U.S. Department of Energy

Electricity Advisory Committee Meeting

NRECA Conference Center

Arlington, VA

February 20, 2018

Summary of Meeting

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Welcome, Introductions, Developments since the September 2017 Meeting

Wanda Reder, EAC Vice Chair and the chair of this meeting, and Matthew Rosenbaum, EAC Designated Federal Officer (DFO), opened the February 2018 meeting of the Electricity Advisory Committee. Ms. Reder welcomed new members and discussed logistics for the meeting. She reminded those assembled that all of the presentations and discussions will be maintained in detailed records on the DOE website. Ms. Reder introduced herself to the meeting participants and provided an overview of the agenda for the two meeting days. She also introduced the Office of Electricity Delivery and Energy Reliability Assistant Secretary Bruce J. Walker and Deputy Assistant Secretary for the OE Transmission Permitting and Technical Assistance division, Katie Jereza. Ms. Reder thanked the departing EAC members – Billy Ball, Clark Gellings, Granger Morgan, Chris Shelton, and David Till – for their contributions and participation over the years and welcomed those attending for the first time.

Update on the DOE Office of Electricity Delivery and Energy Reliability's Programs and Initiatives

Honorable Bruce Walker, Assistant Secretary for Electricity Delivery and Energy Reliability, DOE, introduced his five priorities for OE:

1. Puerto Rico and U.S. Virgin Islands Restoration and Resiliency Efforts
2. North American Energy Systems Resiliency Model
3. Mega-Watt Scale Grid Storage
4. Revolutionize Sensing Technology Utilization
5. Operational Strategy for Cyber and Physical Threats

Mr. Walker responded to Member questions. Regarding the North American grid resilience model:

- The model will be multi-faceted, and look across DOE to integrate renewables.
- It will be built in phases, with phase 1 focused on resiliency and reliability, and once the model works properly, then utilize it from a market-based standpoint.
- DOE, FERC, NERC will need to come together to make sure resiliency is well defined, and metrics are developed for resiliency similar to how they are for reliability.
- DOE will work with NERC to utilize existing regional models, as well as work the GMLC has included in a compendium of all existing models.

Regarding the priority on cyber and physical security, Mr. Walker said the number of increased threats and the sophistication of the threats, led DOE to recognize the need to spend more time focused on cybersecurity, energy security, and emergency restoration. That energy security component includes recognizing interdependences to enable protecting the infrastructure. The new Office of Cybersecurity, Energy Security, and Emergency Response (CESER) will be tasked with focusing on cyber and physical security for electricity and any participating energy systems like gas pipelines, oil pipelines, and hydropower: an all-in approach to understanding where the vulnerabilities are and then trying to address them properly.

Regulatory Reform

Ms. Reder transitioned to a discussion on regulatory reform. The Committee received a directive from the Secretary to identify regulations that could be simplified or that are no longer needed. The Members generated a list of potential ideas in advance of the meeting, so the intent of this discussion was to discuss those ideas and do some additional brainstorming. Ms. Reder explained that, ultimately, the plan is to have 3-5 ideas that are highly impactful, and that the EAC could work on between this meeting and the July meeting. Ms. Reder expressed that the Members should use this dialogue as an opportunity to understand what is in scope, and what is important to this Committee.

Before opening the discussion among Members, Ms. Reder asked DOE for comments on the topic. Mr. Walker expressed the importance of regulatory reform in a few areas. One example cited was the Infrastructure bill, and related discussion of expediting the process to ensure that the investments made get done in a timely way. He shared that there have been some efforts on streamlining certain processes, and he is the DOE representative on the environmental review process to expedite siting, permitting, and coordinating across federal agencies. He said it is being taken very seriously from the standpoint of trying to streamline the processes and eliminate things that do not make sense, but that perhaps there have been added layers that slow the process down. Mr. Walker explained that a lot of what is being done is very operationally focused, action-oriented, and the purpose of the regulatory reform component is getting things to move forward and getting the red tape out of the way. Mr. Walker looks forward to hearing back from Katie Jereza and others about what comes of the discussion.

