ownership through managed charging. Utilities are well-suited to and do engage in identifying gaps in consumers' understanding of VGI and addressing those gaps through education and outreach. However, it is challenging to determine what will incentivize customers to agree to change their charging behavior and to participate in VGI programs. The utilities, automakers, and other stakeholders will need to coordinate on the messaging to construct an informative customer education process and measure the results of the outreach and education activities.

Strong outreach and education with tailored messaging to the specific customer categories is required, with special emphasis on disadvantaged communities. It is important to engage disadvantaged communities on optimizing the utilization of electric transportation to improve their air quality and economic development.

IV. Policy and Planning

Clear mapping of roles and responsibilities for the various state agencies in the VGI space is needed. The VGI Roadmap Update can be utilized as the common information document to provide the basis for coordination among the agencies. In addition, the interagency coordination on VGI can be formalized 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. There needs to be accountability assigned to effectively manage this process. In addition, upcoming charging station rulemakings by the Division of Measurement Standards and CARB should inform the 2019 VGI Roadmap Update, and potentially simplify it.

There needs to be alignment between VGI policies and DER policies. These will conceptually dovetail and be interjoined in the future, especially when V2G becomes a market deployable DER product. In relation to integrating EVs within the broader scope of distributed energy resources (DERs), we support the continuation of current efforts to improve regulatory and market mechanisms, including those related to aggregation and unbundling. We also support current efforts to expand and evolve the scope of Demand Response (DR) to become a technology-agnostic platform that can effectively integrate EVs to offer a wide range of grid services. Distribution-grid-focused DR might be particularly promising.

We believe that voluntary indirect control measures and policies present an important opportunity for managing EV charging. Measures for consideration include: TOU rate design, demand charge design, demand response program design, Low Carbon Fuel Standard program design, storage mandate design, design of rebates to encourage certain technologies or outcomes and identifying available funding for large-scale pilots and demonstrations. Voluntary indirect measures can be leveraged and accelerated in the near-term to avoid potential expensive upgrades to the grid, as we work efficiently through the necessary studies and large-scale demonstrations for more sophisticated smart charging and bi-directional charging. Identifying and removing remaining barriers to smart charging and bi-directional charging is important.

Another issue to be addressed is related to VGI procurement policies. A construct similar to the Storage Mandate can be considered, whereby procurement targets, budgets and timing are identified, and utilities and suppliers can determine specific procurement planning and contractual criteria.

V. Policy, Planning, and Market Interaction Framework

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 will wait to provide detailed comments on this Framework until it is further clarified and officially released. However, we note that an important concept is missing from the Framework. Before the first box, "Technology Innovation & Commercialization," there should be a separate box "Value and Business Case of Technology Determined & Proved."

VI. We recommend the agencies hold additional workshops on the VGI Roadmap Update

Additional opportunities to engage and provide feedback would be helpful to achieving a useful and successful VGI Roadmap Update, especially after the release of the matrix updates and the draft VGI Roadmap Update.

Thank you for your consideration of our comments. Please contact George Bellino and Hannah Goldsmith at george.bellino@gmail.com and hannah@caletc.com should you have any questions.

Sincerely,

Hannah Goldsmith, Deputy Executive Director
California Electric Transportation Coalition

Cc:

Eli Harland, Noel Crisostomo, Matthew Fung, California Energy Commission

Stephanie Palmer (SB 454), Sam Wade (LCFS), California Air Resources Board

Carolyn Sisto, California Public Utilities Commission

Peter Klauer, California Independent System Operator

Tyson Eckerle, Governor's Office of Business & Economic Development

Kevin Schnepp, Sam Ferris, Division of Measurement Standards

Appendix A

I. Cybersecurity

Cybersecurity is identified as a significant issue to ensure safe protection of data transfer from malicious attacks. The Electric Power Research Institute (EPRI) commented that cybersecurity cannot be added to the EV, and the equipment has to be part of the end-to-end architecture. The Department of Energy (DOE) is investing $28M to advance cybersecurity of the nation's critical energy infrastructure.[1] The awardees include cybersecurity experts from the automaker industry, government labs, academia, and utilities who are to define methodologies to prevent, detect, and mitigate cybersecurity vulnerabilities in communications systems and relative hardware. This DOE initiative can be applied to the infrastructure and VGI technology applications for the VGI Roadmap Update. This may help facilitate clarity and alignment among the various stakeholders on cybersecurity needs and requirements.

