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VIA ELECTRONIC MAIL

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Ms. Grace Strom Power
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44 S. Clinton Avenue
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Re: New Jersey 2019 Energy Master Plan Stakeholder Public Comments

University of Delaware EV R&D Group Public Comment

I. Introduction

New Jersey's Energy Master Plan (EMP) to move towards being a cleaner state and a national leader in renewable energy deployment is commendable. The specific goals put forth in Executive Order 28 (EO28) and codified by NJ Bill A-3723 are achievable if all existing technologies and strategies are employed. Electric vehicles (EVs), in particular, are a vital component of this transition. In fact, EVs can support and actually help achieve a variety of EMP goals outlined by EO28 if they are outfitted with vehicle-to-grid (V2G) technology.

V2G-enabled EVs can export energy from their batteries and therefore can provide valuable services to the electric grid. These services include smoothing the variability of solar and wind, stabilizing the continual fluctuations of supply and demand, and reducing the need for expensive natural gas plants by offsetting peak loads. The income from these services will reduce the cost of vehicle ownership thereby enabling more New Jerseyans to drive EVs and promoting EV adoption. Simultaneously, these services reduce the cost of electricity to all ratepayers by reducing the need for new electric system infrastructure development, and thus also enable greater power distribution for EV adoption. Finally, as GIVs act as storage that responds to grid demand, they promise to be a low-cost method of achieving the EMP's energy storage deployment goal.

Enabling V2G so that NJ can reap these benefits requires the following policy actions (elaborated in Section III)[1]:

1. Adopting the SAE J3072 electric safety standard in interconnection regulations
2. Allowing for retail credit-for-export in utility tariffs
3. Raising of fast-track Interconnection Limit from 10 to 25 kW
4. Addressing the accounting issues raised by FERC Order 841
5. Including GIVs in the NJ definition of "storage"

[1] Note: These policy recommendations are the same as those presented by the EV Group during both the "Clean and Reliable Transportation" and "Building a Modern Grid" EMP stakeholder meetings.

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A. UD EV R&D Group and V2G Technology Overview

For nearly 20 years, the University of Delaware's EV Research and Development Group (EV R&D Group; alternatively, the EV Group") has investigated and promoted EV market penetration. The EV Group's Principal Investigator, Dr. Willett Kempton, founded the V2G concept and the EV Group has demonstrated and licensed V2G technology.

V2G-enabled EVs have the ability to feed power from their batteries back to the grid. EVs with controls that allow them to provide grid services are referred to as "grid-integrated electric vehicles" (GIVs). GIVs can be used as storage to stabilize the grid and earn revenue for EV owners. Advanced EV charging stations can adjust the rate at which they charge (i.e., how much power they are drawing at a particular moment) in response to signals from the grid operator; this valuable service is called managed charging. GIVs, in addition to managed charging, discharge energy on demand to be used in three ways:

1. Behind-the-meter to reduce both customer costs and demand on the grid at peak times.
2. At the retail level to export power to the grid in response to price signals or other programs designed by local utilities to cut back on peak demand.
3. In wholesale markets to provide services such as frequency regulation (discharging and charging on the scale of a few minutes, in a way that doesn't run down battery charge) and capacity (being on call to provide power during the highest demand hours of the year).

All three applications earn income (or reduce costs) for EV owners and provide services that lower ratepayer costs. Studies have shown that V2G may provide "many times the benefit"[2] of managed charging alone.

Commercial projects are earning revenue of up to $1,500/EV/year in Denmark, the Netherlands, and France. A UD project participated in the PJM wholesale market from 2013-2016, earning $1200/year/EV. A new UD project, with charging stations capable of exporting up to 1 MW of power, is currently going through the approval process to participate in PJM wholesale markets.

While there are several organizations discussing the potential of EVs as storage, the EV Group has gone a step further and is actually using V2G technology for grid services. We suggest that this is one measure of the relevance, and practicality, of our comments. Currently, the Nissan LEAF is V2G-capable. Other automakers will follow with V2G-capable production models once the right policies create a market opportunity. Automakers who have made public V2G announcements include Nissan, Mitsubishi, Honda and Bluebird.

