



**U.S. Department of Energy**  
**Electricity Advisory Committee Meeting**  
**National Rural Electric Cooperative Association Conference Center**  
**Arlington, VA**  
**October 18, 2018**

**Meeting Summary**

## PARTICIPANTS

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### **Panel: Approaching Gigawatt-Scale Storage Through Emerging Technologies**

John Adams, Smart Grid Subcommittee Chair, introduced the panelists, which included:

- Vincent Sprenkle, Technical Group Manager, Pacific Northwest National Laboratory (PNNL);
- Kelly Speakes-Backman, Chief Executive Officer, Energy Storage Association;
- Troy Miller, Sales Leader, Energy Storage, North America, General Electric;
- Pete Falcier, Vice President, Analytics & Regulatory Affairs, GI Energy;
- Ted Ko, Director of Policy, Stem, Inc.; and
- Susan Mora-Schrader, Director, Utility Initiatives, Exelon Corporation.

#### *Vincent Sprenkle, Pacific Northwest National Laboratory*

Dr. Sprenkle spoke on his detail at the Department of Energy's (DOE's) Office of Electricity (OE) within the Advanced Grid Research and Development (AG R&D) Division to support the Energy Storage Systems program. He began his presentation with an overview of OE's purview within the power system and its emphasis on the bulk transmission system. He went on to describe the Energy Storage (ES) program's emphasis on electrical energy storage and, in particular, batteries, due to the fact that other offices within DOE handle other forms of energy storage, such as thermal storage and pumped-storage hydropower.

He said the OE ES program's primary focus is to lower the cost of batteries while improving a system's ability to capture revenue streams to create additional value. Additionally, Dr. Sprenkle introduced the program's four objectives.

Dr. Sprenkle next spoke on the subject of cost-competitive technology, with a historical look at vanadium "V/V" flow battery research. He said that research in 2012 showed that 42% of the cost of V/V Flow Batteries was for the membrane, with 60% of that cost found in the chemicals themselves. He said that this finding focused PNNL's research efforts and could lead to future coordination with other Labs through a 5-year roadmap that has already lowered the membrane to 8% of the total cost, with 60% of that cost still due to the chemicals, and lowered the overall system cost from \$615/kWh to \$275/kWh. At this point, he felt it was clear that there would be diminishing returns to lower membrane cost and that the research therefore would need to consider other areas for cost-savings. He added that this research effort also led to the spinoff of three new companies and ten new licensees. Dr. Sprenkle went on to highlight where the research may go next. In this case, he said the vanadium material was 60% of the cost and that it wasn't feasible for the Labs to lower the commodity price of the material, so, when they look at how to reduce costs further, PNNL determined it is essential to look at other chemicals. In particular, PNNL wanted to examine organic materials that are earth-abundant, water-soluble (for safety), and more readily available with a price target at the direct current (DC) level of around \$100/kWh. He said that making an organic molecule stable over the number of cycles needed and making it soluble in water were both significant challenges, but noted they are having good success with experiments and that the Lab teams are continuing that research.

Dr. Sprenkle mentioned Assistant Secretary Bruce J. Walker's challenge to the OE energy storage research teams to focus on three main technologies areas towards maturity. Dr. Sprenkle echoed the necessary criteria for success, including identifying earth-abundant materials, optimizing the existing supply chain, and ensuring safety, adding that the redox flow batteries with water-soluble organic materials satisfy those conditions. Then, he mentioned that though zinc-manganese oxide, the typical alkaline materials found in a standard AA battery with a single charge, is widely available and very cheap, that they face challenges making batteries of this type reversible and with a long-lasting life cycle. However, he said this material is about \$25/kWh and the existing manufacturing base creates a promising opportunity for grid-scale storage.

Dr. Sprenkle said the third material of research was sodium-based batteries. With sodium batteries, he said the primary driver is that their annual production rate to lithium is 1000 times higher, but at about 100 times lower cost. As lithium eventually reaches a cost reduction point that bumps up against the bill of materials, Dr. Sprenkle said they could gain another 30% reduction in cost by introducing sodium. He characterized the challenge as bringing the battery's performance up to a point at which it is useful in the same manufacturing infrastructure currently in place. He said OE is also looking at sodium-metal and that sodium-metal predominantly has been sodium-sulfur technology that was developed by NGK, which is a typical 6-8-hour battery system, but for which costs have not come down. Manufacturing costs are high and there are safety issues with that material, he said, so OE is trying to address those, ultimately looking to reduce the cost of these systems at a DC level to \$140/kWh.

In all these efforts, he said OE is trying to establish metrics for each program, which leads to the challenge of seeking a single metric for energy storage. Dr. Sprenkle said that what is commonly understood today is that the value of storage is highly dependent on location. He gave the example of many companies finding applications now where they can justify current storage pricing as economical. He said that the goal is for OE and the National Labs to drive these technologies as far as is reasonable and find the best options to do so, with the understanding that there will be a large market when economical goals are reached.