II. Mandating a VGI Standard

The Interagency VGI Communication Protocol Working Group (VGIWG) determined that there was no distinctive reason or justification for selecting any single standard for VGI communications. It was made evident from the results of the evaluation that some standards, including ISO/IEC 15118, were not yet complete or fully verified to be able to attest compliance to the VGI communications functional requirements for the various charging types and modes.

It is important to note that the VGIWG identified that end-to-end solutions are critical. A key outcome from the VGIWG evaluation was that IEEE 2030.5 was the only standard protocol that is end-to-end capable. It should also be noted that IEEE 2030.5 has exhibited, through R&D pilots, the capability to provide V2G communications and control functionality between the EV and the utility, and that it was selected by the CPUC Smart Inverter Working Group to be the standard for Rule 21 communications. One of the challenges for the VGIWG was: without a clear understanding or definition of the value from VGI and the associated costs for implementation, it is not prudent to select any single standard. There still is no comprehensive understanding of the benefits of VGI and the cost, which is now to be addressed as part of the VGI Roadmap Update framework. Clearly, stakeholders need a value proposition for V1G and V2G to succeed.

Telematics[2] is fast becoming a proven technology for VGI. BMW[3] and Honda[4] are presently executing V1G smart charging aggregation and optimization programs utilizing telematics. Along

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[1] U.S. Department of Energy (DOE) awards of up to $28 million to support the research, development, and demonstration (RD&D) of next-generation tools and technologies to improve the cybersecurity and resilience of the Nation's critical energy infrastructure: https://www.energy.gov/articles/department-energy-invests-28-million-advance-cybersecurity-nation-s-critical-energy.

[2] Telematics is a transfer medium that can be used with various open standards or proprietary protocols (e.g., business to business or business to customer).

[3] BMW Charge Forward Program: https://www.pge.com/en/about/newsroom/newsdetails/index.page?title=20180117_pge_launches_new_program_to_accelerate_electric_vehicle_adoption_in_northern_and_central_california.

with Honda and BMW, other OEMs such as Nissan, General Motors (GM), Fiat Chrysler Automobiles (FCA), and Ford are engaged in the development of the Open Vehicle Grid Integration Platform (OVGIP) which provides a telematics solution for VGI communications integration between the grid and the EV. There are several utilities across the U.S. and in Canada engaging with the OEMs in the planning and development of OVGIP EV DR aggregation and data management pilot programs. OEM telematics provides access to driver-specific travel and charging behavior patterns, and it may enable more granular data for monitoring, measuring, projecting and analyzing EV-load impacts. In addition, by communicating directly with the EVs, telematics may enable additional cost savings in charging infrastructure.[5]

BMW, Honda, Nissan, GM, FCA, and Ford do not support mandating any single standard at this time. Their primary position is that regardless of any determinations affecting standards, telematics should not be excluded. The OEMs support the need to determine what VGI use cases provide value to the grid and to implement large-scale demonstrations to test and validate optional communications standards and protocols that can enable end-to-end solutions.

III. VGI Studies

The interagency VGIWG originally sought to examine the value proposition for the different types of VGI—especially in promising use cases—and to examine and recommend low-cost policy solutions that could result in behavior changes, yielding value to the grid, EV driver, site host, or aggregator (i.e., original VGIWG Tasks 2 and 3). Our comments above expand upon these original tasks. In addition, other studies are needed as detailed below.

VGIWG Task 1 could be updated (including the glossary), and the various VGI benefits and costs studies could be analyzed and compared in order to develop a consensus framework for VGI benefits and costs. This framework project should also explore different ways to attribute costs and benefits to the different stakeholders, so that each stakeholder may have a value proposition.

Current best VGI practices by the various stakeholders on TOU/TOD rates, demand charges, LCFS programs, charging station incentives, and education/outreach programs should be studied, and all the VGI pilots and demonstrations should be cataloged and kept up to date.

Understanding the need (e.g., market potential in the short- and long-term) for V2G, V1G, V2H V2B in the various market segments[6] is also important, as the need may be greater in certain charging market segments. For CAISO services, understanding if this market could become saturated is important. Due to these complexities, a one-size-fits-all communication protocol for

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[4] Honda Smart Charge™ Program: https://www.forbes.com/sites/sebastianblanco/2018/07/31/honda-smartcharge-reward-charging-electric-vehicle/#454458b0679f.