A preliminary list of ideas was circulated to the Committee prior to the meeting in preparation for the discussion. Ms. Reder led the Committee through this list and asked for the Members who submitted the ideas to make comments about them. The first item was *eliminating the requirement to conduct an energy congestion study*. Billy Ball expressed that the original intent of the study is really obsolete. There have been court rulings that have thrown out parts of its potential effectiveness, and it has become a struggle for the Department to try to do what the law requires it to do knowing that the original intent is no longer possible. Since the time the study was first developed there have been other changes happening in the world. He doesn’t know how to eliminate it, but he sees it as being a drain on otherwise very busy people at DOE.

- David Meyer added a few clarifying comments. Mr. Meyer clarified that it is a *transmission* congestion study, directed to look at transmission persistence or locations of transmission congestion on the system. Mr. Meyer added that the more serious issue is that there are two parts of the Secretary's authority: to conduct the study, and to designate national interest electric transmission corridors. Mr. Meyer raised a question as to whether the proposal is to eliminate just the study or to eliminate the Secretary's authority to designate these corridors. Another aspect Mr. Meyer discussed is the way the law is written. The thought is that DOE would do these very broad, not quite national, transmission congestion studies, and on the basis of the information it produced, go on to designate national corridors in certain areas. He continued that the problem is that you can identify the congestion issue, but that is separate from selecting an appropriate transmission solution, and you really can't come up with a suitable corridor until you have the transmission project in mind. He refers to this notion as the top-down process, and noted that recently some people have proposed a bottom-up process. That is, suppose a transmission developer came to DOE and said they have a transmission project they hope to put in place, but they are really interested in talking about the possible designation of authority. The way Mr. Meyer envisions that conversation continuing is asking the developer to show where the congestion that adversely affects consumers is, and show that the proposed transmission project would ease that congestion, and so far as the corridor is concerned show the boundaries. He went on to say that if the Secretary is going to designate a corridor, the boundaries have to be specified. Finally, Mr. Meyer noted DOE would want to know what the case is from the developer, and what the case is for DOE inserting itself into a subject that is fundamentally state responsibility. So, Mr. Meyer said, it is a potentially workable process and an authority that might be useful in certain kinds of circumstances. Revisiting his original statement, he asked if the suggestion is only talking about eliminating the requirement for the transmission congestion study, and what happens to the Secretary's authority to designate corridors.
- Jeff Morris noted that some of the states backfilled that designation with a state preemptive authority over local governments to site transmission lines. There is a nexus with some of the state policies on siting, particularly in the western states, where it is separate from the public utility process.
- Rolf Nordstrom posed clarifying questions: has the DOE ever designated a national interest electric transmission corridor, and regardless of the answer, what would be the effect of the designation if it were made? Mr. Meyer answered that the practical effect is to enable FERC to exercise siting authority under certain conditions that are specified in the law. There has been litigation on the scope of FERC's authority and the issues that came out of the court is whether FERC had authority to overturn a state's decision to reject a proposed transmission project in a corridor. The court ruled that FERC did not have that authority and that if the state acted negatively on the project that was final. FERC's authority is limited to acting if the state does not act within a year of the filing of a complete application. Mr. Meyer explained that DOE did designate two corridors in 2007, one was a very large corridor in the east in the areas of New Jersey, New York and some parts of other states, and another large one in Southern California. DOE was sued on those corridors by some states and environmental organizations, and the court invalidated the congestion study because DOE had not consulted adequately with the states or NEPA. By extension the corridor designations were also invalidated. Since that time no corridors have been proposed. Mr. Meyer added that he learned that you may know that there is a congestion problem but not what the appropriate solution is. Identifying a solution was not part of the DOE mandate.
- Anjan Bose commented that the congestion study requirement was part of the 2005 Energy Act, and many of the reasons have already been said, but he connected it back to the thrust that OE is hoping to have a model of the whole interconnection. Dr. Bose thinks one of the issues with people doing piecemeal modeling and not the whole picture is that you can miss some of the

congestion. It's not about who has the authority to do what, it's that someone should be doing it and right now he does not believe anyone is.

The second item was the suggestion to *eliminate the requirement to produce an update on the status of the Energy Storage Program every two years.* By statute the EAC has a requirement to produce a report every two years, but the questions are: is it valuable, and is it continuing to provide incrementally what it was intended to do?

