Department of Energy
Washington, DC 20585

June 19, 2018

MEMORANDUM TO THE DEPARTMENT OF ENERGY
ELECTRICITY ADVISORY COMMITTEE

FROM: Bruce J. Walker
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SUBJECT: DOE Response to High Penetration of Energy Storage Resources on the Electricity System Recommendations

I would like to thank the EAC for their recommendations regarding future scenarios involving high penetration of energy storage resources. The four scenarios that are laid out based on the drivers for deployment (policy or market) and the relationship grid operators have with energy storage (tight or loose) are relevant and formative examples of future possibilities.

I look forward to continued discussions on the path of our energy storage program and am committed to ensuring a strong and fruitful working relationship between the Committee and this office.

Thank you.

DOE Response to the Electricity Advisory Committee Recommendation:
High Penetration of Energy Storage Resources on the Electricity System

Regarding the recommendations, we have the following comments grouped by the stakeholders impacted.

Grid Owner/Operator

- Certainly, reliability modeling tools and probabilistic forecasting methods should be developed and utilized. Some of our previous work on PV performance and reliability may be leveraged in the new context of energy storage resources (http://energy.sandia.gov/energy/renewable-energy/solar-energy/photovoltaics/pv-systems-and-reliability/).
- Research efforts into the cyber-hardening of grid tech is a very important topic and one that we are currently looking into (https://www.energy.gov/oe/activities/cybersecurity-critical-energy-infrastructure), (https://www.inl.gov/article/national-grid-resilience-and-cybersecurity-testing-capabilities-expanded-at-full-scale/) .
- OE Energy Storage program is supporting the development of a comprehensive energy storage valuation, analysis and modeling open access software tool that can be used by the industry. Beta version of the toolkit will be released later this year (http://eesat.sandia.gov/wp-content/uploads/2017/11/16_David_Copp.pdf). This tool kit will also have additional capabilities for optimal use of energy storage in microgrids. For example, currently Microgrid Design Toolkit (http://www.sandia.gov/CSR/_assets/documents/MDT.pdf) is a planning and modeling tool to address system requirements applied to microgrids. These capabilities will be incorporated into the new toolkit that will allow optimal selection of energy storage in the context of microgrids.
- Addressing challenges associated with reduction in system inertia is an important recommendation, and OE Energy Storage program is supporting the development of new control strategies, power electronic controllers, and protection systems for this purpose. The program is currently supporting research on developing coordination algorithms to enable optimal charging of battery resources while simultaneously supporting local demand and grid essential reliability services and market considerations. A summary of

this activity is summarized in a review paper (https://ieeexplore.ieee.org/document/8016321/).

Policymakers and Regulators

- The reliability modeling tools listed in the grid owner/operator recommendations should include frameworks to quantify and value reliability and resiliency. Definitely the value of resiliency should be investigated with the opportunity for storage to be economically compensated for providing reliability and resiliency.
- Research on minimum technical and economic requirements enabling greater DER interconnection or grid defection seems vague. Couldn't this be technically done now? Perhaps it is more of an economic, or even social, problem. A standard set of protocols that establish roles and responsibilities of customers, utilities would be very useful but could potentially change rapidly with the evolving energy landscape.
- Rate design, regulatory, and policy best practices are very useful but difficult to develop. This needs a deeper collaboration across regulatory, policy and market operators.
- EAC recommendation on convening working groups to resolve conflicts between policy and free market behavior is important. OE Energy Storage program has supported development of working groups in several domains, especially as they related to industry standards through IEEE (http://sites.ieee.org/pes-essb/), with various stakeholders in energy storage safety and reliability (https://share-ng.sandia.gov/ess/ess-safety-forum-2017/), (https://events.pnnl.gov/Default.aspx?topic=Energy_Storage_Systems_Safety_and_Reliability_Forum_2018).
- We agree with EAC recommendation on the need for research on market design for transactive and flexible markets and have done work on transactive energy and control for buildings-grid integration. OE has supported early work in this area (https://bgintegration.pnnl.gov/transactivecontrol.asp) as well as work on a platform for communication between energy devices and resources for information gathering, processing, and control actions (https://bgintegration.pnnl.gov/volttron.asp). This further needs to be extended to include distributed energy storage.

- Researching business and regulatory models, roles, and platforms seems very wide-open, and evaluation of two-way subscription and spot distribution tariff alternatives seems to fit within that scope. While this is important, this is primarily a market function.
- OE Energy Storage program continues to update and fund publicly available information on grid-connected storage deployment and policies through the DOE Global Energy Storage Database (http://www.energystorageexchange.org).

Market Designers and Facilitators

- Regarding "What role would the DOE play in facilitating market designs apart from policy and regulation making?" Including a separate scenario where "microgrids dominate the landscape" does not seem particularly useful since, with high penetration of energy storage resources, microgrids can be arbitrarily formed, dissolved, or changed on-the-fly. This can likely be done on defining and designing market structures for microgrids satisfying certain criteria.
- On the recommendation "Evaluate energy storage deployment in varied topologies and for a wide range of functions and uses," OE Energy Storage program has supported analysis and reports outlying the varied functions and uses energy storage can provide (http://www.sandia.gov/ess/publications/SAND2010-0815.pdf). This early work has led current market designs that incentivize and compensate energy storage resources across the country.

Consumers

- The recommendation to "Support development of storage technologies that can operate as part of a microgrid system" seems redundant or unnecessary as the capability to operate as part of a microgrid will be inherent in energy storage technologies if they are designed to operate alongside other DERs.
- All others seem like excellent recommendations.

All Electricity Market Players

- Regarding the development of modeling tools and more elaborate scenario analysis methods, this is area of active research of the OE Energy Storage program For example,

as the distinction between distribution and transmission systems becomes less clear, the ability to simulate and analyze the impact that energy storage will have on the entire interconnected system will be crucial. Currently, distribution and transmission systems are simulated and analyzed separately.

I hope you find this feedback useful, and if you would like to discuss further, my staff and I are available and look forward to continued interaction.