BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Consider Alternative-Fueled Vehicle Programs, Tariffs, and Policies.	Rulemaking 13-11-007 (Filed February 23, 2018)

MARCH 21, 2018 OPENING COMMENTS OF THE JOINT PARTIES ON ASSIGNED COMMISSIONER'S RULING SEEKING COMMENT ON VEHICLE-INTEGRATION COMMUNICATION PROTOCOL WORKING GROUP ENERGY DIVISION STAFF REPORT

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In accordance with the February 23, 2018 Assigned Commissioner's Ruling ("ACR") Seeking Comment on Vehicle-Grid Integration ("VGI") Communication Protocol Working Group, Energy Efficiency Division Staff Report in the above-captioned proceeding, the Joint Parties[1] hereby submit these comments.

[1] The Joint Parties includes representatives from the California Electric Transportation Coalition, Electric Power Research Institute, Fiat Chrysler Automobiles, Ford Motor Company, American Honda Motor Co., Inc., Kitu Systems, Inc., Nissan North America, Inc., Pacific Gas & Electric

I. INTRODUCTION

In September 2016, the CPUC issued an Assigned Commissioner Ruling, providing the utilities with guidance on what types of programs the utilities should propose pursuant to the Clean Energy and Pollution Reduction Act of 2015, SB 350 (De León).[2] The guidance directed the utilities to address in their applications how they would comply with the International Organization for Standardization and International Electrotechnical Commission's ("ISO/IEC") 15118 Vehicle-to-Grid Communications Protocol in the transportation electrification infrastructure they were proposing to install, or explain what alternative approaches they proposed to meet VGI policy objectives.

Following various workshops, CPUC staff proposed developing a Working Group to evaluate the technical details of existing communication protocols and assess which, if any, might be appropriate for the CPUC to require to be used in ratepayer-supported infrastructure. The formation of this Working Group was later formalized in an April 13, 2017 Scoping Ruling of the Assigned Commissioner and Administrative Law Judges in Application 17-01-020 et al. Energy Division staff worked with staff from the California Energy Commission ("CEC"), California Air Resource Board ("CARB"), the California Independent System Operator ("CAISO"), and the Governor's Office of Business and Economic Development to convene a Working Group

Company, Plug In America, San Diego Gas & Electric Company, Southern California Edison, Southern California Public Power Authority, and Toyota Motor North America.

[2] Senate Bill 350: Clean Energy and Pollution Reduction Act (De León, Chapter 547, Statutes of 2015), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350.

comprised of 130 stakeholders interested in the state's pursuit of bringing VGI to market economically and at scale. The Working Group met from April through December 2017.

On February 23, 2018, the Assigned Commissioner's Ruling and Staff Report were issued, detailing the Working Group process and key deliverables, and including Energy Division staff recommendations for hardware functionality requirements and discussion of communication protocols. The recommended hardware requirements are proposed to apply to utility investments that support Level 2, AC, conductive, multi-user electric vehicle charging equipment. The Assigned Commissioner's Ruling requests comments on any aspect of the Draft Staff Report ("Staff Report"), as well as specific questions addressed below.[3]

II. DISCUSSION

1. Overall feedback on Staff Report

a. Does the Staff Report accurately reflect Working Group discussions?

Summary of Comments

The Joint Parties appreciate this opportunity to participate in the Working Group and provide comments on the Staff Report.

Initially, on page 12 within the Summary section, the Staff Report states "[a]s previously noted, Energy Division staff does not recommend requiring any specific protocol or protocols at this time; however, the hardware performance requirements identified in Section 5 will allow electric vehicle service equipment (EVSE) to accommodate any of the multiple protocols we think are necessary to enable VGI." The Joint Parties recommend the following be stated in the

[3] ACR, p. 5.

Summary section of the Staff Report: **(1) In stating that CPUC Energy Division is not recommending that any standard or protocol be "required," it should also be clear that a requirement is not being made of utilities in terms of *how* they execute VGI, and (2) The Staff Report should also acknowledge that VGI can be accomplished without a hardware component in the charging station**. There are a variety of ways that VGI can be executed, including methods that accomplish VGI without a hardware component in the charging station.

The CPUC's primary objective going forward should be to define what VGI grid services and use cases are the most valued, and what the business models will be to incentivize stakeholders and customers to engage the technologies necessary to provide these services.

Further, the Joint Parties also recommend:

- certain clarifications for Table 3,
- corrections on the status of various IEEE standards and EVSE hardware requirements,
- further definition of multi-user parties (e.g., excluding fleets),
- adding to the section that provides reasons for not requiring communications protocol at this time,
- edits to Figure 2 and accompanying text,
- edits to Table 4 and accompanying text,
- a new section on security be added,
- edits to Table 5 and accompanying text,
- a few corrections regarding DC charging, and
- edits to Appendix A.

Edits for Section 4 "Assessment of Communication Protocols' Abilities to Meet Requirements"

- **Edits to Table 3 –and Supporting Text**

Based on Working Group results, Energy Division staff determined that it is too early to require the IOUs to implement a single existing protocol or combination of protocols to best enable widespread, economic VGI.[4] Energy Division staff correctly notes that markets, protocols, and technology are rapidly developing. Accordingly, the Joint Parties recommend one refinement to Table 3. Members of the IEEE have passed the balloting review on improvements to the IEEE 2030.5 standard, which will enable it to support the row in Table 3 titled "miscellaneous." With the updated release, IEEE 2030.5 will support all of the functional requirements in Table 3. Specifically, the 2018 update to IEEE 2030.5 will enable it to meet the two specific requirements in the "miscellaneous" category:

a. Ability to send GPS information on charging station location, and

b. Ability to send the accurate information to charge when renewable energy is available (cleaner than grid mix).

The Joint Parties believe it is important to reflect the current status of IEEE 2030.5 and recommend a footnote in the final Staff Report to Table 3 (miscellaneous row) that explains this 2018 update to IEEE 2030.5.