- Ramteen Sioshansi responded that producing the biennial storage reviews does take a large investment of time on the part of Subcommittee members, but ultimately it comes down to the value it provides to DOE for its planning. If it is valuable to them, then it is a worthwhile exercise.

The third item was a suggestion to *eliminate the Quadrennial Energy Review (QER)*. Ms. Jereza commented that as far as she knows there is no plan to do another QER, so it is not relevant at the time.

The fourth item was on the topic of *Energy Star moving from energy efficient ratings to integrated energy efficient ratings for load shaping devices to better reflect the system.* Shaun Mann expanded on the suggestion, explaining that the time of use value should be included in Energy Star ratings for devices that have the ability to move load from one time of day to another. Additionally, with a coal fleet, it results in customer savings and fleet savings.

- Armond Cohen asked, given the variety of grids in which the appliances will be operating and therefore their time of use value depending on load supply and the entire load shape of the service territory, how would execution on the basis of that metric look? Mr. Mann replied to Mr. Cohen that, being very rural, they've had time of use rates, high fixed costs and low marginal costs, and time of use rates have been used for most of the system for 20-30 years. He recommended to DOE to use time of use rates inside of their process rule. It is sort of a national representative time of use rate with the option that the local seller or reseller have the ability to recalculate the result of Energy Star ratings based on the local time of use rate available to the customer.
- Marilyn Brown appreciated the suggestion to revise the Energy Star rating systems, but she believes the purpose of the review is to reduce regulatory burden and she worries that such a proposal would probably go the opposite direction. Mr. Mann added that a year or two ago there was a move to make it illegal to sell large tank water heaters that used resistors. For them, that is the core device used for thermal energy storage, a large tank water heater. The point is to bring light to the value of thermal energy storage so that future efforts to make them illegal because they use resistors would be less likely to be seen as palatable.

The fifth topic related to *export controls*. Mladen Kezunovic shared that he passed the request for regulatory reform suggestions to the administrators at Texas A&M University that are dealing with the implementation of export controls, and there were two issues that were raised. One was related to the export associated with the projects with foreign students and staff, and the other was about hiring procedures that are somewhat related to this topic and to participation in the activities of the University. Further, Dr. Kezunovic shared the administrators suggested more elaborate procedures are warranted because of the situation in the world, but it was not clear how to implement those at the University. He said that it trickles down to the faculty that are hiring students, and the faculty are not in any position to evaluate the potential impacts, so more guidance from DOE or the government on how to implement rules can help Universities to make judgements. He noted that no one was seeing the rules themselves as an issue per se, but the issue was needing more guidance on the implementation issues. Incidentally it has financial impact because Texas A&M runs close to $1B in research every year and is run by people that may be under these export control provisions, so if there are some restrictions the research funding may have to decrease.

John Adams asked that, as the discussion continues, Members comment about the national financial impact of reforming these suggested regulations in an effort to prioritize the items on the list. Paul Hudson stepped back and asked a big picture question regarding the fact that Brue Walker mentioned environmental issues, and this list seems central to DOE. It does not seek comments on other areas or agencies that touch the industry. Mr. Hudson wondered if the Committee should be speaking off of a broader list than what was presented. Katie Jereza said in a way they would like to prioritize what DOE can influence, but they also have a facilitator and convening role. She has been told that the list can be broader than just focusing on OE, and if it affects the electricity industry then those ideas are welcome.

The sixth suggestion was *fully complying with the July 15, 1996 Process Improvement Rule*. Lola Infante said this suggestion came from EEI. She asked for clarification on the role of the EAC in compiling the list of topics on regulatory reform. Ms. Jereza explained that the EAC should pick 2-3 suggestions from the list to explore further and weigh in on whether or not DOE should try to solve the problem in some way.

- Tom Weaver reflected on Assistant Secretary Bruce Walker's priorities, specifically the intent to unleash investment in infrastructure. He said that, while a lot of items on the regulatory reform list address regulation that might be good to reform, most won't unleash infrastructure investment. In addition to looking at the list that was created, Mr. Weaver believes the Committee should also be thinking about things that are holding back infrastructure investment, and that perhaps a new list needs to be created to drive toward the real motivation for this exercise.
- Ms. Reder went back to Ms. Infante's original question, and shared that maybe EEI and others have responded with a broader set that could be considered along with homework that has already been done. Ms. Jereza noted that at this stage they are still in an idea-forming phase.
- Mr. Weaver expressed that in the future there probably needs to be a discussion on what the barriers are to the increase in infrastructure investment and that might lead to the ones that are meaningful. Ms. Jereza agreed that is a good place to start.