The benefits of V2G go beyond the financial gains to a customer. In addition, V2G stands to be a valuable component of New Jersey's efforts to achieve New Jersey's clean energy goals, including expanding storage, supporting clean and reliable transportation, and integrating greater amounts of renewable energy generation.

[2] Jonathan Coignard, et al. (Lawrence Berkeley National Laboratory). (2018) Clean vehicles as an enabler for a clean electricity grid. *Environmental Research Letters*, 13 (2018) 054031.

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II. Supporting EO28 Goals

B. Providing Cost-Effective Storage

Governor Murphy and the New Jersey legislature have tasked the Board of Public Utilities with recommending how the State's energy storage goal of 600 MW by 2021 and 2,000 MW by 2030 [EO28] can be achieved. We explain here how electric vehicles (EVs) can help reach this goal at a lower cost than relying solely on stationary storage.

How much does V2G cost in comparison to stationary batteries?
At the end of 2017, the cost for a complete stationary battery system averaged $850 per kW for utility-scale, and much higher for residential.[3] Costs are dropping yearly, but it's likely that these systems won't be economically viable for some time without incentives.

The EV R&D group estimates that adding bidirectional (V2G) capabilities to an EV charger will add in the range of $200 - $500 to production cost. An additional $200 of equipment would enable the system to respond to grid operator signals. For a 6.6 kW Nissan LEAF, that would be $700/EV or $106/kW for bidirectional storage. So, in total, $850/kW for a stationary battery versus $106/kW for V2G storage.

How much storage capacity can EVs provide in New Jersey?
New Jersey has set a goal of 330,000 zero-emissions vehicles (ZEVs). Could this goal theoretically also meet the State's storage goals of 600 and 2,000 MW? At 6.6 kW/EV, 330,000 EVs would be 2,178 MW of storage, more than enough to meet even the 2030 storage goal. Although not all EVs will have V2G capabilities, and not all will be connected to the grid at all times, this simple calculation illustrates that the NJ target of EVs alone could be a significant component of New Jersey's storage capabilities.

C. Supporting clean and reliable transportation

V2G and GIVs have the ability to supplement the effort to transition to a cleaner and more reliable grid and increase the number of ZEVs in NJ to 330,000 by 2025 [EO 28] mentioned above. The following topics address the variety of ways V2G-enabled EVs can support this EMP goal.

Reducing the need for new infrastructure to manage increased EV load:
As more EVs are adopted, greater demand for electricity is put on the grid and the need for infrastructure investment increases. However, V2G and similar managed charging methods can shift load to off-peak time. It therefore can reduce capital expenditures and simultaneously reduce rates and cost of electricity to all ratepayers.

Improving affordability and accessibility of EVs:
Income from V2G services (as demonstrated by commercial operations in PJM and Denmark), with some portion going to the EV owner, reduces the overall cost of vehicle ownership, allowing more New Jerseyans to drive EVs. This also provides an additional incentive to purchase.

[3] For 30-minute capability. Green Tech Media. *Energy Storage Monitor Q4 2017*

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Supporting clean transportation in NJ Transit and state fleets:
The high investment costs of electrifying transit busses and school busses can be mitigated by making the vehicle V2G-enabled, and thus able to earn revenue. Transit vehicles also have regular schedules, meaning that grid services can be easily pre-scheduled. Service reliability will therefore not be undermined.

A pilot for a V2G bus program has been filed by Delmarva Power & Light in Delaware and similar pilot program is in operation in California. V2G school busses are being developed and would be available for such programs should NJ seek to pursue them to reduce their transportation's carbon and diesel footprint.

D. Greater Renewable Energy Integration

NJ EO28 sets a goal of "total conversion of the State's energy production profile to 100% clean energy sources on or before January 1, 2050…" This includes support for solar and substantial offshore wind development goals (offshore wind goal of 3500 MW). Renewable energy variability at high penetration complicates grid integration if it necessitates fossil generation backup, or alternatively, storage. GIVs provide grid storage that can assist in smoothing solar and wind variability and reduce the need for expensive natural gas.

