August 1, 2017

Dear Vehicle Grid Integration (VGI) Working Group sponsoring agencies,

RE: Action items from July 24 discussion on the VGI work plan

On July 24 we had a chance to ask questions about the July 20th update to the VGI working group work plan during our web ex meeting, and a few us made high level comments on the plan. We were directed to follow-up with more specific comments, which we provide below.

We appreciate the many additions to the VGI working group work plan which demonstrate the work plan is a living document. The new work plan clarifications reflect many things that have been adopted in practice in our calls and meetings in June and July. In this same spirit we provide additional clarifications in our attached recommended edits that we believe we have all agreed to in last several calls or the June meeting. For example:

- Determine whether a specific communication technology for charging infrastructure under the CPUC jurisdiction is needed, and
- Mapping communication protocols to VGI use case requirements

In addition, our recommended edits include:

- Referencing Appendix A as part of Deliverable 2
- Identifying broad categories of VGI costs and benefits on a qualitative basis, and if possible on a quantitative basis (Deliverable 2)
- Encouraging recommendations on pilots and demonstrations to validate VGI (Deliverable 3)
- Encouraging the formation of a subgroup on costs and benefits and trade-offs in Deliverable 2

We applaud and share the sponsoring agencies sense of urgency on VGI and make our recommendations in order take advantage of the momentum of the VGI working group to accomplish as much a possible before the working group is disbanded.

Sincerely,

Jeremy Whaling, American Honda Motor Co

Adam Langton, BMW North America

Hannah Goldsmith, CalETC

Sunil Chhaya, EPRI[1]

Dave McCreadie, Ford Motor Company

Rich Scholer, Fiat Chrysler Automobiles US LLC

James Tarchinsky, General Motors

Robert Uyeki, Honda R&D Americas, Inc.

Lance Atkins, Nissan Technical Center North America

Abigail Tinker, Pacific Gas & Electric

Bill Boyce, Sacramento Municipal Utility District

Dean Taylor, Southern California Edison

Dan Mikat, Toyota Motor North America

Attachment

[1] Serving as technical advisor only

Joint utility-automaker edits to the July 20th VGI communications working group work plan

Objective of VGI Communications ~~Protocol~~ Working Group:

The California Public Utilities Commission (CPUC) California Energy Commission (CEC), California Air Resources Board (ARB), California Independent System Operator (CAISO), and Governor's Office of Business and Economic Development (GO-Biz) are sponsoring a working group to provide a recommendation on whether the CPUC should require a communications protocol or protocols for ~~in~~ the ~~electric vehicle service equipment (EVSE) and associated~~ charging infrastructure that investor-owned utilities (IOUs) support with ratepayer funding.[2]1 To answer this question, this working group will evaluate whether any existing communications protocol(s) are necessary to enable Plug-In Electric Vehicle-Grid Integration (VGI) to be deployed economically and at scale. Effective and economic VGI, if deployed at scale, is expected to lower the overall costs of vehicle ownership and~~or~~ increase the perceived value for the customer ~~in order to~~to incentivize electric vehicle adoption. Objective is to determine ~~W~~what communication network ~~-~~requirements are ~~is~~ necessary for utility-funded charging infrastructure to minimize the risk of stranded ~~assets~~ investments and to support long-term VGI goals.

As state agencies, our overall goal is to reduce emissions both by incentivizing the switch from fossil fuel vehicles to zero-emission vehicles and by integrating those vehicles with the electric grid efficiently.

Scope:

The Working Group will examine existing communications protocols and will not attempt to create a new protocol. As part of the group, we will have some more policy-focused discussions and some more technical/engineering-focused discussions. Since we need different types of experts for different parts of this process, we have developed a schedule to help stakeholders plan their participation accordingly.

This group will focus on the light-duty vehicle sector.

The CPUC regulates the IOUs[3] and has no jurisdiction over automakers or EV service providers. If the CPUC decides to adopt a communications protocol(s) for the IOU investments based on the Working Group recommendation, it does not preclude the use of other or additional communications protocols.