Next on the list was *hiring non-U.S. citizens*. Ms. Jereza expressed that, as part of the brainstorming, it shouldn't be taken off of the list, but she is not sure that this would be one of the biggest barriers to unleashing the development of infrastructure.

The next item discussed was *improve, coordinate, and streamline DOE's issuance of Presidential Permits in the transmission siting and permitting process*. Ms. Infante said this and the next three suggestions were all submitted by EEI last summer to DOE. She shared that there are two parts to this: regulatory rollback and the infrastructure bill. The exercise for the Committee was to look at those regulations that are unnecessarily burdensome and what policies can be implemented in order to unleash infrastructure investment. Ms. Infante believes the last four on the list on siting and permitting are part of that set of rules and regulations that fit both requirements, facilitating investment and rolling back unnecessary burdens on regulations.

Also submitted by EEI, the next suggestion was *to issue "No Standard" standards for the products that are at or near maximum technology efficiency levels*. Regarding standards, Dr. Brown commented that when standards are eliminated, often there is backsliding in technology performance. The ones that aren't covered fare better, and that investment is directed toward the poorer performing technologies. In her opinion, Dr. Brown believes "why not, it's already there," and she does not see what the harm is by keeping them instead of eliminating.

Ms. Infante expanded on the next item, *NERC's Standards Efficiency Review (SER) Process to identifying potential efficiencies through retirement or modification of Reliability Standard Requirements*. NERC is undergoing a massive review of their standards. She is not sure if there is a role for DOE or EAC, but she thinks it is important to understand that is going on and will probably end up streamlining security requirements at FERC.

Ms. Infante briefly discussed the final item, s*treamline current reporting requirements*, which relates to EIA's reporting requirements to the industry, and it goes back to it being an unnecessary burden.

- Clark Gellings reacted to the "why not, it's already there" comments that came up during the discussion. Many years ago he managed a forecasting process at a utility and found that they were doing over 30 reports annually going to various departments within the utility. He ended up telling everyone to stop issuing the reports and see who complains, and he was amazed by how few calls he received.
- Dr. Brown stressed the value of the information that is collected to populate the forecasts and modeling that EIA does. She does not want to undermine the annual updates, and the transparency that all of that brings is very valuable.

Ms. Reder called for final thoughts on the regulatory reform agenda item, and reviewed some common themes that developed from the discussion. One theme is barriers on the infrastructure bill and what can be done to free up wherewithal in order to do more of what should be done. She observed the group agreeing that this is something they could rally the forces on and there may be something in writing they could do to help frame the conversation. Ms. Reder also agreed with Mr. Adams' comment regarding prioritization and agreed that criteria need to be developed for prioritizing the list to the extent that the Committee can agree and look at the process to help provide better guidance. Her final observation was that there was substantial dialogue on some things that looked like they would not be priorities. Ms. Reder emphasized that the goal is to put together a product for the July 2018 meeting. Mr. Adams accepted the assignment of the Power Delivery Subcommittee taking the lead, with input from the entire Committee. He hopes to continue this conversation and develop a list of barriers that focuses on policy and regulatory aspects. Mr. Adams and Laney Brown clarified that the question for the Committee is "what are the barriers to investment," and as a next step, reflect upon what in the regulatory structure is impacting those barriers to investment.

Rep. Morris expressed that one of the barriers is that there is a lot federal documentation policies, but the investments are made at the state level. Going through the list, for example, it's the cost of energy storage that means a lot to states. He added that offering cost guidance to states as a reference point for planning would be a useful tool. There are many state rebate programs around Energy Star appliances, but there is no guidance on how their integration with controller units and the smart grid is going to work. Rep. Morris said this shows there is a lack of good data. He added that a forecast for near-, mid-, and long-term costs and evolution of these technologies would be a very useful tool to the bifurcation between federal government and states because that reference point is not available. Its absence ends up being a barrier to investment because uncertainty stops investment from happening.