[5] OEMs instituted an OVGIP pilot with Con Edison whereby customers are incentivized to charge during off peak periods. OEMs via telematics monitors and reports customer charge session data to verify compliance. The implementation of the OVGIP telematics required no utility or customer cost for metering, charger networking services, on vehicle equipment or modifications nor any distribution infrastructure upgrades.

[6] Attached and detached single family homes, MUD common areas, fleets, workplaces, curbside, and off-street public.

all charging markets, charging modes, and vehicle types may not be the best approach in the long-run.

We recommend the VGI Roadmap Update include a dedicated effort for EVs in the medium-duty, heavy-duty and non-road segments as they may have large grid impacts and present many unique VGI opportunities and challenges.

In addition, V2G faces unique barriers, and a separate study to identify these barriers and recommend solutions is warranted.

The interagency VGIWG started to examine how much accuracy is needed for meters and submeters but did not finish. We recommend this task be completed and include the meter needs of CAISO, the LCFS smart charging program, and DMS.

Attachment 1

Goal	Problem/Issue - Initial Proposal (9/6/18)	Problem/Issue - Incorporated Comments (10/29/18)	Comment on Issues	Action	Responsible Organization(s)
Estimate the economic potential for Vehicle-Grid Integration under medium (2030) and long term (2050) scenarios.	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 classess (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 inter-agency/stakeholder EV Load Profile Working Group that aims to: (a) synthesize and document currently available infromation 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 modes. 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. Recommend assigning a specific agency to be responsible for the working group and for coordinating data gathering and sharing processes. This can be outsourced to a 3rd party but accountability should reside with a specific California agency (4) Alternate action can be to coordinate with the automakers to engage them to provide charging load profile data through aggregated source(s). Such an initiative could provide an ongoing data resource for evaluating regional and locational changes in customer behavior as more EVs are deployed. Utility data could be combined with this information to help identify and project impacts on distribution circuits. (5) 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.	(1) All stakeholders (2) All stakeholders (3) Designated State Agency
	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.		Continue current efforts of progressively improving resource planning to capture new 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, we recommend 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 incorpotate V2G, when proper operational models of V2G are developed. There are two issues being included: Supplier technological capabilities assessment for V1G and V2G, and charging market assessment for determining demand from all types of electrified transportation. These are separate issues: first is to define the problem then assess the technological capabilities to address the problem. Assessment of the technological capabilities need to be based on defined requirements for resolving the demand problem.	CPUC; utility/grid operator
	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.		Recommend the following list of actions related to VGI value: (1) Efforts aiming to quantify the value of VGI, especially those that are publicly funded, should account for both benefits and costs. (2) Support an inter-agency/stakeholder effort (e.g., complete the original Task 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, charging market segments); (b) VGI value (benefit and cost) "distribution" among the various parties involved (e.g., participant/driver, utility customers, service providers/aggregators, automakers, broad society, etc.). Such framework should also leverage and not contradict existing efforts, methods, and processes to quantify the value of other DERs. The framework should determine 1) the need for (market potential of) V1G, V2G and "passive" policy solutions in each segment and types of charging (AC, DC, conductive, wireless) 2) the value to each player in the use case, and 3) different ways to share the value among the stakeholders using the framework developed above. Also, complete the VGIWG orgininal task 3 to identfy the costs and benefits from a wide range of low-cost policy solutions to the various stakeholders in various charging market segments. The customer value from low-cost policy solutions related to rate design can be confirmed by paper studies and validated in large-scale demonstrations. (3) Identify and distinguish between VGI value both at the (3a) project-level as well as at the (3b) system-level. (3a) VGI pilots, especially those recieving 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. If possible, separate the system level values into bulk system (generation) and distribution system. (4) Support an initiative to compare all existing studies on VGI value (benefits and costs), and to advise on best-practices, consistent with DER methods, to account for VGI benefits and costs. 5) Need as large as possible demonstrations of promising V1G and V2G and "passive" use cases to test and validate the net value proposition for the various stakeholders, functionality (including cybersecurity) and customer acceptance. *Specified outcomes have to be defined to determine the value to the customer and the ratepayer for the VGI use case solution; testing and verification of the solutions to achieve the outcomes has to be accomplished. Results from the testing (scaled customer programs reference E2.1) will allow non-hypothetical evaluation of cost benefit to the utilities which will then can be translated into value for the EV customer and the ratepayer. This should further provide the basis for qualifying the economic value to the suppliers providing the technology solutions. Should consider the imputed cost determinations for EV owners and ratepayers. Understanding EV customer value is an imperative for VGI adoption and acceleration.*	(1) All stakeholders (2) Inter-agency Working Group (3a) Stakeholders managing VGI pilots (3b) All stakeholders (4) Inter-agency, CEC-coordinated (5) Stakeholders managing VGi demos
