



Center for Carbon-free Power Integration  
Electric Vehicle R&D Group  
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January 30, 2018

By Electronic Mail

Honorable Irene Kim Asbury, Secretary  
NJ Board of Public Utilities  
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Dear Secretary Asbury:

The University of Delaware's Electric Vehicle Research and Development Group, Principal Investigator Willett Kempton, researches and develops EV-related technologies, including vehicle-to-grid (V2G). Funded by both public and industry partners, the group develops patents, testing and deploying the resultant technologies, and convenes or participates in standards committees (IEC, SAE and NEC) to develop EV and charging station standards. Members of our group publish peer-reviewed articles and speak widely on these topics.

We appreciate this opportunity to:

- Update the Stakeholder Group on the progress of V2G: a number of projects are in commercial operation,
- Recommend that the State of New Jersey and the BPU put in place the legislative and/or regulatory structures necessary for V2G to participate in electric markets, and
- Recommend that the BPU authorize a pilot V2G program so the state's utilities can familiarize themselves with how V2G aggregation can cost-effectively provide benefits to the distribution system.

**V2G Is in Commercial Use Today**

The suite of technologies developed for V2G allows not only aggregated control of EV charging (here called "aggregated controlled charging," sometimes labeled "V1G"), but also export of energy from car batteries to the grid. Both functions can provide grid services, but full V2G has many times the market value of aggregated controlled charging. V2G systems are currently receiving payment for grid services in the following commercial markets and demonstration projects:

- In Denmark, Nissan and Nuvve Corp., a V2G services provider, offer a commercial program, with the vehicle count at 30 and expanding as fast as the supply of charging stations permits. In addition, a fleet of ten Nissan e-NV200s has been in operation since 2016, providing grid services to the grid operator, Energinet.dk.
- In Delaware, 25 V2G-enabled BMW Mini Es provided regulation commercially on the PJM market for several years beginning in 2013.

- In the Netherlands, 10 V2G-enabled EVs and chargers have been deployed in the Amsterdam area for the past two months, providing primary reserves for the grid operator TenneT. This is a commercially-qualified grid services operation, awaiting final approval from TenneT.
- The UK Government last week awarded £15.2m to a coalition of companies to deploy 1,200 V2G chargers in the UK over the next two years.

### **V2G-Capable Vehicles Are in Mass Production**

The most widely selling EV in the world, the Nissan LEAF, is capable of V2G operations.<sup>1</sup> Nuvve Corp, a V2G services provider, has added controls so that this mass-produced car, along with a small-volume production charger, is providing V2G services on both the Danish market and the Netherlands market, in both cases being paid to do so. Nuvve is working with two additional OEMs to bring V2G-capable EVs to market in the US.

The Regulatory Assistance Project's (RAP) report to the BPU, "Getting From Here to There," questions whether participation in a V2G program would invalidate EV battery warranties. However, in Europe, Nissan provides the same warranty to their batteries being used for V2G and to those used in conventional EVs. While unmanaged battery cycling can decrease battery lifetime, studies have shown that when batteries are maintained in a middle range of charge during the process, cycling makes only a minor contribution to degradation.<sup>2</sup> This process is handled automatically in V2G systems.

### **Recommended Actions**

RAP's otherwise excellent report to the BPU suggests that "while V2G may be considered by to be hypothetical or far in the future, regulators should keep it in mind as a valuable goal." If regulators merely "keep it in mind," New Jersey will effectively block this valuable resource from use in the state. Only a paragraph or two of changes to state law are needed to allow this resource to compete. By comparison, Delaware has already passed such changes, which made it possible to carry out a commercially viable pilot. During the 2018 legislative session, two Delaware legislators are introducing an update to this law, based on experience so far, to make it more widely applicable and more OEM-friendly. Florida is expected to pass a law that facilitates V2G initiatives this session.<sup>3</sup>

Legislative and regulatory changes are required if V2G is to provide the benefits of which it is capable. The following are essential:

- The customer who provides V2G services must be credited by the local utility for energy returned to the grid. This can be accomplished by allowing an EV to qualify for net metering, among other mechanisms.
- Interconnection rules should state that compliance with standard SAE J3072 is sufficient to meet utility interconnection requirements. The Society for Automotive Engineers has developed this

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<sup>1</sup> <http://nissannews.com/en-US/nissan/usa/releases/overview-2018-nissan-leaf>

<sup>2</sup> Lunz B, et al. Influence of plug-in hybrid electric vehicle charging strategies on charging and battery degradation costs. Energy Policy 2012. Kempton W, Tomic, J. Vehicle-to-grid power fundamentals: Calculating capacity and net revenue. J. Power Sources 2005.

<sup>3</sup> Florida SB 852 and HB 633.

standard specifically to allow the safe interconnection of V2G-enabled vehicles and charging stations. The UL standards for solar inverters (UL1741) commonly referred to in state regulations are inadequate for V2G.

- The state should explicitly acknowledge that an EV, which is a net load (measured at the customer meter), will not be prohibited from providing grid services.

If the Stakeholder Group would like to further accelerate V2G in New Jersey, they should encourage New Jersey's utilities to plan for making the most efficient use of V2G capabilities. The means we suggest is a V2G pilot program approved by the Board of Public Utilities. Delmarva Power is currently requesting public service commission approval for a V2G pilot in Delaware.

Our group would be happy to answer questions, provide model legislation or contribute data and analysis on any of these topics. Please contact any of us for more information.

### Disclosure

Related to commercialization, we disclose that the University of Delaware as an institution and Willett Kempton as an individual have patents licensed to, and minority ownership rights in, Nuvve, a company that is carrying out V2G commercially. Nevertheless, the University of Delaware, and specifically the authors of this briefing, are committed to providing objective, vendor-neutral information about this storage resource. Enabling this new technology in New Jersey rules would not favor any particular company, rather it would open the market to all companies providing these services.

Sincerely,



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