Rolf Nordstrom asked for further clarification on the question at hand – is it to identify the biggest policy and regulatory barriers, or to identify investment barriers? He also asked for clarification on the next steps after identifying the barriers, which he understood was to create a decision-making framework for evaluating regulatory reform proposals that accomplish that goal. Ms. Jereza responded that knowing a project can take a long time could be a deterrent to investment, but another aspect is that when something takes 7-8 years then it could be that events change. For example, if an investment involves a seven-year process, then state legislators and regulators could turn over during that time and the desire and will to finish the project may change, which could also be a barrier. Ms. Jereza also believes there is an interest in moving forward with infrastructure investment where it's a public/private partnership. She made a comment on the federal government streamlining their processes but also finding ways to get out of the way. She also presented a circumstance where there is a little bit of investment from the federal government that could spur greater investment in an area.

Dr. Brown suggested that the investment discussion be characterized around three of the five pillars that were presented by Assistant Secretary Bruce Walker. In particular, investment in infrastructure to make the electricity system more resilient, reliable, and to recover more quickly. The Power Delivery and Smart Grid Subcommittees are looking at this topic and have struggled because it's not just about eliminating regulatory burdens, but there's a need to create markets, create resiliency and reliability products that can bid into wholesale markets, etc. Dr. Brown believes that there is a lot that will come forward if the Committee tries to coalesce the discussion around those three of the five pillars.

Ms. Reder concluded the discussion and reminded Members that they will be asked to provide input before the July meeting.

EAC Smart Grid Subcommittee Update

Marilyn Brown, Smart Grid Subcommittee Vice Chair, provided an update on the Subcommittee's activities and plans. She began by sharing some background on the Subcommittee. The Energy Independence & Security Act of 2007 §1303 advised the Department to establish a smart grid advisory committee that would cover "the development of smart grid technologies, the progress of a national transition to the use of smart-grid technologies and services, the evolution of widely-accepted technical and practical standards and protocols to allow interoperability and inter-communication among smart-grid capable devices, and the optimum means of using Federal incentive authority to encourage such progress." Dr. Brown then transitioned into a discussion on upcoming work products that the Subcommittee is focused on.

There were four work products topics proposed in October 2017, and those were combined into two products: Integration of Electric Vehicles (EV) into the Smart Grid & Business Models for Non-Utility Participants; and Resiliency and Reliability & Infrastructure Investment in the Grid. The Subcommittee has been inviting experts to presents during its monthly teleconference meetings. In November, Tom Weaver, AEP, talked about the role that an investment in 2 MW of storage provided to help deal with the overload of a transformer and substation system. Dr. Brown shared a graphic of battery capacity being extremely valuable, and able to be bid into the PJM system because it can manage about 6 hours of delivery. In the case shared, there is 1 MW coming in and out over about one hour. Dr. Brown expressed that this is a great example of how storage can assist with peak shaving and islanding. In January, Tim Littman with UC-Berkeley joined the Subcommittee call. He is developing an open source platform for plug-in EV smart charging in California, so the Members were able to get an update on the progress of that project. The Subcommittee also is beginning to develop a framework for a white paper on EV integration into the grid and looking into new business models. Dr. Brown shared that one of the organizing principles is that the impact of EV and ability to provide value to grid resilience depends upon the mode in which they are interacting with the grid. There are three modes: the grid providing power to vehicles; vehicles providing backup generation to buildings, homes, and businesses; and the most complicated is vehicle to grid. The diagram on slide 6 of her presentation showed some of the ancillary services that can be provided by each of the three modes of interaction. These modes each have a set of barriers and challenges to their optimal operation which can be categorized into technological, socioeconomic/financial, and policy/regulatory. The Subcommittee also is trying to categorize the types of business models that might be needed in order to move forward on the three modes, including questions about asset ownership, interaction with utilities, mobility services, and battery management.

Dr. Brown added that the Subcommittee already has developed a short report on the EV topic, and Members are preparing additional supplements. There is also a GoogleForm questionnaire that has been created to collect from EAC Members their feedback on the three modes and the barriers and business cases in their regions. In March, a call will be scheduled with one or two speakers from the DOE EERE Transportation program. Lastly, the questionnaire responses will be analyzed, and the Subcommittee will have a finished product for review in July.