Next, Dr. Sprenkle spoke about the second energy storage objective for OE's Advanced Grid R&D Division, Safety and Reliability. He said that work on this objective began with a 2015 DOE safety document that identified three different priorities in terms of safety – research, education and outreach. For the research priority, he gave the example of tools developed at Sandia National Laboratories that look at how to handle fire propagation and tracks monthly codes and standards updates. He also said that effort led to the Energy Storage Safety Collaborative, now made up of over 100 individuals and organizations. He mentioned that the program organizes a yearly safety and reliability forum.

Next, in regard to reliability, he said that utility staff have requested a way to incorporate predictability within an energy storage system, wanting to know that, when an asset is called upon, how much power and energy will be coming from that system. As such, this is a focus of the reliability objective. Dr. Sprenkle said the second reliability objective is developing an independent evaluation of how these systems can be expected to perform. He said his effort

started out at a small scale using lithium-ion due to the extensive private sector engagement on the material. While he said OE does not support materials research on lithium-ion, he said that OE does support research examining the reliability and degradation of these batteries in various grid functions. Dr. Sprenkle then showed a graph of various grid applications that suggested lithium-ion was particularly well-suited for frequency regulation. With testing, he said researchers are also able to track the degradation of the system over its lifetime and that this testing provides further insight into how these batteries perform at different state-of-charge windows, adding that this research could potentially lead to prolonging the lifetime of assets as they feed into continuously smarter controls. He said OE is also moving to kilowatt-scale module testing, which he said will provide a predictive understanding of energy storage system lifetime while providing an independent validation of performance.

Dr. Sprenkle next expanded on OE's regulatory environment objective, speaking first about their supported field testing. He also announced a new policy database, about to publicly launch, that details energy storage policies from across the country. He said the database has been a great tool for when policymakers in the same place need to see what others are doing. The next subject he covered was the industrial acceptance priority, which includes support for roughly 45 MWh and 134 MWh at 22 sites, deployed through both procurement and commissioning. He said these systems support research on testing and evaluating installations. Dr. Sprenkle highlighted a couple of valuations projects in both market areas, as well as vertically-integrated areas where there is more of an avoided cost process. The first example he gave was from Sterling, Massachusetts and highlighted the annual peak savings, in which there was an additional savings of \$125K through the 2018 heat wave, avoiding high peak charges. Next, Dr. Sprenkle discussed an AVISTA Turner system process, which was deployed at Schweitzer Engineering and that highlighted that the outage management of critical loads was extremely important. While the project didn't meet the required revenue from a utility perspective, he said the customer-side benefits were massive in the industrial setting and easily outweighed the full cost of the project. Lastly, Dr. Sprenkle discussed the Orcas Power and Light Cooperative's storage system project for transmission deferral. He said that the benefits show that transmission deferral represents a little over 50% of the value. However, this project was also tied to community solar which lead to a \$1.4 million cost against the utility, but this benefit flows to the customer, he stated. These evaluations have a very high fidelity at the local level, he said, but that it needs to come to a system level in order to start capturing behind-the-meter (BTM) data and generation data with the same level of fidelity and can obtain the whole value stack in order to incorporate more customer and societal benefits. This is an area where higher-level planning and design tools would help, he said.

Mr. Adams then introduced the rest of the panel.

*Kelly Speakes-Backman, Energy Storage Association*

Ms. Speakes-Backman began her presentation discussing the Energy Storage Association (ESA), the national association representing energy storage in all its forms, comprised of members across the value chain. She said that the members bring perspectives from their diverse backgrounds to promote the widespread deployment of energy storage in all its forms for a more sustainable, efficient, reliable, and affordable grid for all. She said the organization

recently launched its *Vision for Energy Storage* study to model a clear and actionable pathway to 35 GWs of storage by 2025. The major takeaways from the research she said show that the economy is electrifying at a rapid pace and that the cost of outages is going up. She said the organization sees a bulk of those installations in the Northeast and the Southwestern states, including Hawaii, with most of the installation taking place by 2025. She said the organization's modeling also identified that much of that installation will be BTM. The applications of it she said are demand response, ramping, Volt/Var, transmission and distribution (T&D) support, capacity, and black start capabilities.

Ms. Speakes-Backman expanded on the market drivers, including the electrification and digitization of our economy, the rising cost of disruption (i.e., outages, surges, spikes, etc.), and demands for flexibility. The benefits of 35 GW of storage includes \$4 billion in operational cost savings as well as considerably cleaner air, she said. She continued by saying that the main barriers to this level of energy storage are the lack of effective means to value and compensate storage for its capabilities. She said that the recent Federal Energy Regulatory Commission (FERC) Orders 841 and 845 are removing barriers, and that her organization is very excited to work with the regional transmission operators on related developments.