- **Edits to second paragraph of Section 4**

The second paragraph in Section 4 of the Staff Report discussing the communication protocols, that functional requirements support, should be deleted. The paragraph states:

[4] Staff Report, p. 29.

The Working Group's documentation suggest that IEEE 2030.5 supports most of the use cases identified by stakeholders and can complete the communication end-to-end from PFE to EV without the need for an additional communication protocol. However, stakeholders were unable to reach consensus to support selecting IEEE 2030.5 as a required protocol for several reasons. First, other protocols have been developed to communicate specialized information between specific actors. For example, a utility could use OpenADR to communicate realtime pricing to a network service provider, which then uses OCPP to communicate a price schedule to the EVSE, which uses ISO 15118 to conform a charge rate that is consistent with a driver's preferences, which were communicated to the EVSE by the EVBS. Second, vehicle telematics may also be capable of supporting communication between a PFE and EVBS without using the IEEE 2030.5 protocol.

The Joint Parties recommend the above paragraph be deleted from the report because the reasons given for not selecting IEEE 2030.5 are not valid. Having other alternatives is not a significant reason for not selecting IEEE2030.5, or for that matter any other protocol. Conversely it could be stated the ISO 15118 / OCPP / OpenADR combination of protocols were not selected because IEEE 2030.5 is a viable alternative. The second reason given for not selecting IEEE 2030.5 is also not valid because the statement about Telematics can apply to any protocol, not just to IEEE 2030.5 EVSE communications.

The primary reason for not selecting any protocol or set of protocols is explained in the report: "*Based on working group results, Energy Division Staff determined it is too early to require the IOUs to implement a single existing protocol or combination of protocols to best enable*

widespread, economic VGI.[5] *Energy Division staff correctly notes that markets, protocols, and technology are rapidly developing and at this time we do not want to preclude any protocols or use cases that can deliver VGI value.*"

- **Explanation of why a communications protocol should not be mandated**

The Joint Parties recommend adding additional reasons on page 29 to explain why specific communications protocols are not being mandated. The Joint Parties suggest adding the following reasons:

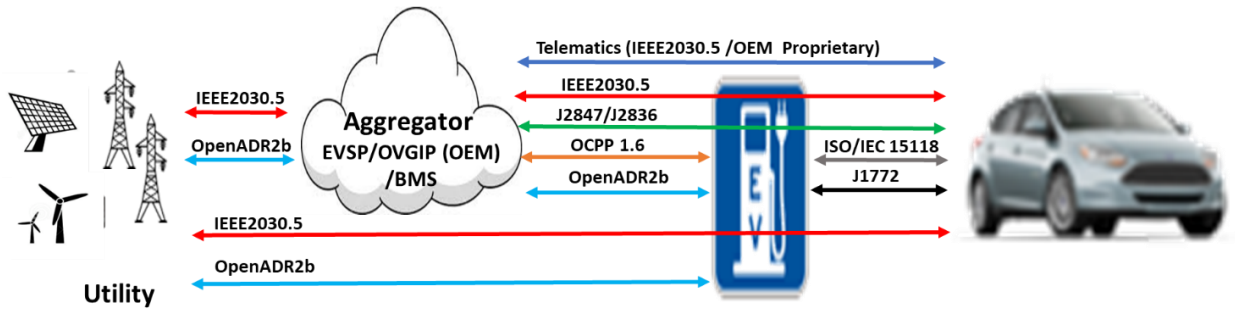
- Some of the fully-functional protocols bypass the EVSE and go directly from the PFE to the EV and some fully-functional protocols go through the EVSE. Each option can enable different business models for EV charging services. The Working Group has no basis at this time for favoring one business model over another.
- The expansion of VGI functionality and the impact on, existing communications protocols is another reason the Working Group did not recommend a specific VGI communications protocol.
- There is a need to further evaluate and understand cybersecurity implications on the specific communications protocols.
- The costs, including hardware and software implementation, and benefits of the different communication protocol options or combinations are not known at this time.
    - Completing the rest of the sponsoring agencies' workplan in 2018 and 2019, combined with our additional recommendations (see response to Question 3) should be able to provide the answers necessary to compare the different communications protocols (e.g. cost and benefit information, analysis of low-cost policy alternatives, etc.).

[5] Staff Report, p. 29.

- **Figure 2 should be deleted and replaced with the correct version**

The Joint Parties include a revised version of Figure 2 "Diagram of AC Communications Pathways," below, which accurately reflects a summary of the Mapping Sub Working Group member's graphical representations of the specific protocols. The Joint Parties request that the current Figure 2 be deleted because it does not adequately show that IEEE 2030.5 is bridged (or routed) through the EVSE or aggregator without the need for it to be decrypted and translated to another protocol. In addition, Figure 2 only addresses communications pathways for AC Level 2 Conductive Charging protocol applications and should be labeled accordingly. DC Charging communications protocols such as IEEE 2030.1.1 are not addressed.

Figure 2: Diagram of AC Communications Pathways



Note: Line through the EVSE means EVSE is acting as a bridge for the protocol to the EV – provides a pass through of the messages without translation, encryption and decryption

- **Table 2 should be qualified with additional text**

The Joint Parties recommend including an explanation in the final Staff Report stating that this is a rapidly evolving field and automakers are changing their plans in response to a variety of factors (e.g. competition, improvements in protocols, improved understanding of the business case). In addition, the final Staff Report should explain that this poll was taken in a Working Group meeting, rather than a formal survey where the automakers had time to fully consider before

replying, and that not all participating automakers responded (e.g. Tesla and Toyota). Automakers such as General Motors, Ford, BMW, Honda, Nissan, Tesla, Fiat Chrysler, and potentially others, have or are pursuing telematics for VGI communications, and the Joint Parties recommend this be added to this section of the final Staff Report.