	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 resouce 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.		Recommend 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 sytem-level (separating the bulk system from the distribution system). (3) Leverage existing DER value frameworks, quantification methodologies, and processes. For example, We recommends that the framework task examine multiple frameworks including the CPUC's ongoing effort addressing Multi Use Applications (MUA) for stationary 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"- http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M171/K555/171555623.PDF 5) EVs can act as a DER and provide grid services; this may require testing and verification for specific scenarios. The results from this testing and verfication process can be applied to valuation models that interject distribution system conditions for future integrated distribution resource planning and value assessment. This can leverage the load profile data (E1.1) which can also be used to project future EV load impact profiles into the 2030 / 2050 timeframes.	All stakeholders
		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.	We disagree 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 and useful, there is no clear evidence of a consensus among customers in California that additional "locational or tempotal" resolution is preferred or needed. For example, this lack of consensus on the prefrence 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." We agree 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 opportuntieos to manage grid conditons.	(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 conditons 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
Identify promising business models for self-sustaining private development of infrastructure and markets for VGI	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, charing stations, and vehicles is unknown.	1) The term interoperability can be confusing as it applies to different things. Interoperability is not a standard but is a functionality. According to the VGIWG glossary, Interoperability can mean interoperability between utility areas, interoperability of charging network providers' back-office billing systems, or interoperability to the site host (to change out networks). The CEC issue is primarily referring to the interoperablity between EVSE and EVSE networks. The ability for all EVSEs to be able to communicate with all EVSE networks and allow for roaming between charging network providers by providing a back-office clearing house to allow for a single customer bill. This is the interoperability issue CARB is addressing as part of their proceeding on SB454 and should have significant bearing on this issue for the VGI Roadmap Update. 2) The issue accross service territories really just applies to public access charging – where vehicles are going to different service territories. Fleets, homes and private workplaces do not need to deal with this. Also, the market is deregulated, so it is rare that a utility plays the role of charging network operator. CNOs just deal with different utility rates in different regions and charge for charging or provide DR signals as needed, so the problem is solved. In the future, signals could be very specific down to the circuit level. If anything is needed to solve this issue it's a common standard or maybe two standards statewide (nationwide) so that CNOs don't have to deal with many different standards in a balkanized system across the states and regions.	We make the following recommendations related to interoperability: (1) Consensus is needed among EV and EVSE makers/stakeholders on communication standards and interoperability requirements. Ideally, EV and EVSE providers would align and provide certainty on interoperable 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 demos are needed to test, validate, evaluate, and quatify the cost and benefit impacts of: (2a) implementing the different EV-EVSE ıcommunication standards and interoperability functionality; and (2b) integrating the different EV and/or EVSE communications standards to be interoperable with existing standards "upstream" to the grid i.e. to ensure proper communication and integration with EVSP and the grid. We emphasize 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 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 communication standards, stakeholders should at least align on a list of criteria that communication standards should meet, and be tested and validated against for varying use cases, including interoperability requirements. Such criteria should include end-to-end cybersecurity and grid reliability. The testing and validation will help determine cost impacts on vehicle and equipment manufacturers. (3) Need for stronger coordination between state agencies to align and streamline rulemaking on issues related to communication standards and interoperability, 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).	(1) EV and EVSE makers/stakeholders (2) All industry stakeholders (3) State agencies

	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.		Two recommendations for action: (1) There are 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 We recommend continuing these efforts, including CAISO's new ESDER phase 4 starting in Q1 2019. (2) More broadly, looking into the future, we recommend 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
	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."		Market will ultimately dictate what the compositon 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