Ms. Speakes-Backman went on to describe the essential policy considerations for storage which include removing barriers to access, positioning storage competitively, and creating a means to value storage's flexibility. She said ESA promotes these considerations and is pushing states and commissions to include storage in long-term resource planning. Lastly, Ms. Speakes-Backman said that the organization wants to create more paths that value storage's flexibility to support resiliency, security, and other benefits. Ms. Speakes-Backman concluded with a brief call to action to engage legislators on these issues.

Troy Miller, General Electric

The next speaker, Mr. Miller, described his perspective from General Electric (GE), first giving an example from past technology transformation change. He gave the example of the early 1900s, where cities were unsure what to do with horse manure, which he pointed out was a moot point by 1913, when cars replaced horses. GE spends a lot of time looking at markets and examining rapid change over 10-year periods and the rapid generation mix that are currently underway, Mr. Miller said.

Mr. Miller described what's driving current market changes, mentioning decarbonization, digitization, decentralization, the changing demands of customers, and customer impatience over the speed of change. He continued by sharing a brief history of storage at GE, starting back in 2011 with a standalone system. By 2016, he said, systems were co-located. At first, the systems were largely sodium-based with research funded by the Office of Electricity and the National Labs, he said. Then, through 2017, he said system design changed to thermal-hybrids with fully integrated systems. Now in 2018, he said they are using reservoir systems.

Mr. Miller then continued with a specific project example in the Imperial Irrigation District in California. The system has traditional black start capability, allowing operators to create a microgrid to black start the District's gas turbine. The system also captures other essential

functions, he said, like participating in spinning reserves market without having to use the gas turbine. He mentioned that the project won Innovation of the Year 2017, and that he thinks this type of project represents a major development for the completely renewable generation goal that California is trying to achieve.

Next, Mr. Miller discussed a 41 MWh project based in the United Kingdom merchant market, in an existing building with Arenco for Grid Services. He said the system participates in UK's ancillary services market with a 420ms activation time and noted that these systems are getting bigger, which grows the value.

Next, the panel took questions.

Shaun Mann asked Mr. Miller why the hybridized systems are co-located. Mr. Miller responded that the controls are hybridized because if the unit was external, then the system wouldn't operate under the same interconnect, which he identified as what provides a lot of the value as it limits the stops and starts on the turbine, prolonging its life and reducing maintenance needs.

Clay Koplin touched on Assistant Secretary Walker's challenge of lowering the national grid spinning reserves. He asked, given the current economic climate where large generators are being decommissioned, if Mr. Miller was familiar with the ability to leave spinning generators in place to provide ancillary services. Mr. Miller said he knew of the concept, but that he did not know of that specific Wyoming-based GE project. Mr. Miller thought the idea had potential to provide tremendous value.

Delia Patterson asked Dr. Sprenkle how OE looks at time horizons for the three battery technologies and asked if he had any insight as to which may be the most promising. Dr. Sprenkle replied that there are roadmaps with yearly targets and that these technologies are typically assessed over a 5-year period. While these three are the focus, he said there are other technologies that could see breakthroughs and could then be elevated.

Ms. Patterson then asked about the availability of the policy database and how it will be publicized. Dr. Sprenkle responded that it will be available on [sandia.gov/ess](http://sandia.gov/ess). OE Deputy Assistant Secretary (DAS) Katie Jereza added that the database would also be made available for the EAC as well.

### *Pete Falcier, GI Energy*

Mr. Falcier then began his presentation, discussing his work at GI Energy and his background with on-the-ground development work, particularly on combined heat-power (CHP) systems in large office towers. He said that much of the experience he brings to storage comes from his CHP on-site development work. Mr. Falcier said that over time, his work grew into regulatory work as he began using his analytics and data modeling experience to support the creation of tariffs.

Mr. Falcier went to describe on how GI Energy fits within the Shell family of businesses and briefly covered the organization's history. He continued by speaking about the New York

Reforming the Energy Vision (NY REV) Demo Front-of-the-Meter (FTM) Energy Storage Services Agreements (ESSA) model. He said that the ESSA model was selected because it was an innovative business model and that the lessons the company had learned from the CHP business were fundamentally different from their experience, which necessitated extensive customer education, including a total change to how customers would pay for electricity. Additionally, he said these systems were installed where there were willing customers and not necessarily in places that benefited the grid. In its interaction with ConEd, he said GI Energy discovered that there are places that need these types of assets. Mr. Falcier said that the hope for the business model was essentially an equivalent of a power purchase agreement, but for storage. He said that the goal for his organization was to create something more scalable and to reduce some of the necessary customization, which he said led to a goal of focusing on a front-of-the-meter approach so that the host sites would view the project from the perspective of a real estate transaction. Even in New York City, he said the company found sites that were largely underutilized and could be turned into valuable energy properties.

