**Vehicle-Grid Integration in the Southeast**

**First Stakeholders’ Meeting - Minutes**

**November 27, 2017**

**Participants:**

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| **Chattanooga EPB:**  Bill Copeland  **Georgia Tech:**  Marilyn Brown  Deepak Divan  Omar Asensio  Karthik Kandasamy  Rohit Jinsiwale  Anmol Soni  **Greenlink Group:**  Matt Cox | **Nissan**:  Cornelius Willingham  **NRDC:**  Katie Southworth  **Nuvve:**  Ted Smith  **ORNL:**  Tom King  Robert Wagner  **Southern Company:**  Darren Epps |

***Summary of discussion:***

As we work to define the services under the different forms of Grid Vehicle Integration (GVI) - it would be useful to also consider the timeline associated with their potential commercialization.

This project examines both the technology and business model developments needed for GVI to become a reality. There was a consensus that the technologies are largely available already, but that the business models were less well developed.

Katie Southworth mentioned that EPRI has resources that might be useful emerging from their Grid Edge Initiative. Deepak Divan will explore these.

Robert Wagner mentioned that Michael Starke at ORNL has a project with GM and ABB focused on secondary used batteries. Marilyn Brown mentioned that TVA is examining the use of used EV batteries to provide stationary storage for grid support (Joe Hoagland is a point of contact).

Ted Smith noted that Nuvve is currently in commercial operation mode providing Energy As A Service with its V2G technology in Europe and is launching projects in California with support from the California Energy Commission. They involve a combination of technology demonstration and commercialization. In addition, in Florida, work on autonomous vehicles grid integration is beginning. Outside the US, Nuvve’s upcoming V2G demonstration work with UNDP facilities in Africa could provide useful lessons.

Deepak Divan suggested specifying Vehicle to Business and Vehicle to Home as specific subsets of the Vehicle to Customer in the chart called “Modes of VGI.” They are receiving a great deal of attention currently because of their value as back-up services. Also, the G2V mode should call out “coordinated charging.”

Inputs from Cornelius Willingham:

The vehicles are V2G-ready; there is only one external device that is needed to make it happen: bidirectional chargers.

Battery cost and replacement is one of the largest costs for EVs and VGI.

On the other hand, EVs have the advantage of low O&M expenses.

Adding the CO2 savings to this would provide further addition to the benefits from EVs when computing comparative values.

Marilyn Brown noted that this GT project is seeking to add the value of ancillary services to the benefits of EVs.

Ted Smith noted that looking at fleets and commercial/fleet vehicles has worked as a good first step since the issues faced with individual vehicle owners are reduced with aggregated fleet demand.

Darren Epps mentioned the potential value of ancillary services provided by small electric trucks (e.g., the Mitsubishi EV Cantor).

For example, in the Southeast, engaging UPS (headquartered in Atlanta) and Fed Ex (headquartered in Memphis) might be particularly valuable.

In terms of the specific ancillary services that GVI can provide, frequency regulation might be saturated in some U.S. markets. The markets are much larger in Denmark than those in California. Ted Smith noted that Nuvve has estimated a 25% reduction in total cost of ownership for GVI vehicles in Europe. Specifically, Nuvve estimates a € 1400/car-year value for frequency regulation.

The “service stack” for VGI in California includes demand charge management and the reduction of high on-demand charges. The microgrid concept may also be a driver in the U.S. and Europe.

There was a general consensus that rate design is very important. There is a need to experiment with different rate models.

Marilyn Brown noted that the rising share of variable renewable energy in Europe is a key driver of the demand for such ancillary grid services in Europe. The Nordic countries have particularly high VRE penetration.

The Southeast provides a unique set of factors that will determine the applicability of different models. These include lower power prices and vertically integrated electric utilities.

Deepak Divan noted that one concern is the potential accelerated degradation of batteries due to battery cycling and the cancellation of EV warranties by OEMs. Ted Smith suggested that data and stress tests indicate that the damage to batteries can be reduced and battery quality can be maintained with proper monitoring. Batteries with GVI management can maintain their health and last longer than unmanaged batteries in EVs used just for mobility.

Darren Epps mentioned that the Southern Company is working on a Pilot Microgrid Project in Birmingham, where a “neighborhood of the future” is the focus. He also noted the particular considerations in the case of markets in the Southeast:

Low power prices

Absence of demand charges

Further, in the case of household usage, cost of battery cycling and paying the warranty may be a concern which is why starting with fleets has been the chosen route for these projects

Tom King noted that ORNL is involved in a V2H demonstration project together with Habitat for Humanity and Fiat in North Carolina. It is part of DOE’s Grid Modernization Program.

Another consideration is - how will charging demand for power be integrated with different models of tariffs - especially if fast chargers are deployed and used at a larger scale. EVs can lead to surges in demand for charging power over space and time, requiring investment in new transformers. Owners of DC fast charging stations have to pay for transformer upgrades, and they also must pay “demand charges”, which can be onerous. Tesla has paid these costs.

Ted Smith offered that estimates of the total costs of upgrading the grid to facilitate better GVI are needed. In the Netherlands, for example, 33% penetration has required a spending of € 200 bn.

Distribution feeders at the end of radial lines may be in particular need of upgrades.

Bill Copeland gave a great talk on EVs in general and the Chattanooga Electric Power Board (EPB), in particular. In his introductory remarks he noted that the addition of an EV to a household is equivalent to their purchase of four electric dryers, producing “favorable rate pressure for all electric system participants.”

He estimates that BEVs (such as the Nissan Leaf) could provide the U.S. with $450 million in consumer benefit over 20 years, based on current projections. A BEV costs $421 per year for fuel, while a gasoline car costs $1,500 for yearly fuel, on average.

TVA provides an attractive combination of price and carbon content. To optimize this advantage, TVA needs to understand value and customer behavior.

Omar Asensio mentioned his research on EV recharging behavior and the large market for driving short distances.

The group agreed that there is opportunity here for EV manufacturers to provide different options such as ICE vehicles for rent or free for a few long distance trips to EV owners as an alternative in order to encourage adoption of EVs.