There may be other policies or pilots the CPUC and other state agencies can implement to advance VGI more broadly. ~~While participants may identify these during the course of the~~

[2] In some proposed projects, the IOUs directly procure and own the EVSE; in other proposed projects, the IOUs qualify EVSE models that a customer can purchase and install. If CPUC were to require a communications protocol, it would apply in either case.

[3]

~~Working Group, T~~this working group is not expected to make recommendations for policies or pilots beyond what will apply to the ~~EVSE and associated~~ charging infrastructure that IOUs support with ratepayer funding. However, during the course of the Working Group the participants may identify recommendations for next steps to advance VGI, such as a high-level use case value and cost benefit assessment and a VGI use case implementation roadmap, ~~Rather, the consideration or implementation of such recommendations are more appropriately~~ which may be addressed for implementation under the state's work under the VGI ~~Roadmap, which is currently~~Roadmap currently being considered under the CEC's Integrated Energy Policy Report proceeding.

Policy Context:

The CPUC initiated this discussion of communications protocols because we are currently reviewing IOU proposals to accelerate transportation electrification in California over the next five years. Many of the IOU proposals include projects to install EV charging infrastructure and we are examining how to ensure their investments enable EV adoption and ~~do not result in stranded assets~~ can adapt to future VGI implementations. In our evaluation of these utility proposals, we are considering whether we need to require any protocol(s) for the utility procurement or qualification of EVSEs. Because CPUC's jurisdiction is over the IOUs and their investments, the type of protocol(s) CPUC could potentially require for utility investments is one that goes through the EVSE. While there are many additional ways the CPUC can facilitate VGI, for the purposes of this working group, we are ~~focusing~~ evaluating ~~on a~~ whether we should require the installation of specific communication technology ~~adopt a communications protocol(s)~~ for IOU investments in ~~EVSE and supporting;~~charging infrastructure to speed EV adoption and further enable EV grid services at distribution and transmission levels.

To evaluate the specific question of the necessity of communications or "intelligence" within the EVSE to enable VGI, we need to understand the broader network architecture required by various VGI use cases. We are examining a more comprehensive set of VGI requirements and the general value of those VGI products. The role of the EVSE will be defined within the context of these requirements and provide the rationale for the CPUC to ultimately answer a very specific question regarding the need for a communications protocol(s) on the EVSE to unlock the value of VGI.

The CPUC will incorporate the final recommendation of this Working Group into the record of one or more electric vehicle proceedings (A.17-01-020 et al., R.13-11-007, A.17-06-031, A.17-06-033, A.17-06-034) to receive further stakeholder feedback on the recommendation and determine whether to adopt the Working Group's recommendations.

The Working Group outputs will also help inform the ARB's SB 454 Electric Vehicle Charging Open Access Act activities and allow the CEC to understand how to better characterize electric vehicle load and infrastructure flexibility as part of its energy and transportation demand

forecasting efforts and CEC's investment Alternative and Renewable Fuel Vehicle Technology Program and research and development programs.

Strategy:

This interagency-led Working Group will identify ~~and assess~~ opportunities in which VGI can create value from multiple market participants' ~~perspectives, the communications network architecture and~~ perspectives on the ~~functional~~ VGI communications network functional requirements necessary to capture that value, and the assessment of the communications protocol(s) and ~~or~~ other mechanisms ~~that~~ to meet those requirements. The working group will allow participants to review, understand, and discuss the technical details of existing communications protocols and to assess ~~how~~ if they meet the requirements~~. for the VGI communications network architecture~~. The group will not create new communications protocols.

Expectations for Active Participants Contributing to Deliverables:

The Working Group expects that subgroups will form to assist in the development of material needed to answer the questions identified below and use the supporting documents to avoid duplication of prior work. The Facilitator will assist these subgroups in establishing a reasonable and timely review process to determine the level of agreement among stakeholders for delivered products.

Observers are welcome to attend as they are available and interested.