Mr. Falcier continued with a description of how the business model created challenges from the regulatory environment where these systems do not quite have a place within the utility asset structure. He noted the convergence of FERC rulemakings alongside the developments in New York. He went on to detail four projects that are in development in the New York City region and show opportunity to showcase actual storage value stacking of grid services as well as a potential Non-Wires Alternative prototype for T&D deferral, which would reduce system peak load and provide other wholesale value benefits. Mr. Falcier said that these developments with value stacking also require middleware. He said his company had partnered with the Shell Energy North America (SENA)-Energy Desk HOSSt Platform to coordinate operations with Con Edison – something that the utility had not done before – to provide greater visibility into the asset for the New York Independent System Operator and bring Con Edison to the same level.

Mr. Falcier characterized the barriers to these projects as largely regulatory and described how because of these barriers the project was unable to be treated as a FTM asset (rather than a BTM system) and thus incurred considerable additional charges. He proposed that these systems should be simply treated as interconnection costs alongside wholesale tariffs. He continued by saying that there was much work to be done in defining how FTM distribution-tied storage systems should be treated, whether that be a generating unit, a load-serving entity, a T&D asset, or a full-fledged commercial retail account.

#### *Ted Ko, Stem, Inc.*

Mr. Ko began his presentation by describing the work his company, Stem, does in BTM development work in commercial and industrial buildings. He continued by saying that storage should be looked at within a convergence of software and that, therefore, it is time to think of gigawatt-scale energy storage services rather than simply the gigawatt-scale hardware.

Mr. Ko said that Stem, founded in 2009 and based near San Francisco, is the leading installer of BTM energy storage assets in commercial and industrial buildings. He said the company has over 900 sites installed or in-process, 8 utility contracts for 350 MW of grid services, and projected finance funds of over \$650M. He said this to emphasize that this market segment is

already here and not just a concept.

He said that, without software, storage is essentially “just a dumb box.” Mr. Ko said that their software uses artificial intelligence (AI) to assess the storage as well as the building’s power usage information to understand how to best operate the storage asset to maximize customer savings and value. He added that the software also provides grid services, and is able to receive automated signals from grid operators to dispatch resources for local or system needs. This new paradigm he said is a game changer for how operators can use assets as virtual power plants to coordinate local needs to supply fast, reliable services. He said that through networking, the virtual power plants concept can turn distributed energy resources (DERs) from uncertain load modifiers into scalable, reliable grid resources. As an example, he said Stem systems were called upon during a heat wave in 2017 through 100 simultaneous events that, even while smaller systems, created an aggregate impact that will continue to be scalable over time.

He gave the example of a contract that calls for 85 MW and 4-hour duration service. He said that didn’t mean Stem would install just 85 MW of batteries, as those batteries would serve additional roles. He said the portfolio of services supports a diversification of value streams that creates a more stable platform and that the software can determine which resources to tap for any particular event. Mr. Ko continued with the example of using the service for transmission deferral with smaller utilities to pilot projects at a local level.

Mr. Ko closed by speaking to what he thought the grid would need in the future, mentioning gigawatts of storage services, citing a situation where California had to essentially throw away 10 GWs of solar that ratepayers had already paid for during a curtailment event. He said that all buildings could be turned into service providers as virtual power plants, as capacity over broad grid needs, or local resources as non-wires-alternatives.

*Susan Mora-Schrader, Exelon Corporation*

Next, Ms. Mora-Schrader discussed her role within Exelon to bring storage to the marketplace, particularly in areas with restructured markets, which create different types of constraints on utility store developments. She said Exelon has worked both with ESA on a pilot program as well as with Stem in Maryland to test different business models. She said that one of the issues the company has is that it is one of the largest energy companies in the country, yet within a very small service territory. She said it becomes difficult to site new resources in their dense geography, leading to a smaller storage footprint as opposed to solar, even when considering rooftop solar. She said her role is to coordinate across all their utility brands and structures to fulfill Exelon’s vision for the grid of the future.

She said the company is committed to DER and decarbonization and that she supports its efforts across all their jurisdictions. Within Exelon’s six jurisdictions, there are three grid modernization proceedings ongoing, and each touches on issues of increasing storage opportunities and capturing value. She said her organization supports working groups in these jurisdictions to address barriers to fulfilling a grid modernization vision, including storage in Maryland and microgrid/non-wires alternatives (NWA) in Washington, DC. Ms. Mora-Schrader said that all of these grid modernization proceedings touch on how to bring more storage onto

the grid and how to extract more value from those installations. She mentioned this work includes a working group and microgrid demonstration project in Illinois that leverages DOE funding. She said Delaware is having a discussion on how storage affects electric vehicle charging within a broader conversation about transportation electrification. She also said that New Jersey is just beginning its conversation about how storage fits into a potential, new, and ambitious state energy plan forming under the current governor. Pennsylvania has a political conversation ongoing in the legislature about using storage as a resilience tool.