III. Policy recommendations

V2G faces regulatory barriers that inhibit market penetration. The following policy actions are needed so that New Jersey can capitalize on V2G benefits that support the State's transition towards a cleaner economy:

1. Adopt SAE J3072 Safety Standard

Allow for interconnection of GIV systems using the industry safety standard created by the Society of Automotive Engineers: SAE J3072. This standard ensures that the charging station will act as a protective gatekeeper, allowing only approved EVs to export. SAE J3072 is compatible with the National Electric Code and incorporates IEEE 1547 by reference. The same standard has been cleared with relevant stakeholders in Delaware with no opposition from utilities, munis, or state agencies and a bill including it among acceptable interconnection standards will be introduced into the legislature (as all electric safety standards required for interconnection are specified in the DE legislative code) in January 2019.

2. Allow for retail credit-for-export in utility tariffs

There is need for a model utility tariff that would ensure EV owners are billed for consumption and credited for export. In this tariff, credits should be provided against the customer's bill in dollars or kWh for export. (As with any storage, it is important to remember that EV consumption is always greater than production.) If metering, accounting, and tariff allow, crediting in dollars (at the rate

per kWh in effect at the time of export) has advantages over crediting in kWh, including incentivizing response to time-of-use rates.

3. Raise the expedited (Level 1) interconnection limit from 10 to 25 kW

The Interstate Renewable Energy Council (IREC) reports that "systems up to 25 kW are unlikely to cause adverse system impacts and thus can be safely connected with a simple screening process."[4] As such, NJ should raise the level one interconnection limit from 10 to 25 kW to ease interconnection for small technologies for which expensive interconnection studies and processes are unnecessary.

4. Allow GIVs to compete on an even playing field with transmission-connected storage in wholesale markets

FERC Order 841 (February 2018), when implemented by RTOs, will allow all storage systems to purchase at wholesale rates the portion of their charging energy that is later resold in wholesale markets. For behind-the-meter storage, this relies on voluntary utility cooperation in tracking end-use vs. wholesale charging energy. FERC calls this "netting out." The BPU should have utilities evaluate the feasibility of netting out accounting. If netting out is found not to be feasible, then retail credit-for-export is essential (per policy recommendation two).

5. Explicitly include GIVs in the New Jersey definition of "storage," and make them eligible for all storage incentives

Grid-integrated vehicles do, as we have shown, have the ability to act as storage and provide storage-related services to the grid. GIVs, therefore, should be explicitly included in policies and incentives that enable and support storage.

Additionally, beyond amending the necessary policy recommendations above to enable V2G, New Jersey can further incentivize this technology by:

1. Permitting utilities to rate-base V2G pilot programs
2. Interpreting the state's storage goals, which are stated in megawatts, in a way that fulfills the state's intent to maximize storage benefits. This would mean setting a megawatthour goal in line with current technology, including utility-scale batteries which provide power for several hours.

[4] Priority Considerations for Interconnection Standards: A Quick Reference Guide for Utility Regulators, IREC, August 2017. For the recommended standards themselves, see: Model Interconnection Procedures, IREC, 2013. https://irecusa.org/publications/model-interconnection-procedures/

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Conclusion

In short, in order for NJ to achieve their EMP goals, the State and the BPU in particular will need to take advantage of all existing and emerging technologies. V2G is a triple opportunity: it provides storage, cleans up transportation, and lowers ratepayer costs. Incorporating low-cost storage from V2G can make these goals more attainable and more cost-effective. However, V2G's benefits can only be taken advantage of once these barriers are removed, through BPU code amendments and/or through utility action like those above.

UD's EV R&D Group has extensive experience in this field and has been a leader in researching and implementing V2G technology and EV policy. We offer to be available for additional discussion and questions regarding our analysis of existing barriers in NJ and ways to solve them, and related EV policies.[5]

Respectfully,

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[5] The EV Group has written policy briefs and conducted literature reviews on policies that have demonstrated effectiveness in promoting EV adoption and market penetration. We would be glad to provide expert commentary on our research or share the research itself should the EMP committee be interested.