Stakeholder Viewpoints to be Examined:

i. EV user (driver/rider)

ii. Electric Vehicle (EV) Original Equipment Manufacturer (OEM)

iii. Distribution System Operator (DSO or Utility) and Independent System Operator (ISO)

iv. Site Host (for Charging Stations)

v. Electric Vehicle Service Equipment (EVSE) Operator or Service Provider (EVSP)

vi. EVSE Original Equipment Manufacturer

vii. VGI Resource Aggregator (for retail or wholesale energy services)

viii. Non-Participating Ratepayer or Society

Tasks and Deliverables:

Deliverable 1: Map Communication Protocols to the VGI Use Cases' Communications ~~Network s~~Functional ~~and~~ Requirements. ~~to Existing Communications Protocols~~

By referring to existing standards documentation that are relevant to California and the United States and learning from international markets where possible, identify the use cases for which VGI can provide value, the functional requirements necessary to achieve those use cases, and the network architecture(s) or pathways that meet those requirements. The VGI value could be delivered to the customer, distribution, and wholesale grid services as identified in the VGI Whitepaper and others as needed. Devices and actors within these communications network architectures may or may not utilize standards / protocols to facilitate VGI services.

Sub-working groups

1. Terms and Definitions

VGI Working Group participants will create a standard list of terms and definitions to be used within the work and deliverables of this working group, so that all Working Group participants use the same terminology. The sub-working group will review the submitted terms and definitions, and align any similar terms and identify consensus definitions where necessary. The sub-working group will present their consolidated glossary to the full working group.

2. Use Case Identification

VGI Working Group participants will submit proposed use cases for consideration and label them with the categories identified in the VGI Roadmap:

a. Unidirectional power flow (V1G) with one resource and unified actors

b. V1G with many resources and aggregated resources

c. V1G with fragmented actors

d. Bidirectional power flow (V2G)

Use cases may fit into more than one category. Once participants have submitted the categorized use cases, the Use Case Identification sub-working group will evaluate them for accuracy.

Using a standard Excel template, the use case submitters will then identify the functional and non-functional communications requirements and any other requirements necessary to achieve the use case(s) and the communication pathway(s) needed to meet those requirements. Participants can also specify alternative ways to achieve the use case requirements that do not require ~~a~~ communications technology solution. ~~protocol.~~ Communication pathways include:

a. Network Service Provider (NSP)[4] to Building Management System (BMS)

b. NSP to EVSE

c. NSP to Electric Vehicle (EV)

d. NSP to Customer

e. BMS to EVSE

f. BMS to EV

g. BMS to Customer

h. EVSE to EV

i. EVSE to Customer

j. EV to Customer

As part of the template, use case submitters will identify which communication pathway(s) are necessary to meet their use case's requirements, as well as alternatives ways to achieve the use case and other requirements (e.g. customer requirements or non-functional requirements). ~~which communication pathway(s) could be used to meet the requirements, but are not necessary to achieve the use case.~~ A small team of participants, led by Stephanie Palmer of ARB, will review all of the completed requirements ~~templates~~ for accuracy and consistency and consolidate them into one final Excel file.

Figure 1: Entities included within the provision of electricity or information during a charging event.

(Note: Arrows are not comprehensive.)

Network Service Provider

Building Energy Management System

Electric Vehicle Service Equipment

Plug-In Electric Vehicle

Customer

3. Mapping the Communication Protocols to the Use Case Requirements ~~to Communications Protocols~~

[4] "Network Service Provider" in its use here is broadly defined and may encompass any provider of a communication to an EV, including an EV OEM, EVSP, Grid Operator, Aggregator, etc.

The Mapping Sub-Working Group, ~~U~~using the final list of use ~~cases~~cases with the established communications functional requirements ~~and network requirements and communication pathways~~ identified by the Use Case Sub-Working Group, ~~the Mapping Sub-Working Group w~~shall identify **how** each existing standard meets these requirements. This may include (but is not limited to) **how** the standards implement the network architecture, commands, messages, and responses; and addresses protocol cybersecurity compliance within the network architecture. ~~ill map existing communications protocols to the requirements and communications network pathways. Participants will first brainstorm all existing protocols that should be mapped.~~ This sub-working group will require the participation of experts for each standard that is examined to explain exactly how the standard meets the VGI use case ~~communications network architecture use case~~ functional, network architecture, and cybersecurity requirements.