Ms. Mora-Schrader continued with a discussion of the barriers to storage in restructured markets. She recognized that if utilities could incorporate more value streams from storage, it would be an assistance to storage's market entry. She said that there are barriers to tapping these value streams and that regulatory flexibility for asset categorization, the competing interests of ownership and operation, and the push and pull of FTM versus BTM, is needed. She said these systems are creating new types of collaborations as well as new revenue models.

Ms. Mora-Schrader then expanded on the goal of the storage stakeholder working group in Maryland. She said the stated goal was to identify the challenges that currently exist for storage development in Maryland and then identify opportunities for the governor or state legislators to move past those barriers. However, Ms. Mora-Schrader could not say with confidence that there is a sufficient understanding about the performance and operational characteristics of storage among policymakers, adding that utilities though do understand the technical challenges. She said that there are however many installations and that it would be best to look at the data available and test particular business models that have been proven to unlock the most value for customers. She said the working group is finalizing drafts of four business models, with the intention for investor-owned utilities to select two of them in pilot programs. She said that these four plans are: utility-owned systems, with benefits going to the ratepayers; a partnership with lease for a third party to operate in the wholesale market; an inverse in which a third party would own the battery and, when a utility was not using it for reliability, could harness the value streams; and a virtual power plant model, as Mr. Ko described in his talk, where systems are spread across multiple sites and aggregated together digitally.

The panel then took questions.

Mladen Kezunovic asked the panelists to speak on mobility. Ms. Mora-Schrader answered that Exelon has a traditional NWA project in Baltimore with a scalable solution to match potential load changes over time. She said that, while it is not traditionally mobile, the need can be assessed over time and the solution potentially moved to a different location on the system as the need changes.

Dr. Kezunovic then asked the panel to speak about cybersecurity and degradation. Mr. Miller spoke about a GE storage product built on a trailer so that it can be used temporarily, then said that degradation due to the use for multiple value streams is part of the initial development calculation. Mr. Ko added that this was an example of how important software is to the degradation and valuation of participation in grid service opportunities. Ms. Speakes-Backman added that this question also touches on the temporal nature of storage. Mr. Falcier discussed the cybersecurity component and how some of the software interactions require highly protected

networks, an issue that was currently constraining development.

Anda Ray asked about how developers handle working both within regulated markets and within free markets. Mr. Ko responded that Stem is already doing that and finding solutions, particularly in California. Ms. Speakes-Backman also noted it is a temporary condition that will hopefully be cleared up with FERC Order 841, despite its delay. Mr. Falcier added that his company is certainly caught up in the dual nature of their work. He called it a challenge, but said that the ongoing work is still valuable.

Bob Cummings emphasized how important storage is for the grid of the future, explaining how without it, operators have to dump wind and solar to stay within the bandwidth of frequency. He added that, at the distribution level, operators must be careful not to double count and that much of the load storage and DERs are now replaced from behind the meter to keep the system within reliability bounds. Ms. Mora-Schrader added that while wholesale markets are not that attractive, there are other value streams that cannot otherwise be captured. As an example, she mentioned resilience services that do not have specific benefits and create issues for development projects. Mr. Ko suggested that perhaps DOE should further research how to tighten terminology and frameworks within particular issues around resilience. Ms. Speakes-Backman added that many efforts around the states have trouble getting started because of the uncertainty around these issues.

Tom Bialek asked if there were targets for round-trip efficiencies for the focus areas. Dr. Sprenkle responded affirmatively, but added that they are fairly different for each technology, which plays a greater role when targeting arbitrage.

Mr. Koplín asked Mr. Ko if Internet-of-Things (IoT) devices could also be considered virtual power plants, particularly emphasizing load shedding and how that customer push model will affect the grid of the future. Mr. Ko responded affirmatively, adding that those systems could certainly work, and that California recently launched a new load shedding product that would allow ES to target negative wholesale prices. He said that while that product is limited to ES, it was not unfathomable for other BTM IoT devices to provide similar value. However, he added that those devices would need to match the reliability and predictability of ES systems.

### **EAC Smart Grid Subcommittee Update**

Mr. Adams, EAC Smart Grid Subcommittee Chair, provided an update on the Subcommittee's activities currently underway. He said that Dr. Kezunovic will lead the March panel on Value Proposition for Big Data Analytics. He said they have proposed a draft for the panel and mentioned the panel on a call, during which many Subcommittee members showed interest in participating. Mr. Adams said that, based on the comments from that call, Dr. Kezunovic had been working on the second draft of the template to reflect the thoughts of the Subcommittee members. He added that they will review the changes and that the Subcommittee would be given an opportunity to discuss the suggestions for the template. In addition, he said a call had been scheduled for November 5 to discuss the panel for March.