Reduce cost of electrification by measuring how emerging opportunities can utilize vehicle-grid integration technologies	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 data 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 or ride-hail stakeholders (e.g., Transportation Network Companies) and public transit agencies that use or plan on using EVs would be important and useful. We also encourage the involvement of Metropolitan Transportation Planning agencies, as they have access to local level driving patterns that would be useful to this effort. (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 effecient to focus on (1) and (2) above in the short-term with plans to focus on (3) in the longer term.	(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
	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 surrounging buildings while reducing real estate allocated for stationary storage. However, viable models are unproven or		This is a technology development and localized grid integration initiative that requires planning, development, implementation, and evaluation. The action is the CEC and industry stakeholders, inlcuding utilities, work directly with the communities and cities to determine VGI technology initiatives beneficial for their electrification and charging infrastructure operations. The approach is evaluation of VGI technologies, integration applications, and initiated fielded pilots and demonstration that verify the credibility of the technology applications and identifies the associated grid integration, safety and reliability issues. Cost benefit and effectiveness analysis would be required to ascertain the value for commercializing and integrating the technology applications determined beneficial to communities and cities.	CEC / VGI stakeholders
	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.		Recommend the continuation and update of efforts aiming to characterize the grid impacts of large-scale transportation electrification for MDV and HDV. In that regard, we reiterate our recommendations for actions (1) and (2) proposed in E1.1 to better characterize the load shapes of MDV and HDV. Recommend a dedicated effort for MDV and HDV to characterize the grid impact and support data analysis to determine how to minimize grid upgrade costs. It may be useful for a state agency be designated to be responsible for this working group.	All stakeholders
Prioritize and track the benefits of managed PEV charging to low-income consumers and disadvantaged communities.	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.		Recommend 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)
	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.		Recommend coordinating and streamlining the reporting requirements related to VGI across all state agencies, in order to avoid added costs and potential duplicated efforts It was noted that beyond EV-specific Time of Use (TOU) rates and VGI pilots that are limited in scope, few smart-charging programs are currently available for the public. As smart-charging programs expand, this issue might get automatically resolved. Therefore, suggest the actions focuses on the need for expanding smart-charging programs.	State agencies
Enhance the consumer experience.	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.		Utilities are well-suited to and do engage in identifying gaps in consumers' understanding of VGI and addressing those gaps through education and outreach. It is challenging to determine what will incentivize customers to agree to change their charging behavior and to participate in VGI programs. The utilities, automakers, and other stakeholders should coordinate on the messaging to construct an informative customer education process and measure the results of the outreach and education activities on consumer awareness. We suggest exploring a statewide EV customer/owner survey to understand and directly address the gaps in customer comprehension of managed charging and the benefits. Outcome should direct an information development plan for an outreach and education program that addresses the identified issues with customer understanding. Follow up surveys should be conducted to test the effectiveness of the information to enhance customer understanding.	OEMs and utilities, VGI stakeholders
	All makes of PEVs and charging equipment are not interoperable.	Not all makes of PEVs and charging equipment are interoperable.		Reiterate our recommendations for actions proposed in E2.1 Interoperability testing activities and standards need to be further developed and encouraged - utilize pilot programs as basis for testing.	
	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.		Defer to CARB regarding determinations related to SB454 and DMS rulemaking on Handbooks 130 and 44. We anticipate these rulemakings will be done by early Q2 2019. The consumer experience could be improved as a result of these rulemakings and some of the VGI Roadmap will need to change based on these other agency efforts. As such, the final version of the 2019 VGI Roadmap Update should be informed by and consistent with these rulemakings.	*CARB*
		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.			
		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 installatoin and provision of bidirectional charging services.		(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

