Vehicle-Grid Integration Initiative:
Expert Interview Summary

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Overview

A series of 12 expert interviews were conducted as part of this "Vehicle-Grid Integration Working Group Framing" project, representing different stakeholder groups in the VGI space. These included three California investor-owned utilities, two major automotive companies, four electric vehicle service equipment (EVSE) manufacturers, and three electricity grid service providers. The interviews were conducted either in person or by phone, for 30-45 minutes per interview. The key findings from the interviews are presented below, and a list of the interviewees wishing to be named is provided in Appendix A. The expert opinions about the overall VGI value proposition are summarized first, followed by the key barriers to further adoption of VGI concepts that they identified during the interviews.

VGI Value Propositions

The participants interviewed for this project included leading industry experts in California on the concepts of VGI, including rates, V1G and V2G. These include those with extensive knowledge of electricity power markets and opportunities for EVs and other distributed energy resources (DER) resources to participate. The complex issue of the VGI value proposition breaks down across a few lines, including type (i.e. V1G vs. V2G), applications (e.g. managing customer bill, integrating excess renewables, etc.), approach (e.g. indirect control such as through rates, direct control such as through demand response (DR) events, etc.), and the range of potential value streams that can be accessed. Potential value streams may include direct value to host sites, utility grid distribution level values, larger electricity system transmission level values, and additional potential value streams through regulatory compliance strategies. Fundamentally, VGI value questions revolve around: What are the benefits vs. the costs? How much value is associated with and created by each VGI use-case? How is value attributed to and distributed among the various players?

The views related to the VGI value proposition expressed by the experts interviewed varied both among and within the four stakeholder groups, as noted below, but first some overall key themes were apparent across all of the groups. These overall themes include:

- the important concept that VGI value estimations must now focus on *overall net value* (i.e. both benefits and costs) for each use case rather than gross revenues as have mainly been the focus in the past, and as some VGI schemes entail significant sunk and variable costs and different benefits and costs for each market player (e.g. driver, network operator, utility, etc.);
- near-term opportunity to explore the basic V1G solution focuses on: *EV charging cost reduction to EV drivers, workplaces, and fleets,* through active or passive managed charging that achieves demand charge reduction and flexible load adaptation to TOU rates, as well as pilot VGI rates;
- *the evolving "duck curve" in California represents a set of emerging opportunities for VGI*, with both load reduction and grid-service opportunities during the evening ramp, as well as with load increase and valley-filling opportunities at

other times to absorb low-cost and low-carbon renewables that may otherwise by curtailed;
- *new developments in the California Low Carbon Fuel Standard program* that now recognize VGI value in calculating electricity-sector credits are an important emerging opportunity; and
- Alignment among, as well as a clear value proposition for, the various groups of actors involved in a VGI offering is important to ensure the successful performance of VGI business models.

With regard to the views expressed by the four stakeholder groups, the electric utility group was unanimous in saying that one of the best near-term opportunities was to take advantage of their latest rate structures to manage charging for site electricity cost reduction. Some interviewees suggested indirect tools have a lot of value. For example, some individual residential EV customers could achieve significant annual savings compared to gasoline by taking advantage of the default or the best rates and cheapest adequate charging infrastructure solutions. Some larger fleet and electrified transit organizations could also achieve significant annual savings compared to gasoline or diesel by taking advantage of rate structures and managing their demand, depending on the size of the fleet and details of their flexible load characteristics. Further study is required to determine optimal rate structures and potential savings under managed charging.

The automotive companies tended to also indicate that smart charging/V1G was the clear near-term opportunity with low implementation cost and difficulty, but both mentioned V2G as well as a future concept that has promise but also some clear barriers (discussed below). Automotive companies also mentioned some near-term grid service opportunities that do not require V2G capability such as responding to DR events. Both automakers suggested that they are involved in recent pilot projects that are beginning to reveal more about the potential for VGI values to be established for certain use cases in example early markets.

The EVSE manufacturers interviewed mentioned a wide range of potential VGI value streams, and the potential to combined multiple value streams for enhanced benefits. These include taking advantage of TOU rates in California for bill savings, DR programs at workplaces for grid services, fleet VGI opportunities including with electric school buses, and residential V2G. A few of them mentioned the changing shape of the California duck curve as an opportunity for VGI to help with alleviating the evening ramp as well as valley-filling at other times of low demand.

The grid services companies also mentioned a range of potential VGI value streams. These include behind the meter DR and load shifting and load augmentation during times of excess grid power to help with “duck curve” issues in California, the potential for V2G as well as V1G concepts, transmission and distribution system upgrade deferral value, storage for local solar photovoltaics, and the potential for greenhouse gas emission reduction through greater acceptance of renewable sources of electricity.