Mr. Adams moved on to summarize the deliverables under discussion in the Subcommittee. He noted that the Subcommittee's meeting on October 17 focused on potential topics for work products. He said the panel on Perspectives on Grid Resilience led by Sheri Givens provided many recommendations as well. He said that, with the permission of the panel members, he would like to consider those recommendations for potential panel topics. He mentioned that a Doodle poll has been created to rank the following topics:

- Big data analytics, including signature analysis;
- Development of an optimum DER model;
- Inertia examination, including load-side impacts; and
- Integrated planning methods.

Mr. Adams stated that customers are buying rotational energy. He said that northwest Texas had an inertia problem, which is the distance between the synchronous units. He explained that synchronous units have synchronously collected elements that are electrically connected firmly to the grid. He said that this results in the energy in that rotational mass being transferred directly. He explained that generators have asynchronous motors, which are rotational devices not connected tightly. He said induction motors are being used by pump jacks and for fracking in West Texas, which is resulting in a load problem where there is not enough transmission to supply the entire load. He said they are installing synchronous condensers because they do not have enough inertia or bridge strength. He said that he will make a pitch for this topic on inertia to the members voting on the Subcommittee's work topics.

Mr. Mann commented that they could take synchronous condensers, add rotating mass to it, and call it a fly wheel, for which they could get a battery investment tax credit. Mr. Adams acknowledged that as a possibility.

Dr. Bialek stated that this discussion on inertia tied well with Joe Eto's presentation from the July in-person meeting during which he talked about the reduction in the amount of synchronous motors that are on the system. Dr. Bialek said that the concept of acquiring more synchronous type assets on the system would make sense. He added that Joe Eto's presentation along with the ideas Michael Heyeck spoke about load being part of inertia fit in together. Mr. Heyeck noted the EAC reports sent to Assistant Secretary Walker, who had asked EAC to consider cybersecurity, among other things. He said that the topic on inertia needs to be broadened, probably needing to be advanced in the smart grid space.

Dr. Kezunovic asked whether there is any restriction for the Subcommittee to work on more than one work product since there were many great panel discussions that provide background information.

Mr. Heyeck responded that there is no limit, but that they needed confirm that the chairs and the vice-chairs would not be the only ones contributing. Mr. Adams stated that he does not object to working on multiple issues simultaneously. DAS Jereza added that DOE has support from contractors because, as the Department acknowledges, the time of EAC members is limited.

Mr. Cummings mentioned that he has been doing analytic work in the Western Interconnection using phasor-measurement unit (PMU) data. He said that his group is working on high-speed energy injection use from inverter-based resources that can shorten and reduce the amount of

spinning reserve on the system. He said that the Subcommittee would need to identify a way to leverage their work in storage and inverter technology to answer Assistant Secretary Walker's concerns.

Dr. Bialek said that he agrees that spinning reserve could be lumped into the inertia examination. He said he is aware of many discussions on high-speed injection via inverters and storage and other types of devices. He said this ties into the cybersecurity aspect of that equipment, which he said could be the ultimate tradeoff moving forward.

Mr. Cummings commented that, if done correctly, it would not be necessary for every inverter to be connected to every other inverter. Instead, he said there would be a cohesive, autonomous action. However, he said that if aggregators are involved, it would be necessary for them to know what was put together and that they would need to find a way to communicate that. He said that he is not an advocate of command-control on the inverter fleet and thinks it should be handled autonomously.

Mr. Heyeck noted that it is important to make sure their work products are relevant to DOE and that they understand what DOE is already doing in order to not duplicate work. He thanked Mr. Adams for the update.

### **EAC Energy Storage Subcommittee Update**

Lola Infante, EAC Energy Storage Subcommittee Vice Chair, provided a brief update on the Energy Storage Subcommittee's two work products near completion. She began with a discussion of the 2018 Biennial Storage Review. She explained that the Energy Storage Subcommittee was formed in March 2008 in response to Title VI, Section 614 (e) of the Energy Independence and Security Act (EISA) of 2007. Title VI, Section 641(e)(5), which states the following:

1. Section 641(e)(5): "...the Council shall (A) assess, every two years, the performance of the Department in meeting the goals of the plans developed under paragraph (4); and (B) make specific recommendations to the Secretary on programs or activities that should be established or terminated to meet those goals."

Dr. Infante noted that there have been three reviews since the EISA of 2007 and that 2018 is the latest iteration. She said that the Subcommittee received clearance from DOE to delay the review.