Edits for Section 5 "Discussion of Hardware Requirements"

- **Table 4 should be deleted and replaced with the new table proposed below with accompanying text that explains the challenges associated with "Field Upgradeable"**

Table 4 in the Staff Report should be modified with the new table proposed below to better represent the recommended EVSE requirements to support implementation of optional VGI communications protocol. The Joint Parties recommend the table be revised to remove the "Domain of Communications" column. The column has no direct relevance to the categorization of the requirements. Further, the columns of the table should be reorganized to first reflect the "Requirement Description," and then the corresponding method for meeting each requirement. The "Field Upgradeable" requirement in the report table should be revised to clarify the need for software extensibility to enhance EVSE functional performance and to avoid necessity for field upgrades to the hardware.

Table 4: Minimum Hardware Functional Requirements for Level 2, AC, Conductive Multi User EVSEs to support the Protocol necessary to Enable VGI

Requirement Description	*Recommended EVSE Hardware Functionality/Physical Layer*
Provide interoperability with widely applied and implemented physical layer network connectivity	Compliant with IEEE802.11n for high bandwith wireless networking Compliant with IEEE802.3 for Ethernet connectivity for Local Area Network and Wide Area Network applications
Mitigate on-site software upgrades	Capability to update EVSE software remotely over the air
Ability to support real time protocol translation/encryption/decryption between separate standard communications protocols	Incorporate processor and IP stack that will accommodate multiple communications protocols
Ensure installed hardware will not be affected or minimally affected to add or modify functionality	Extensibility to add or modify functionality should be software based to avoid need for field upgrades to the hardware
Supports use of internet protocols for networking and management of EVSE	Compliance with TCP/IP transport and IPV6 protocol
Provide physical layer required by standards for EVSE to EV communications	Incorporate PLC communications module compliant for HomePlug GreenPHY specifications

- **A new section on security should be added**

Security is a significant element not directly specified or qualified in the EVSE baseline requirements. The topic of cybersecurity was discussed numerous times throughout the VGI Working Group meetings, especially the vulnerabilities with decryption, encryption, and translation of VGI messages within externally accessible devices, such as the EVSE. The resulting recommendation is that a separate working group dedicated to the evaluation and determination of cybersecurity requirements should be established; and that the working group should include cybersecurity experts from industry and the government. The expert's participation will ensure

access to comprehensive knowledge of cybersecurity standards and applicability to VGI communications protocol implementations.

In reference to this security issue, Kevin Harnett an IT Specialist in Information Security with the U.S. Department of Transportation, and other members of the U.S. Department of Energy and Homeland Security team, reviewed the CPUC Staff Draft Report on the VGI Communications Protocols Working Group. Mr. Harnett identified the following:

> *"There is no mention of having digitally signed firmware and encryption (which should be specified) for the EVSE over-the-air (OTA) or USB updated processes, and this is a major cybersecurity issue. The OTA EVSE capability could be used by hackers to install malware on EVSEs that could propagate to other interfaces, such as the EVs, smart meters, DER, building energy management systems (BEMS), grid, etc."*

There is also the issue of middleman-attack vulnerabilities, previously mentioned, with the decryption and re-encryption of messages within the EVSE.

Mr. Harnett also recommends cybersecurity controls relative to firmware authentication and integrity verification and transport encryption, and the need to use best practices such as EVSE third-party independent penetration testing and institution of a vulnerability disclosure program for EVSE vendors. Mr. Harnett send the e-mail to the VGI Working Group Service List on March 6, 2018. Accordingly, the Joint Parties recommend the final Staff Report include a more in-depth discussion on cybersecurity that includes the points above.

- **A more accurate description of currently available EVSE hardware should be added**

The Staff Report states "[m]any EVSPs stated that currently available hardware is more likely to be capable of supporting ISO 15118 than other protocols considered by the Working Group, but that options for hardware that supports other protocols or multiple protocols are in

development."[6] This statement is made without rationale or justification. Commercially available EVSE hardware within the U.S. do not presently support either protocol except within specific small-scale pilots. The Joint Parties recommend removing the comment or revising the sentence to state that hardware is being developed to support both ISO 15118 and IEEE 2030.5 communications protocols, which aligns with the hardware and physical-layer requirement recommendations in Table 4. Compliance to these hardware and physical layer requirements means the EVSE hardware that supports ISO 15118 should also be capable of supporting IEEE 2030.5.

- **A specific recommendation that every EVSE does not need to include the recommended hardware in Table 4 should be added**

The Staff Report appropriately discusses an alternative to include all hardware requirements on each EVSE; that instead an external protocol converter can be used to control multiple EVSEs[7], however, the Staff Report does not specifically state whether a protocol converter may be used to meet the requirements for VGI command and control through a master EVSE protocol converter at a multi EVSE charging site. The Joint Parties recommend the final Staff Report clarify that the hardware requirement can be met with the use of an external or master EVSE protocol converter that complies with the applicable Table 4 requirements. This option is important in order to provide flexibility to reduce costs for site hosts when the site hosts are implementing EVSE hardware in IOU programs.

[6] Staff Report, p. 28.
[7] Staff Report, p. 34.

- **Table 5 should be improved in several ways**

The Joint Parties recommend that Table 5 be edited as follows:

Table 5: Domain Identified Supportable Communications Protocols to Enable VGI High Leve Communications for L2/AC/Conductive Charging in Multi User Environments

Domain for Communications	***Supportable Protocols (Currently Available)***
PFE to EV	IEEE 2030.5 (Utilizes EVSE as a bridge/not a gateway) J2847/J2836 (Implementation of IEEE 2030.5) Telematics (for IEEE 2030.5 can support)
PFE to EVSE	IEEE 2030.5 OpenADR 2b OCPP 1.6
EVSE to EV	IEEE 2030.5 ISO/IEC 15118
Vehicle OEM to EV	Telematics (IEEE2030.5 or OEM Proprietary)

In the new Table 5 above, the Joint Parties: removed the word "Recommended" from the heading, and replaced it with "Supportable;" removed references to "combination of the following" because each listed protocol can stand alone within the particular Domain; and changed the table title to remove the connotation that this is directed primarily at multi-user EVSEs because some of the protocols do not necessitate direct implementation in the EVSE, i.e. Telematics and IEEE 2030.5. The Joint Parties' recommended Table 5 also aligns with the recommended Figure 2. Further, we have added a row called "PFE to EV" because automakers can be a PFE, and so can other parties, including: utilities, site hosts, third party aggregators, building energy management systems, and others.