Increase the potential number of and readiness of future EVSE site hosts.	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.		The Building Code requires some pre-cursors to support the installation of EVSE in new construction, like adequate capacity and receway. These measures should be expanded and the best ways to make existing construction "EV ready" should be evaluated. Better education and outreach to ensure EVSE are installed once the occupant takes posession.	Building Standards Commission, Department of Housing and Community Development, CEC, Division of State Architect, CARB, other relevant Building Code entities
	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.		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). We support and emphasize the need for the continuation of these efforts. Should also consider power sharing and sequencing for capacity-limited existing construction.	Utility/grid operator, CPUC
	~~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.~~				
	~~Dense deployment of EVSE in specific locations can be challenging for utilities to integrate with the electric grid.~~				
	~~Information describing best practices for operating and maintaining EVSE from site hosts and EVSPs participating in publically funded programs is not readily available.~~				
Improve cybersecurity	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 timley 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 cybersecutiy requirements and solutions can be included in the large-scale demos referenced in the proposed actions for E2.1. (3) Leverage the information, methodologies, and criteria from th recently awarded cybersecurity programs by the DOE.	All stakeholders
Advance communication and hardware technology standardization and interoperability	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.		Reiterate our recommendations for actions proposed in E2.1	
	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 unnecesarily withheld from the market without readily available data enabled with communications standards.		Reiterates our recommendations for actions proposed in E2.1	
	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.		In relation to sub-metering: We recommend 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. Vehicle on-board metering can be used in certain use-cases, in lieu of utility-grade infrastructure metering. Need to evaluate The VGIWG started to examine how much accuracy is needed for meters and submeter in VGI applications, especially aggregation scenarios. We recommend this be completed and include metering criteria input from CAISO, and other relevant state agencies like CARB (LCFS smart charging program) and DMS (currently considering adopting accuracy regulations).	CPUC, utility/grid operator, other industry stakeholders CEC, CARB (LCFS), Division of Measurement Standards
	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.		Requires market certainty to create the neccessity for developing integrated solutions for advanced communication and control functions and for achieving quantities that can provide economies of scale. Refer to P1.3	CEC, CPUC
Develop advanced battery and charging technologies	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.			
	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.			

Charging technologies	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.		Reiterate our recommendations on EV load profiles, proposed in E1.1.	
		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.		Reiterate our recommendations proposed in C2.5. Pursue the advancement and implementation of J3072 standard that supports V2G vehicle authentication for reverse power flow to the grid. Requires further coordination between OEMs and safety organizations and IOUS for OEM self certification requirments.	OEMs, IOUs, SDOs
Improve technology transfer between stakeholders	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.		Technology and knowledge transfer can be catalyzed by the implementation of large scale pilots and programs that provide the impetus for stakeholders to work together to engage in collaborative solutions in the demonstration programs. Will promote more comprehensive coorperative dialogue on VGI solutions.	CEC, CPUC, IOUs, Stakeholders
		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.		(1) Explore the idea of launching an inter-agency effort to fund and develop an online state-wide data wearhouse 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 recieve 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?)	All stakeholders, led by state agencies
Identify scenarios and cost targets for future technology research and development	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.			CEC , all Stakeholders
Frame the interactions between policy initiatives, market push, and demand pull factors that are required for achieving widespread deployment of managed charging and grid	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		(1) Clear mapping of roles and responsibilites 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 inter-agency 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
	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.		Requires intentional effort to develop cross agency communication and coordination on electric transportation initiatives (P1.1)	State Agencies
	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.		Consider a process similar to that accomplished under the Battery Storage Mandate procurement proceedings, which established program targets. Stakeholders and IOUs then determined the procurement policies and the funding or investment requirements. Reconsideration of authorizing V1G to be a procurable energy storage resource might be relevant.	CPUC, CEC

reliability goals and propose changes to EV deployment plans and VGI policy to address gaps.	~~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.12-11-007, Title 20, Rule 21 Interconnection, Open Access, Low Carbon Fuel Standard).~~				
	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.			
Identify the current and emergent needs of the electric grid and where feasible, determine the potential benefits from managed electric vehicle charging	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, we recommend the continuation of current efforts to explore expanding and evolving the scope of DR to become a technology-agnostic platform that can effectively integrate EVs to offer a wide range of grid services.	CPUC, CAISO, Industry stakeholders
	~~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.~~				
Align stakeholders' interests in robust open markets for smart infrastructure investment	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.		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. Adopt and enhance the VGI Glossary of Terms and definitions developed by the VGIWG.	All stakeholders, led by state agencies
	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		Reiterate our recommendations for actions proposed in E2.1 to test, validate, evaluate, and quatify the cost and benefit of the grid impact. Also, We reiterate our recommendations for actions proposed in E2.2 regarding the development and evolvement of aggregation models.	