Dr. Infante mentioned that the scope of the review had broadened over the years. The 2018 Review will maintain the same comprehensive scope as the previous review, looking at all the energy storage activities which DOE (specifically OE) is supporting. However, she said the Subcommittee is introducing changes to the evaluation process, which caused them to have a delayed start. She said that the Subcommittee still would conduct stakeholder interviews as they had for the prior review, but that the Subcommittee was trying to better target the types of groups that are DOE's primary targets, particularly different industry participants and stakeholders. She said that, this year, the Subcommittee took advantage of the Energy Storage Peer Review process for the first time. She noted that it made sense to start by attending the peer review to determine whether feedback gathered there could be incorporated into their assessment, and then

supplemented with additional information gathered from discussions and interviews. She added that they are confident this will be a more effective way to move forward with conducting their own review. She said that the Subcommittee was aiming for March 2019 for EAC approval, and that it is fairly on target. She said that they were hoping to have the first draft finished after Christmas.

Dr. Infante moved on to summarize the peer review, which took place September 25-27 in Santa Fe, New Mexico. Flora Flygt, Ramteen Sioshansi, and she attended this peer review. She said that they conducted a few interviews and that the interviewees consisted of energy storage developers, researchers, and deployers. She mentioned that she was very impressed by the breadth and comprehensiveness of the storage program and encouraged people to go next year if they are interested in energy storage. She added that the peer review provided an opportunity to see the totality of OE's research portfolio. Dr. Infante said that the Subcommittee had a call scheduled to decide on their next interviewees.

Mr. Heyeck asked where they were in the five-year report cycle. Dr. Infante responded that the five-year report cycle will be done in 2021, around the same time as the next biennial review.

Dr. Infante then provided an update on the Rate, Tariff, and Market Design for Energy Storage Work Product. She said that "Rate, Tariff, and Market Design" will not be the final title of the work product as the concept has changed slightly, even though the overall theme had stayed the same. She said that the rationale for that product came from the recognition of two related factors:

- That energy storage is different from other resources, able to provide services and support various types of grid operations. She added that different value streams can be drawn for each one.
- That value is not always clear and that it is often difficult to quantify it, which in turn makes building a business case for energy storage more difficult.

The Energy Storage Subcommittee is working to translate the value into consumer savings and thus help stakeholders make that case to regulators, which she said are the factors that can limit the deployment of energy storage. She said that the ultimate objective of the paper is to determine whether DOE can better leverage its technical expertise and practical knowledge to help the industry better define and convey the value of energy storage. Furthermore, she said this paper aims to help regulators and state legislatures better address energy storage in their proceedings and processes in general.

Dr. Infante moved on to summarize their planned process. She said that the Subcommittee came up with this topic from discussion at the EAC in-person meeting in February 2018 during the panel in which regulators discussed rates, tariffs, and market design for energy storage. She said that, in June, DOE organized a webinar for the Energy Storage Subcommittee, during which they reviewed their list of activities that related to policy issues. She said that Chris Lawrence would schedule interviews with those regulators to determine what their needs were for this product. Dr. Infante said the Subcommittee was aiming for March 2019 for EAC approval, adding that they were on track to meet this deadline.

Mr. Heyeck asked how the March 2019 panel would differ from the panel they just had on grid-scale storage, which included discussion on tariff use. Dr. Infante responded that the March panel would discuss technical risks. She said that there was some resistance from the regulators and the market participants on the actual performance in the risk associated with energy storage. The technical risk part she said falls nicely under DOE's R&D process. She added that they would discuss more about this topic during the Energy Storage Subcommittee meeting, scheduled for that day at 12:30 p.m.

Mr. Adams commented that one of the things he learned from the panel was that storage was not about just a generator or transmission operator, but was something different. He added that storage cannot be solely put in any of the other slots even if it fits in well in some cases. He asked if there is anything DOE can do about it, since all of that is addressed at a state level. He added that he is okay not discussing this topic, as DOE can have no influence on this issue.

Mr. Heyeck said that it sometimes can be good to convene a discussion about one of the impediments to its development, and that the EAC can bring up the impediments, which could be relevant. Dr. Infante added that there might be some gaps in research about the different use cases. DAS Jereza confirmed that DOE does not have the authority for regulatory actions in this area. She said that the technical assistance program that DOE administers convenes the national organizations. She added that it is a limited role but one that could be useful from a technical side. Mr. Adams added that storage is a different asset class. Where he comes from, he said their determination is that it is a generator and cannot be owned by transmission companies. Dr. Bialek added that in the context of technical issues, it would be beneficial to consider long-term barriers to energy storage deployment.