Dr. Brown asked Ms. Brown to discuss the work product on infrastructure investments on grid resiliency and reliability. The work product is a joint undertaking between the Smart Grid and Power Delivery Subcommittees. Ms. Brown shared that the product will be developed to increase awareness of grid resiliency and restoration efforts in light of catastrophic events, but also to recognize that standard outage events can cost the U.S. billions of dollars. The Subcommittees are proposing an integrated analysis based on firsthand experience of utility professionals across generation, transmission, and distribution, as well as from an ITC perspective. They are also looking at planning and restoration efforts to get a better understanding of the elements that come into play, what is considered to be successful, best practices, a potential maturity model, how to assess structure, and potential value mechanisms. The Subcommittee is considering scope and has begun to structure a plan to collecting data.

EAC Power Delivery Subcommittee Update

John Adams, EAC Power Delivery Subcommittee Chair, provided an update on the Subcommittee's activities and plans. He began by providing background on the Subcommittee and noted that the Subcommittee is not legislatively mandated and does not have a statutorily required deliverable. The last completed work product submitted to DOE was the Value of a VAR white paper. Mr. Adams thanked David Till for all of his efforts on the paper. Mr. Adams reviewed the current plans for the Subcommittee, which includes two work products that are in progress – the Transmission-Distribution Interface (TDI) Work Product, and the Investment in Resiliency & Reliability Work Product discussed by Ms. Brown – and a third work product on regulatory reform. Mr. Adams explained that the main question for the TDI product is: with increasing amounts of Distributed Energy Resource penetration, how will the Transmission-Distribution Interface need to evolve to ensure reliability? So far, the Subcommittee has conducted multiple phone interviews. Observations were collected and an outline was created. At this point, the Subcommittee has not come to conclusions, but the goal is to have the final product voted on by the Committee at the July EAC meeting.

Mr. Adams discussed the joint product with the Smart Grid Subcommittee on investments on grid resiliency and reliability. He said there have been a lot of events since the last time the EEI Mutual Assistance Program was last revised, and he believes that the program should be examined. The work product will review resiliency designs that consider priority of loads, engineering standards, modeling, societal value, consumer acceptance, private investment, etc.

The final work product Mr. Adams discussed was the Regulatory Reform Recommendations. As a next step and follow up to the discussions held earlier in the meeting, Mr. Adams requested that Members think about and send any case studies where they have had investments that looked like good investments but came up against some regulatory barriers.

EAC Energy Storage Subcommittee Update

Ramteen Sioshansi, Energy Storage Subcommittee Chair, provided a brief update on some of the current and proposed work products for the Subcommittee. The first product, Alternative Energy Storage Technologies, is currently in progress. Dr. Sioshansi shared that the Members felt that historically a lot of the work products produced tended to have a focus on electricity-in/electricity-out storage technologies, so the genesis of the white paper is in trying to expand the focus and bring to the attention of DOE the nontraditional functions of energy storage. The white paper surveys different thermal and chemical storage technologies. One item that came up was a definitional issue with a lack of delineation between energy storage and demand response technologies. For example, controlled water pumping may be demand response (electricity demand to operate water pumps is shifted in time) or energy storage (functionally equivalent to using a battery). The product is 2-3 pages and provides definitional and scoping information to the Department on different technologies. The current draft has a few recommendations for helping with some definitional issues and updating guidance documents to better reflect the technologies. Before the Committee votes on the work product, EERE will provide feedback on the context of the paper.

The second work product, Energy Storage for Resiliency and Reliability, was presented by Laney Brown. Ms. Brown emphasized that this work product is aligned with Assistant Secretary Bruce Walker's priorities. The focus is looking at the value of storage to support resiliency and reliability, in addition to the other values that storage provides. Ms. Brown that the one-day storage workshop during the June 2017 meeting informed the work product, and those use cases were surveyed to come up with recommendations. In addition, the EAC Members provided feedback and recommendations during that workshop, and those were compiled and incorporated into the work product. A draft has been developed and the Subcommittee is looking for Members to provide feedback. The expectation is that this work product will go for EAC vote at the July meeting.