- **Recommended edits for section 5b on recommended protocols to enable VGI**

Section 5b of the Staff Report, which suggests recommendations for communications protocols supporting VGI, is somewhat inconsistent with both the Working Group discussion and the findings articulated elsewhere in the report. While this section correctly acknowledges that VGI implementation needs communications protocols in addition to the recommended hardware

requirements, this section would more appropriately clarify the current and future trends in the communications protocols that will be supported by the recommended hardware requirements as well as some of the alternative approaches discussed within the Working Group. It was precisely these trends, future communications-standards updates and alternatives that led the Working Group to reach consensus on hardware requirements rather than recommending a specific communication protocol.

The description of convergence in the functional capabilities among the charging communications protocols on page 36 also doesn't clearly identify the directions is this area. Newer versions of OCPP are expanding functions to support ISO 15118 capabilities and the SAE suite may harmonize the DC charging communications with ISO 15118 Edition 2 while continuing to support implementation of extensive VGI capabilities using IEEE 2030.5.

- **Fleets should be specifically excluded and private workplaces should be defined**

While the Staff Report does not specifically include fleets, the Joint Parties recommend that fleets be explicitly excluded. The Working Group agreed that fleets are more like single-family homes or private workplaces and not like public/multi-user locations that often need pricing information to pay for charging. Accordingly, the Staff Report should clearly state that fleets, single-family homes (detached and attached) and private workplaces are excluded, rather than leaving this to interpretation of the terms such as "private," "public," or "multi-user."

In addition, the final Staff Report should define "private workplaces" as those workplaces where only employee charging is allowed in the employee parking lot. And "public workplaces" should be defined as workplaces with mixed-use charging, where employees and other public parties (e.g. residents in the neighborhood, or visitors to retail establishments in the neighborhood) could charge. Visitor charging would be a separate lot reserved only for visitors to the workplace.

Both visitor charging and public workplace charging would be included in the recommended requirements in Table 4, but private workplaces would not.

Edits for Section 6 "Next Steps"

On page 37, the Staff Report lists issues or recommendations that need additional action or consideration. The first bullet, which states "Identify the most prominent use cases," should be updated to instead say "Identify the most valuable use cases from the perspective of the utility and the wholesale market."

Edits for Multiple Sections

- **Recommended corrections regarding DC charging**

With respect to DC charging, the report descriptions are somewhat inconsistent with discussions of the Working Group. DC fast charging, defined in the VGI glossary as charging over 20kW, was discussed by the Working Group and discarded from further VGI communication protocol discussion because driver needs and expectations for DC fast charging are incompatible with VGI functions between the EVSE and vehicle. The driver expects to charge immediately and quickly while VGI typically implements some delay or slow-down in charging. Future VGI needs for DC fast charging may include equipment upstream of the EVSE to allow VGI functions while not impacting driver use of the DC fast charging EVSE (such as energy storage or direct communications with the driver prior to the charging session), but these details were not discussed by the Working Group. On the other hand, use-cases were submitted and discussions held within the Working Group for residential and fleet location DC slow charging, defined in the VGI glossary as charging less than 20kW, and the bi-directional power flow capabilities of the DC Power Converter System (see VGI glossary for the term definition).

Specific DC charging related clarifications:

- Page 22 - The submitted direct current flow use cases covered primarily DC slow charging with bi-directional DC power converter systems in residential and fleet applications rather than "public DC charging infrastructure" as described in the report.
- Page 26 - In footnote 24, the CHAdeMO description should be updated to be consistent with workgroup created VGI Glossary and describe this as protocol for "DC charging" not just "fast charging".
- Page 28 - In Table 2, the acronym ChaDeMo should be corrected to CHAdeMO.
- Page 32 - The phrase "The working group did not assess DC slow charging" should be removed. DC slow charging and bi-directional power flow capabilities of DC power converter systems were not included in the proposed hardware specification because they were focused on residential and fleet applications that were already exempted to allow for the wider array of individual VGI approaches that those users may want to employ. It was also not included because the diversity in DC hardware and bi-directional DC power converter system controls made a common set of hardware specifications difficult to identify.

Comments on and edits to Appendix A

Appendix A represents only a perspective on a few specific topics where the Working Group either didn't discuss or didn't reach consensus on the needs, business cases, or future of VGI. Many of these topics need a stronger understanding of VGI value and business cases obtained through studies and demonstrations as highlighted in Staff Report, Section 6: Next Steps.

It is not currently well understood whether and how much EV adoption is supported by adding VGI value relative to the impact that cost and availability of electric vehicles and charging infrastructure has on EV adoption. Therefore, it is inappropriate at this time to assume that VGI is *needed* to drive consumer EV adoption, as stated on page 43: "achieve maximum possible VGI

benefits needed to support EV adoption." Instead, this section should note that the CPUC and CEC should study the actual value of VGI, so that the CPUC can evaluate what costs associated with VGI are justified and whether the three listed performance attributes are necessary to achieve VGI net benefits.