Jeff Morris commented that at the state level, processes for planning and procurement are established. He said that 32 out of the 50 states do some form of integrated resource planning (e.g. least cost, life cycle risk). He said that his organization had been working for five years in his state to push out a DER planning process for the utilities. He said that any rational data for energy storage is lacking. He added that the real need for policymakers is to obtain good data about some of the cost projections, life cycle, and service capacity issues that make up those processes. In addition, he said that state legislators are still the regulators for public power. Whether it is the demonstration or the technical administration, he said the program is really useful and sometimes it is not clear to the regulators on how to access that program. Dr. Infante said that Mr. Morris would be a good interviewee for this project. There were no further questions.

### **Public Comments**

Mr. Heyeck said that they received a letter on October 15, 2018 from a member of the public, which will be posted on the EAC website. There were no other public comments.

### **Adjournment of Day Two of October 2018 EAC Meeting**

Mr. Heyeck said that the next EAC meeting would be held March 13-14 at the same location, starting at 1 p.m. and ending at noon the next day. He added that they are trying to convene

experts for that meeting's panels, one related to smart grid and the other related to energy storage. Topics include cybersecurity and FERC updates. He said Subcommittees are the right forum to bring up topics for presentations, panels, and work products. He pointed out that the EAC approves work products during its in-person meetings, so the Committee will need to make room during the Subcommittee reports in the March meeting agenda to approve the work products. He said that they are also looking forward with preliminary plans for the June and October in-person meetings in 2019.

Chris Ayers said that this was his third EAC meeting. He asked to what extent the EAC directly asks DOE to identify specific areas where they would benefit from an outside industry perspective. He also asked whether EAC members meet with DOE for a periodic self-assessment of how useful the EAC's recommendations have been to DOE.

Mr. Heyeck answered that having Assistant Secretary Walker attend the EAC meeting the previous day gave them an idea of something specific DOE was looking for (i.e., spinning reserves). Mr. Heyeck pointed out that during last February's meeting, Assistant Secretary Walker provided EAC the five pillars, which gave EAC the outline of areas where OE plans to focus. He added that the processes, panels, and work products go through Leadership for review. He said the EAC asks DOE for their input in order to make sure the EAC is on a useful track. Mr. Heyeck asked DAS Jereza for her comments.

DAS Jereza said that DOE was trying to do an ongoing assessment by reflecting on past interactions with the EAC to determine what had been impactful throughout its history. She recognized there had been changes over the years in level of engagement with the EAC, and that DOE is now thinking about having different touch points with the Committee, such as calling EAC members for informal input when issues arise. Also, some DOE projects ask for steering committees, so that may be another way for the EAC to be engaged. She noted that DOE is trying to be mindful of harnessing the expertise in the EAC. She said that the work products are important, but she views them as just a formalization of the discussions that DOE is having with the EAC. She said that OE is trying to prioritize those five pillars, but that they also do not want to miss important developments that could take the industry in a whole different direction. She added that she encourages thinking outside the box to help identify areas the Department is missing.

Mr. Heyeck said that the EAC has narrowed work products down to seven pages so that they could produce products more quickly and efficiently.

Drew Fellon said that he had ideas for potential speakers around cybersecurity and other topics, and asked with whom he should share those suggestions. Mr. Heyeck said he could give suggestions to him or Wanda Reder, and that he could also bring them up during Subcommittee meetings.

DAS Jereza said that she appreciated the dialogue during the meeting. She pointed out that many people had questions during the panels and presentations, and that it would be better to find ways to have more time for questions during future EAC meetings. She said that there was much to strategically think about on how these discussions fit into the North American energy sector. She

added that she is hearing a lot of panelists raising costs and benefits during their discussions, and she is looking forward to the discussions on risk surrounding energy storage.

Mr. Heyeck asked Mr. Mansueti if he had any comments. Mr. Mansueti said that DOE needs to be careful not to tell the EAC what to tell DOE. He said that the EAC is DOE's advisory committee, and that it is not valuable to DOE if the EAC does not tell DOE what they think. Ms. Reder said that the discussions were good, and she appreciated the effort that went into putting together the panels. She added that it was great to hear the discussions and questions, but that she felt it was important to think about how they could be used to inform work moving forward.

Mr. Heyeck reiterated that that next EAC meeting will take place on March 13-14. The meeting was then adjourned.

Respectfully Submitted and Certified as Accurate,



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Michael Heyeck  
The Grid Group, LLC  
Chair  
DOE Electricity Advisory Committee

02/15/2019

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Date



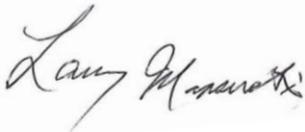
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Wanda Reder  
Grid-X Partners, LLC  
Vice-Chair  
DOE Electricity Advisory Committee

02/15/2019

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Date



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Lawrence Mansueti  
Office of Electricity  
Designated Federal Official  
DOE Electricity Advisory Committee

02/15/2019

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Date