IMPLEMENTING VEHICLE TO GRID (V2G) FROM A FLEET OPERATOR’S PERSPECTIVE

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From A Fleet Operator’s Perspective

What is V2G, and Why/Which Fleet Operators Should Care About It?

One of the important topics in fleet vehicle electrification today is vehicle-to-grid, or V2G. The basic concept of V2G is to use the energy stored in the batteries of electric vehicles (EVs) to augment the utility grid during peak loads. Figure 1 shows the potential relative power available from a variety EVs classes during different times of the day. As can be seen from Figure 1, operators of EV fleets (“Fleet EVSE” and “Commercial EVSE” in Figure 1) are well-positioned to provide power back to the grid during peak load times, which in most major US metro areas is between 5PM and 9PM during the work week.

One of the more obvious questions regarding V2G is “what is in it for the fleet operator”? In areas where “time of use” (TOU) net metering is in effect, fleet operators whose vehicles have energy remaining in their vehicles during peak load hours can put that energy back into the grid at a premium, and then charge their EVs during super-off-peak hours. Given that super-off-peak energy costs could be as low as one-half or one-third the energy costs during peak hours, the ability to “arbitrage” TOU net metering can significantly reduce energy costs for EV fleet operators. For EV fleet operators, the general considerations to determine if V2G makes sense are:

- Are the fleet EVs generally available to transfer energy to the grid during the majority of hours between 5pm and 9pm;
- Have a large battery capacity with at least 15% of their useable capacity remaining at the end of their shift.

The reason that utility grid operators support V2G is also based on cost avoidance. While paying extra for energy put back onto the grid during peak load hours may not sound attractive to grid operators, it is significantly more economical than building new powerplants, or buying power on the open market during peak hours. Just as importantly, there are expected to be over 100 million EVs on the road by 2030, with a total energy storage capacity of about 5TWh. Figure 2 illustrates just how big of a problem this will become for electric utility providers. California’s demand alone is shown in Figure 2; other large states have similar issues.

OK – I Want to Implement V2G for My EV Fleet. What is Involved?

There are two obvious ingredients that are required for a V2G solution: an EV fleet, and a grid to plug into. For the EV fleet, there are five factors that influence how successful V2G will be:

1. Can/will your company specify & manage and control the EV fleet charging infrastructure?
(This includes ability to specify bi-direction EV charging equipment)

2. Is the intended EV’s fleet V2G compatible? (Not all electric vehicles will support bi-directional power flow)

3. What is your typical fleet duty cycle? (Do you expect your EVs will be available to put energy back onto the grid during peak load hours?)

4. Will your EVs have significant capacity available to support grid services during high demand times? Eg 15% or more of their useable capacity. (Energy/range)

5. Does your site have unusually high electrical “demand charge” cost challenges?

Initial questions on the utility side are:

1. Does your utility support interconnections of bi-directional (grid interactive) EV chargers? (UL 1741-SA Certified)

2. Does your utility support/require net energy metering with time-of-use tiered billing?

3. Are you experiencing high cost differences based on time of energy use?

The other key enablers for a V2G solution is reliable bi-directional charging infrastructure, and a software “aggregator” to coordinate energy usage with the utility provider. Each of these are described below.

A Bi-Directional Charging Infrastructure

For a charging infrastructure to be capable of supporting V2G, it must be able to both take energy from the grid to charge EVs, as well take energy from EVs and put it back onto the grid. This is known as a bi-directional charging. In the US, bi-directional chargers are typically certified under two UL standards, in addition to the UL standards that apply to all EV chargers. Those standards are:

- UL 1741-SA is a standard that governs distributed energy resources that can put power on the utility grid, such as inverters, converters, and controllers. The “SA” version of the standard came about after markets in California and Hawaii started to experience instabilities when distributed energy resources went on and/or off of the grid arbitrarily. Because of this, UL 1741-SA specifies the several operating modes that these equipment types must support to maintain grid stability.

- UL 9741 (“Investigation for Bidirectional Electric Vehicle Charging System Equipment”) is an increasingly popular standard that augments UL 1741-SA specifically for EVs. It specifies how bi-directional chargers are to be constructed and tested prior to achieving UL certification. UL 9741 not only covers the inverter/power conditioning system (PCS), but the dispenser that connects to the EV as well, and any other subsystems.

A bi-directional charger must meet UL1741-SA standards and should meet UL9741 standards for UL approved V2G operation. In the case of Rhombus Energy Solutions products, both the dispenser and PCS would be certified together (the figure below shows a Rhombus dispenser and 60kW PCS).
An Aggregator
For large fleet EV deployments, it would be both inefficient and impractical for each charger to communicate with the utility – there could be over a hundred chargers in a typical EV fleet “vehicle yard”. Additionally, the power connection to the vehicle site may not be sufficient to power all of the vehicles simultaneously requiring more intelligent management of EV charging resources.

To manage this, most V2G applications utilize a software application known as an “aggregator” (see the diagram below). Like the name implies, the aggregator talks to the chargers (and the vehicles they connected to) to understand their energy needs and operating schedule + range requirements. The aggregator also communicates with the utility transmission system operator (TSO) and distribution systems operator (DSO) to understand current and projected power availability and associated electricity rates. This operational information and market information is combined to determine the “optimum” schedule for when to put power onto the grid, as well as when to charge the vehicles, to achieve the greatest financial benefit to the EV operator.

Putting It All Together
The aim of investing in V2G technology is to reduce energy costs for owning and operating a company’s EV fleet. Bi-directional charging infrastructure typically costs more than “standard” unidirectional chargers, as well as licensing costs for the aggregator software. The Return On Investment varies but is typically shortest for bigger vehicles with larger battery packs that are parked for a large percentage of the day. For vehicles such as, school buses, and medium/heavy duty short-haul delivery trucks, these factors can result in a very short ROI. School buses, in particular, have the potential for the shortest ROI due to both their battery capacity and the extended time that they are in the vehicle yard, especially given their presence during most peak demand hours. Additionally, utility, state and federal grant programs can further incentivize V2G deployments.

Rhombus Energy Solutions: Expertise on Vehicle to Grid for EV Fleets
As a leader in the development and manufacturing of bi-directional, high-power energy systems for both vehicle charging and photovoltaic solar applications, Rhombus is an expert in high-power charging systems for EVs, and especially in the area of vehicle-to-grid (V2G) charging. Our VectorStat® hardware and software allows fleet customers to gather data from all of their infrastructure nodes, regardless of connectivity or network issues, to effectively manage their energy resources. VectorStat’s applet-based open architecture also enables the easy integration of new features and functionality, whether to support new hardware or to provide cutting-edge data analytics capabilities. Find out how we can help you build a V2G-capable charging infrastructure by contacting us at info@rhombusenergy.com.