With regards to the performance attributes mentioned in Appendix A, we have concerns about including them in the final Staff Report because these were not thoroughly discussed or vetted by the Working Group. The performance attributes do not clearly align with the VGI goals. For example, while "network speed" may be important in some contexts, it is not relevant for all VGI services. The concept of "speed" is not defined outside of an EVSE context (e.g., the PFE to EV context). In addition, there has not been a comprehensive evaluation of the need or value of frequency regulation to determine that VGI programs must meet the requirements to support frequency regulation. The CPUC should evaluate the benefits of VGI before defining performance or functional requirements as listed in Appendix A.

On page 43, Appendix A states "CEC staff presented recommendations that any EVSE requirements considered should operationalize three performance attributes further detailed below." The Joint Parties recommend that this be clarified to state that performance attributes should be set for VGI, not EVSE. The Working Group established that VGI can be enabled without an EVSE, so it is necessary to take a broader look at performance that does not assume EVSE involvement in VGI control of charging. Additionally, many charging events do not occur at EVSEs.

Regarding frequency response, on pages 43-44, the needed response speed of VGI depends on the particular VGI framework being addressed. The Working Group identified over 140 rows of possible VGI benefits in the draft VGI framework document as part of the Working

Group's Deliverable 1.1[8]. The frequency-response framework mentioned here is a possible high-value framework, but is also of limited market magnitude[9] compared to other resources, and its share of the future VGI market is currently unclear.

Regarding measurement, on page 44, measurement of electricity with an EVSE-embedded submeter was identified by the Working Group as having both functions for consumer-facing payment for electricity, as covered in NIST Handbook 44, as well as functions for utility distribution and wholesale market transaction reconciliation. The measurement location, responsible parties and certification requirements have not yet been fully harmonized among these various functional needs. In addition, the application of NIST Handbook 44 EVSE meter requirements was discussed in specific Working Group meetings and it was determined that the EVSE meter requirements needed to be addressed by a separate specific working group. There are significant cost and complex compliance issues with some of the Handbook 44 requirements, which are not directly applicable nor effective for VGI.

Regarding customer simplicity, on pages 44-45, the Working Group included customer-simplicity-related requirements[10] within the evaluation of the communications protocols as those features were part of the submitted use-cases. As identified in Table 3 in the body of the report, multiple communication standards are able to address these Smart Charging functions either alone or in combination. And, communication with an EVSE is not the only way to learn customer preferences. Rather than making assumptions about how this can be accomplished, CPUC and CEC staff should define what they want to accomplish with these performance attributes instead of making assumptions about technology and charging behavior that will change quickly as the

[8] And in order to support Deliverable 2 on the net value of VGI.
[9] CPUC-sponsored "2025 California Demand Response Potential Study" Figure 70, page 5-60.
[10] Including functional, non-functional requirements, and customer requirements.

market evolves. For example, telematics is a promising option that merits further implementation, does not involve the EVSE and is a very simple option from a customer perspective.

Given the Working Group discussion, the unique value of including these specific topics in the Appendix of the Staff Report is unclear as there are other discussed topics of significance which were not included.

b. Are there any key stakeholder comments that are missing from or misrepresented in the Staff Report?

Appendix A in the Staff Report lists various topics from the CEC, including recommendations that any EVSE requirements considered should achieve speed, measurement, and customer simplicity.[11] CEC considers these attributes essential within EVSE to remain highly-functional and resilient to changes in grid operational conditions at the transmission and distribution levels, and technologies used in the automotive and charging sectors.[12] As noted above we do not agree with many of the points in Appendix A. Also, the rationale for considering these attributes requires discussion among the collective members of the Working Group, and assessment with the Working Group determined use cases and functional requirements.

We recommend that the final staff report include 1) an Appendix B that prints the final workplan of the sponsoring agencies and notes that Deliverables 2 and 3 were not completed, and 2) an Appendix C that lists all of the topics that require more discussion from all parties including, but not limited to:

- DC slow charging at home or fleet locations
- Wireless, inductive charging

[11] Staff Report, p. 43.
[12] Staff Report, p. 43.

- DC Fast charging
- Cybersecurity and physical security needs at the EVSE.
- Metering
- Implementation costs of various communications protocols or communications-enabling options vs. value to implement
- V2G
- Implications of other regulatory proceedings (Storage, Rule 21, LCFS, etc.)
- Recommendations in the answer to the last question below

c. Are all of the deliverables referenced in the Staff Report,[13] such as the VGI Glossary, complete and accurate based on the Working Group discussions and findings?

The Joint Parties have no additions to the VGI Glossary at this time, but recommends that this glossary be considered a living document and both continually updated and used. For the VGI glossary to be a success, stakeholders must be disciplined and encourage to use the terms correctly.

The Joint Parties recommend that the Consolidated VGI Benefits Framework be added to the VGI website. This consolidated framework should be a considered a living document, posted, continually updated and used. It was developed with input from many stakeholders who examined over 10 different benefits frameworks and was invaluable in the work of the Deliverable 1.1 subgroup (glossary) and with Deliverable 2 tasks in mind. This framework is as complete as the glossary is complete.

The Joint Parties also recommend that the small changes and footnote we recommended above to Table 3 should be added to the report of the Mapping subgroup.

13 All deliverables are available on: www.cpuc.ca.gov/vgi.

2. Scope of Electric Vehicle Service Equipment ("EVSE") Hardware Performance Requirements

a. Is it appropriate, as described in the Staff Report, to exclude single-user EVSE in privately-accessible locations (e.g., home charging) from the EVSE hardware requirements for utilities?

Yes. As the Staff Report correctly noted, there are cost concerns that outweigh the additional benefits in private locations such as homes,[14] and correctly mentioned "cybersecurity, metering, and software development costs may be additional to any hardware costs."[15] Networking and physical security costs add even more costs to charging locations with restricted access such as home, fleet, and private workplace charging. While the additional costs were debated within the VGIWG, there was not a definitive answer, and some estimates were substantial especially for price-sensitive charging market segments such as homes and fleets. The Joint Parties believe that the cost to create a charging station that meets the requirements in Table 4 are not well known, potentially significant and not justifiable for these private access locations for all of the reasons in the following paragraphs and the reasons above.