Based on the results of the three Deliverable 1 sub-working groups, state agency staff will develop a summary of deliverable 1 and present this to the entire Working Group for feedback. The summary will identify which communications protocols will meet the VGI use case communications functional and network architecture ~~requirements.~~requirements. ~~must or can be used to achieve each use case~~.

Deliverable 2: Costs and Benefits of Choosing a Protocol to Enable VGI

Building upon the analysis created for Deliverable 1 above, stakeholders will broadly assess the costs and benefits associated with choosing one or more communications protocols. First, the group will identify categories of costs and benefits associated with each use case. Then the group~~we~~ will compare standards against one another based on ~~which use cases~~ the resulting costs and benefits they provide. We will develop sub-working groups as necessary (e.g. identification of relative costs, benefits and trade-offs). Deliverable 2 will require ~~two~~ the following ~~-~~main tasks:

1. Identify costs and benefits of each use case and communications protocol. Consider the benefits and costs from both a grid and customer perspective. Identify relative costs and benefits from the criteria list in Appendix A ~~and~~ in a qualitative way, and if possible in a quantitative way for broad VGI categories. ~~,~~ Identify any tradeoffs. We acknowledge that costs of a protocol and benefits of a use case may evolve over time.

   a. Costs. Define costs, including opportunity costs

      i. Identify costs of each use case and categorize them (cost to EV user, cost to grid, cost to site host, etc.). If available, stakeholders may contribute verifiable quantitative estimates for elements in the architectures.

      ii. For each standard(s) or alternative communications path(s) that must or can be used to achieve the use case, how does ~~the~~ requiring the installation of specific communication technology ~~adoption or absence of the standard~~ affect the costs of

the use case compared to not having it? What factors will increase or decrease these costs?

b. Benefits. We will not attempt to assign an exact numerical value for the benefits associated with different use case~~s~~, as we do not think that exercise would be useful or timely in helping us complete the Working Group activities. Benefits and qualitative value are not limited to services for which a market currently exists and can include achievement of the qualitative criteria and policy objectives, including those identified in Appendix A~~.~~

i. List benefits and the high level qualitative value of each use case and categorize them (benefit to EV user, benefit to grid, benefit to site host, etc.). For each standard(s) or alternative communications path(s) that must or can be used to achieve the requirements of the use case. ~~use case~~, how does ~~the~~requiring the installation of specific communication technology ~~adoption or absence of the standard~~ affect the benefits of the use case compared to not having it? What factors will increase or decrease these benefits?

2. Assess whether a communications protocol, a combination of protocols, or an alternative to a protocol generates the greatest benefits for each use case and in consideration of the set of use cases as a whole.

Deliverable 3: Policy Recommendation

Provide recommendations on the market or policy actions needed to more appropriately value, procure, or put into operation VGI resources.

a. Is there a consensus recommendation for the CPUC on standard(s) to be used in the SB350 TE infrastructure investment proposals currently under review? This recommendation should be focused on the communication pathway over which the CPUC has jurisdiction: on the ratepayer- funded EVSE and charging infrastructure. Should this recommendation be aligned across other agency EV infrastructure programs?

b. If there is not a consensus recommendation, do individuals recommend other actions to ensure the utility infrastructure investments will support and accelerate TE in California?

c. Identify additional action items on standards or other issues identified in the course of the working group and identify appropriate avenue for future research or demonstration. To ensure continuous progressive development of VGI, the Working Group could recommend next step actions (with assigned ownership) that are deemed beneficial to the success of VGI in California. Recommended actions could be transitioned into related VGI initiatives and program development efforts and proceedings underway within the California Agencies and the IOUs. Examples include recommendations for implementing and evaluating promising VGI communication networks through pilot programs.