Overall the various groups interviewed mentioned many of the same concepts but with a somewhat different emphasis as discussed above. They also identified a somewhat different set of current and prospective barriers to near and longer term VGI concepts as discussed in the section below.

Remaining VGI Implementation Barriers

The participants in the survey identified several key barriers still remaining for VGI implementation. These included technical, economic, and regulatory/institutional types of barriers. The types and specific barriers mentioned by each key group of interviewees is summarized below.

To spur VGI adoption and the success of what VGI has to offer, the electric utilities were aligned in prescribing the need for an industry-wide, collaborative focus on defining both VGI use cases and the net value for each use case. To achieve this goal, electric utilities highlighted a range of barriers. The broadest topic discussed was the implementation of VGI-related standards. Electric utilities stressed that the market should adopt currently mature, approved, and utilized standards where appropriate. At the same time, utilities recognized that new standards may be needed as the VGI industry develops[1]. Electric utilities support reviewing and exploring larger scale VGI demonstrations, both to vet the suitability of communication standards as well as to verify VGI net benefits. A related barrier mentioned is the relatively high cost of pursuing certifications (e.g. Underwriter Labs (UL) and IEEE/SAE) to expand infrastructure solutions that are relatively low cost. Electric utilities also pointed to the challenge of navigating a complex and sprawling regulatory environment, spearheaded simultaneously by multiple agencies. Lastly, as lessons learned from implementing programs, electric utilities pointed to a need for stronger education strategies and improved enrollment processes for drivers.

The automotive companies tended to focus on issues related to VGI value stream definition, consumer awareness and enrollment, and utility interfaces as key barriers. For utility procedures as a barrier, the issues raised were related to dealing with the local utility for accessing released customer data, enrolling customers in DR programs, and dealing with an interconnection procedure for a V2G-type system. One manufacturer mentioned the situation with various communication standards being considered, and some confusion among the industry about how best to employ them, as a current barrier. Also, mentioned as barriers for V2G were the issues of the lack of UL listing ability for EV onboard inverters, and the potential voiding of battery warranty for V2G usage where one manufacturer said they were taking steps to allow that under certain circumstances to evaluate the issue further.

The EVSE manufacturers that were interviewed tended to focus on access to markets and driver information (especially for workplaces), communication standards, and consumer awareness/education as key barriers for VGI. More specific issues mentioned included: 1) difficulty with conflicts between enrollment in multiple DR type programs, that is currently not

[1] Utilities expressed support for the Final Energy Division Staff Report from the Vehicle-Grid Integration Communication Protocol Working Group: http://www.cpuc.ca.gov/vgi/

allowed but frequently not a conflict for VGI based services; 2) the need to gain better access to wholesale markets; 3) relatively low levels of established values for VGI so far; 4) developing software platforms for efficiently enrolling and aggregating customers for larger grid services program participation; and 5) the desirability of standardizing on OCPP and OpenADR for the "cloud"-EVSE communication link. One EVSE manufacturer also commented that the industry rate of technology advance is outrunning the pace of regulatory procedure development, creating a market disconnect barrier.

The grid services company experts mentioned some similar themes to the EVSE manufacturer representatives, such as issues of aggregating customers for market participation and how to take advantage of opportunities with both retail and potentially wholesale markets and price structures. The grid service companies also mentioned a number of additional more technical issues and barriers such as the ability of VGI to provide local distribution level voltage support/response but without a mechanism for compensation, the inability to export power beyond the level of local loads (barring an export agreement with the utility and full interconnection), and the need to identify which meter the EVSE is connected to for Sublap zone identification purposes. Two of the three companies mentioned communication standards as a barrier, with one favoring a convergence on ISO 15118 as a leading and internationally-focused solution for the vehicle-EVSE communication link. One company also stressed the costs of CAISO metering and associated grid services scheduling as barriers for participation in the wholesale market in California.

Appendix A: Vehicle-Grid Integration Expert Interview Participation

The experts interviewed for this project included the following organizations and individuals. The project team greatly thanks them for their participation.

1. Electric Utility A, Representative Name(s)
2. Electric Utility B, Representative Name(s)
3. Electric Utility C, Representative Name(s)
4. Automobile Company A, Representative Name(s)
5. Automobile Company B, Representative Name(s)
6. Electric Vehicle Service Equipment Provider A, Representative Name(s)
7. Electric Vehicle Service Equipment Provider B, Representative Name(s)
8. Electric Vehicle Service Equipment Provider C, Representative Name(s)
9. Electric Vehicle Service Equipment Provider D, Representative Name(s)
10. Electric Utility Grid Service Provider A, Representative Name(s)
11. Electric Utility Grid Service Provider B, Representative Name(s)
12. Electric Utility Grid Service Provider C, Representative Name(s)