While the Staff Report calls for moving forward on EVSE hardware requirements for certain charging market segments, a cautious approach is needed before expanding requirements onto other segments especially because the cybersecurity and physical security issues are significant. Cybersecurity is critical to the deployment of communication protocols that end at the EVSE. For this agency proposal, which is not defining any specific standard(s), the ultimate design of real world deployments must include requirements related to securing the hardware (e.g., anti-tampering) including the storage, processor, and communications cards. Penetration and other necessary testing should also be conducted. The Joint Parties recommend that the agency panel

[14] Staff Report, p. 32.
[15] Staff Report, p. 32.

assign the work to a subgroup to determine the requirements by utilizing as source documents existing cybersecurity requirements and best practices available from the government, non-profit and private sectors. This subgroup could also make recommendations regarding software application security for the various multi-step and one-step communication solutions from the PFE to the EV.

Low-cost and/or customized solutions for the home, fleet and private workplace charging segments should be explored first before any mandate that EVSE in these locations meet the requirements in Table 4. Continuing to provide freedom of choice for site-hosts in these locations will result in many innovative solutions including new ways to avoid networking fees and reduce up-front costs of the EVSE. Examples available today that can save an EV driver substantial amounts (e.g., $300 to $800 per year) and avoid costs to the grid include:

- Use of home or site-host internet / wi-fi to receive price signals from an aggregator
- Use of existing telematics
- Signing up for a time-of-use rate, and using the EV's dashboard or the driver's cell phone app to charge at low-cost times.
- Charging at slower speeds (e.g,1.4 kW, 3.3 kW or 6.6 kW) compared to faster speeds (e.g., 10 kW or 19.2 kW)
- Signing up for a demand response program that uses existing J 1772 PWM technology
- DC slow charging (e.g. 6kW or 10 kW) that is linked to rooftop or canopy located solar.
- Emerging AC inductive charging solutions
- Various customized solutions appropriate to homes, fleets and/or private workplaces.

b. Is it appropriate, as described in the Staff Report, to exclude workplaces or fleets that only use their EVSE for business vehicles from the EVSE hardware requirements for utilities?

Yes. Please see Section B.1.

c. If a third party, such as an aggregator, plans to aggregate residential or private workplace charging loads to provide grid benefits, would the recommended hardware requirements be appropriate to apply to these use cases?

By the word "appropriate," the Joint Parties interpret this question to be asking whether the hardware requirements in Table 4 should be mandated for residences and private workplaces. We think the answer is no. A voluntary approach is appropriate at this time, as aggregators are free to explore these markets. The Staff Report correctly finds that the hardware requirements should be limited to certain charging market segments. The issue was thoroughly discussed in the VGIWG. The proposed EVSE hardware requirements should not apply to private charging stations (i.e., charging stations in single-family homes, both attached and detached, fleets and private workplaces) including those that are either single-user or multi-user. See additional comments in Section B. 1.

Automakers can be the aggregators and bypass the EVSE.[16] The automaker solutions, using telematics[17] with proprietary software or IEEE 2030.5 protocol, could be an effective and low-cost solution especially for homes, fleets and private workplaces. The Joint Parties are actively exploring this option as it is available today and ready for large-scale demonstrations. If automakers become the aggregators and bypass the EVSE with telematics, then the EVSE that meets the requirements in Table 4 becomes a stranded asset.

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[16] For example, using IEEE 2030.5 or any of its future updates via the automaker's telematics system effectively bypasses the EVSE. Or using a proprietary protocol and the automaker's telematics system completely bypasses the EVSE.

[17] Automakers such as General Motors, Ford, BMW, Honda, Tesla, Fiat Chrysler America and potentially others have or are pursuing telematics as a low cost, low risk solution.

c. i. <u>If so, should the scope of the hardware requirements be extended to single-user residential or private workplace EVSE?</u>

No. See Sections B.1-3.

c. ii. <u>If not, what EVSE hardware is necessary to enable an aggregator to provide VGI services (e.g. demand response) to residential and private workplaces in addition to any utility program offerings?</u>

The Joint Parties recommend a voluntary approach in the residential, private workplace and fleet market segments, consistent with the Staff Report. The service providers who want to aggregate these customers can decide the best cost benefit solution especially given that there are many low-cost solutions[18] and a lot of price sensitivity from customers. In addition, this question has an inherent assumption that an aggregator is needed, which is not necessarily the case, especially for level 1 charging.

Requiring simple demand response capability where the site-host chooses between demand response capability in the EVSE or upstream at a system level, could be acceptable. However, such a scenario would only be appropriate for level 2, AC, conductive charging[19] in fleets and private workplaces. This can be done with current J 1772 PWM technology. For single-family homes where only one or two EVs use a charging station, requiring demand response integrated within the EVSE is too costly at this time due to networking fees. The main concern of all

[18] Simple timers on an EVSE or EV could meet the needs of the grid.
[19] Not for inductive charging or for DC slow charging in homes, fleets or workplaces.

stakeholders should be accelerating adoption as that will improve the business case for EVSE providers and automakers. Accordingly, adding costs should be avoided.

3. Identifying future VGI work

a. Are there specific research or technology pilots underway that could aid in identifying the value of use cases and/or the business case(s) for implementing VGI?

Below is a list of VGI project that utilities have been or are involved with. However, these projects for the most part are of little value in identifying the business case for implementing VGI. In general, the studies below, don't look at the big picture on value of VGI, and don't imply that a new, comprehensive study on VGI value / business case by the VGIWG is not needed.

Past:

- SCE's Los Angeles Air Force Base V2G pilot
- SCE's workplace charging pilot
- SCE's Irvine smart grid pilot
- SCE's residential smart charging pilot
- PG&E's vehicle-to-home pilot
- PG&E' and BMW's iChargeForward pilot
- Torrance V2G project with School buses
- EPRI's EVSE field demonstration of OCPP enabled AC charging stations at Tennessee Valley Authority included demonstration of remote control using OCPP (TVA 1-105530 Supplemental)

Current and Future:

- PG&E's Electric School Bus Renewables Integration project (SB350 PRP approved Jan. 2018)
- PG&E's Rideshare Load Management project (submitted in EPIC 3 application, pending approval)
- SDG&E electric school bus (proposed in Jan 2018 Application)

- BMW's Total Charge Management pilot (expansion on iChargeForward)
- EPRI studies funded by CEC or USDOE
    - CEC 14-086 - Distribution System Aware Vehicle to Grid Services for Improved Grid Stability and Reliability
    - CEC 16-054 - Open Vehicle to Building/Microgrid Integration Enabling ZNE and Improved Distribution Grid Services
    - DOE EE 007792 - Comprehensive Assessment of On- and Off-Board Vehicle-to-Grid Technology Performance and Impacts on Battery and the Grid
    - CEC 17-302 - Enhancing Urban Resiliency and Public Safety through Virtual Microgrids through a Public Private Partnerships
    - CEC 15-075 - Open Demand Side Resource Integration Platform
- Other EPRI programs and projects:

- DR Fast Charging for EV with Hawaiian Electric Company 1-105563/1-105564 Supplemental (This evaluation of demand response at a DC fast charger (field demonstration) is still underway and involves curtailment of DC charging sessions at a CHAdeMO charger in Hawaii.)
- Energy Management Circuit Breaker 1-106513 Supplemental (This program enables remote control and monitoring of loads at the circuit level. Includes and EV charger embedded in a circuit breaker footprint with remote control capability. Field deployment is currently active. Project will wrap up in August of 2018.)
- CEC 49ers Stadium Charging Station 1-106565/1-106457 13-606 CEC ARV-14-004. This project deployed and monitored large scale AC chargers at a public garage. Included demonstration of Open Charge Point Protocol by ChargePoint. Project nearing completion (final report is being developed now).
- Seapark Charging Infrastructure Demo 1-108803 Supplemental. This project will deploy AC charging infrastructure at a city fleet garage with multiple charging technologies. Each

will be evaluated on their merits and costs. The project runs through 2020 with deployment expected in 2019.

- SMUD PEV Power Metering 1-105787 Supplemental. This project is a lab evaluation of advanced metering infrastructure (AMI), charging stations and vehicle on-board metrology. Testing has been completed in the lab. Working on report.

b. Are there ideas for new research, development, or deployment pilots that would help utilities, electric vehicle service providers, and/or automobile manufacturers to identify the value of use cases and/or the business case(s) for VGI?

The most important part of the path forward is to understand the value of VGI benefits with funded studies and large-scale demonstrations. In order to make a business case and determine the best VGI communication protocol(s) to install on EVs, most automakers need a better understanding of the VGI benefits. The Joint Parties believe that the automakers are best suited to determine the costs of VGI communication protocol(s) given their unique vehicles and circumstances. And through funded studies and large-scale demonstrations, both the VGI benefits, as well as implementation and transaction costs—depending on the specific vehicles and circumstances—could be determined. Once the automakers and utilities understand the VGI benefits more clearly, then they can develop business cases and improve utility programs.

Two key steps are needed based on similar experience with the stationary-storage efforts and both can be funded simultaneously:

- A VGI value study on net benefits that examines promising services and benefit streams in the consolidated VGI benefits framework from Deliverable 1.1[20] of the VGI Working

[20] The consolidated benefits framework from Deliverable 1.1 lists over 140 types of VGI benefits (monetized and non-monetized) and answers questions such as who needs, what is the need, what

Group. This effort would leverage the work of the VGI Working Group's Deliverable 2, which was not finished in 2017.

- Large-scale demonstrations in 2018 and later years by automakers, utilities and others (up to 2,000 EVs) of promising use cases in several different charging-market segments (including public, fleet, workplace and homes) in order to get validation of the realizable benefits of VGI as well as costs of implementing VGI in real-world situations.[21] Demonstrations will allow parties to understand more about the ability of EV-centric VGI-communication solutions (e.g. telematics) and EVSE-centric solutions (e.g., IEC/ISO 15118 with OCPP or IEEE 2030.5) to connect EVs to the grid in a useful way.[22] Pilots and large-scale demonstrations are especially necessary to validate the efficacy of the protocol(s) implementation to execute the performance and functional requirements, verify performance and reliability of the EVSE hardware communications devices, and certify the interoperability of the applied communications protocols between all use case actors. Implementation of any standard, hardware and software, requires engineering development to ensure the complete system is integrated and passes validation testing, and any applicable certification testing.

meets the need, how is it measured, and how to meet the need. The consolidated benefits framework was used in the VGI glossary and will help in Deliverable 2.

[21] Large-scale demonstrations should also include determining monetized and non-monetized benefits, costs, performance, trade-offs, and other lessons learned, as well as the ability to meet technical and customer requirements.

[22] By "connect EVs to the grid," we mean from the PFE to the EV. Demonstrations will also allow better understanding of "one-step," end-to-end solutions (PFE to EV) and "two-step" end-to-end solutions (PFE to EVSE to EV) that require protocol translation, decryption/encryption, etc. Note: PFE is a term the VGI Working Group developed and it means power flow entity. The PFE is broad term that may include the aggregator, utility, site host, EV service provider, Energy Service Company, alternative energy supplier, energy portal, or clearing house.

This approach allows a more level playing field for different business models from the automakers and EVSE providers by including communication solutions such as telematics that are not directly affected by the agency proposal that came out of the 2017 VGI Working Group.[23] Large-scale VGI demonstrations would sustain the momentum on VGI and accelerate development efforts by the automakers and charging station developers. Timely and coordinated approval of cost recovery or funding from the CPUC, CEC and/or other agencies would facilitate near-term validation of the two above action items on VGI value.

In addition, utility lab and field tests should be conducted in conjunction with existing and upcoming EV infrastructure pilots. The need for a rigorous approach to technical requirements and validation was well shown in early utility EV charging pilots, where it was demonstrated that there was a gap in performance between what suppliers claimed and what was able to be executed in the utility space. The utilities should be encouraged to continue this approach moving forward. Because of the number of potential communications and control paths identified by the Working Group, a utility pilot approach that could be executed to rapidly assess the different systems in combination and in execution in utility space would be valuable. A test bed is envisioned, where a lab setup could swap in and out various components and test their effect and impact rapidly.

The VGI sponsoring agencies' workplan Deliverable 3 on policy recommendations should be funded in 2018, as this work did not start in 2017. Many of the best ideas to accelerate VGI are low-cost efforts that can be accomplished via policy (e.g. rates, education, charging rebate design).[24]

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[23] One of the most promising solutions is to use automaker telematics solutions as the VGI communication pathway (PFE to EV) where the automaker (or its partner) is the aggregator and no EVSE is needed for direct communication. Automakers such as General Motors, Ford, BMW, Honda, Tesla, Fiat Chrysler America and potentially others are all pursuing this low-cost, low-risk solution.

[24] See the consolidated VGI benefits framework for more examples.

The 2013 VGI Roadmap should be updated in 2018 with new deliverables, assignments to agencies, clear funding, and a more frequent process for convening all the VGI agencies and stakeholders.

An EV data-sharing effort is needed in 2018. The Joint Parties support the recommendation on page 81 of the draft 2017 Integrated Energy Policy Report for the CEC to lead a collaborative effort with researchers, local government, air district, and utility charging infrastructure program administrators, and others to share data about charging-infrastructure programs. Given that charging-station and EV data is being collected in multiple forums, the Joint Parties support this recommendation so that experts will be brought together to compare and understand existing data, and determine what gaps need to be addressed. In addition, this voluntary approach is more cost-effective and will yield better results than a mandatory data collection approach (e.g., the CEC's proposed Title 20 requirements on charging stations).

The VGI Working Group should be continued in 2018 on a less frequent basis. The informal nature of the VGI Working Group has allowed improved dialogue. In addition, it is more efficient for both the agencies and stakeholders involved. Not only should the original five VGI sponsoring agencies be involved, but staff from the Department of Food and Agriculture's Division of Measurement Standards, the CEC's Electric Program Investment Charge and demand forecasting divisions, and CARB's Low Carbon Fuel Standard program should be added to the VGI Working Group.

In order to sustain the Working Group's efforts, VGI consultants should be retained and funded by the VGI sponsoring agencies. At the last several meetings and calls of the VGI Working Group, there were constructive recommendations from various VGI consultants. The Joint Parties

agree that a more sustainable approach to the VGI Working Group and VGI Roadmap update tasks involve hiring consultants in 2018, including:

- Cybersecurity experts to address any additional needs to implementing end-to-end VGI communication protocols or comparing protocols.
- Survey experts to understand the consumer experience aspects of VGI solutions.
- Project management and report writing for the VGI Roadmap update. We note that the CEC funded a similar effort in 2013 even though the lead agency was the California Independent System Operator.
- Project management and report writing for the VGI Working Group's remaining tasks (e.g., Deliverable 2 and 3) and for the CEC's proposed data-sharing effort.

c. Are there any policy proceedings not identified in the Staff Report that should be included in the VGI discussion going forward?

Yes. CARB's proposed changes to the Low-Carbon Fuel Standard ("LCFS") regulation include residential and non-residential charging as a new way to earn "incremental" LCFS credits for being cleaner than the grid-average electricity through Time-of-Use ("TOU") credits where the carbon intensity of the electricity changes every hour over a 24 hour period in every quarter of the year. This is a way of encouraging VGI and should be included in all future VGI discussions.

The Federal Energy Regulatory Commission (FERC) proceeding RM18-9-000 "Participation of Distributed Energy Resource Aggregations in Markets Operated by Regional Transmission Organizations and Independent System Operators"[25] will discuss:

[25] Available at https://elibrary.ferc.gov/idmws/common/OpenNat.asp?fileID=14823758.

a. Information for FERC to "determine what action to take on the distributed energy resource aggregation reforms proposed in its Notice of Proposed Rulemaking on Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators (NOPR [RM16-23-000])." (CAISO currently has a FERC waiver to allow the DERP and DER aggregation rules currently in place in the California wholesale market.)

b. Issues related to the potential effects of DERs on the bulk power system. The Federal Energy Regulatory Commission also has a proceeding on Distributed Energy Resources to allow Independent System Operators in other states to do what CAISO does today.

III. CONCLUSION

The Joint Parties appreciate this opportunity to comment on the recommendations and status presented in the Staff Report. In conclusion, the Joint Parties recommend: **(1) In saying that CPUC Energy Division is not recommending that any standard or protocol be "required," it should also be clear that a requirement is not being made of utilities in terms of *how* they execute VGI, and (2) the Staff Report should also acknowledge that VGI can be accomplished without a hardware component in the charging station**.

It is worth restating that the primary objective going forward should be to define what VGI grid services and use cases are the most valued, and what the business models will be to incentivize stakeholders and customers to engage the technologies necessary to provide these services. VGI pilot programs at scale will be appropriate to vet the standards, assess cost for implementation and deployment, and verify value to the utility and the ratepayer.

The Joint Parties respectfully request that the Commission adopt the aforementioned recommendations.

Date: March 21, 2018

Respectfully submitted,

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[26] Pursuant to Rule 1.8(d) of the Rules of Practice and Procedure of the California Public Utilities Commission, I certify that I am authorized by the parties listed in the first paragraph to sign and tender this document on their behalf. Those parties are listed in Appendix 1.

APPENDIX 1

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