Dr. Sioshansi next provided an update on the Rate, Tariff, and Market Design for Energy Storage Work Product, which is still in its early phase. This product aims to highlight the problems created by historical market, rate, tariff, and regulatory design as they pertain to energy storage and provide a survey of what has been implemented in practice and proposals on the table to address the issues. Dr. Sioshansi explained that the recommendations to be made would help the Department assist state regulators and legislators determine how to address energy storage within their regulatory proceedings. Currently, the work product has been outlined and conversations were held with DOE energy storage experts. Dr. Sioshansi shared that the working group will be meeting in-person after the EAC meeting to debrief from the Rate, Tariff, and Market Design for Energy Storage Panel held during the EAC meeting, and discuss next steps and follow-on action items.

The final work product that is in its initial phase is the Biennial Storage Assessment, which is a statutorily required deliverable of the Energy Storage Subcommittee. This assessment reviews how well the Department addressed and met the goals that were set out in the 5-year storage plan. Dr. Sioshansi explained that work has not convened on this work product because the Subcommittee is awaiting the Department's response to the 2016 Biennial Storage Review. The goal is to complete the work product and vote on it by the October EAC meeting. If that timing cannot be met, there is an option to have a special WebEx meeting at the end of the year to vote on it. Dr. Sioshansi reminded the Committee that the Energy Storage Subcommittee has a statutory requirement to have at least 15 Members.

Ms. Reder summarized the presentations and Subcommittee activities. She recognized that Members have put in a lot of effort to advance the work products and thanked everyone for their time and contributions. She reiterated that the Committee has heard from Assistant Secretary Bruce Walker on his top five priorities, and noted that some of the work products discussed today already have some good ground work, but that others may have gaps. Ms. Reder asked the Committee to share input on resiliency and reliability. She recognized that there is some great Subcommittee work that is headed in that direction, and that it would behoove the EAC to have some good dialogue with DOE liaisons to understand what DOE has in motion. She emphasized that there are tremendous resources and prior work that has been done, and it is important not to reinvent the wheel. Ms. Reder encouraged the Subcommittees to engage with the DOE liaisons in an effort to better define scope, keep focused, prioritize, and provide valuable recommendations to the Department. From the DOE perspective, the communication and engagements will help the reviewers turn around responses in a timely fashion. A new goal set by Katie Jereza is to get feedback from DOE on work products by the next meeting.

Katie Jereza expanded on Ms. Reder's thoughts by adding that work products and recommendations should move away from tactical recommendations and move toward strategic ideas. She said that while it is helpful to get justification that the Department is working on the right things, it does not necessarily need to be part of a recommendation. Ms. Jereza encouraged the Committee to think along long term and strategic lines. Heather Sanders commented that the EAC could provide input into helping to shape and expand on the five priorities. Laney Brown commented that it is important to understand what DOE is or is not doing, and perhaps there could be a process in place to assist with speeding up the scoping of work products. Ms. Jereza agreed and added that she envisions that, when there is a concept, DOE can help inform the Committee on what is going on, and review and follow up on the submitted proposal to help with defining the scope. Then the liaisons could assist with diving down and provide real examples of projects that exist. Ms. Jereza stressed that as the writing moves forward the key is that there should be continuous dialogue and interaction between the EAC and DOE liaisons.

Lola Infante asked what things DOE is in a unique position to undertake. Ms. Reder noted that DOE has a unique role in convening different entities. Ms. Jereza added that DOE is a science R&D organization, and for the most part has an objective perspective. The Department does work with many different stakeholders and they do have the ability to bring them together. An example she provided was that the OE Transmission Permitting and Technical Assistance division provides technical assistance to states, and those relationships that have been built could help bring stakeholders forward to this Committee. Dr. Bose referred back to Ms. Brown's comment to reinforce the difference between what's already going on in DOE versus what new topics are being brought forward by the Committee. He mentioned that when talking about resiliency or cybersecurity, there are a lot of projects that are in progress that touch on those subjects, but the question for the EAC is what is new and how can their recommendations be more focused. Similarly, Mladen Kezunovic noted the importance of FOAs. He believes it would be interesting to get an update on FOAs that are out and reflect on what they are and are not covering. Ms. Jereza agreed with Dr. Kezunovic's idea, and stated that there is a delicate balance in being able to form the subject matter and the challenges that DOE should be considering, but also being careful when it's a competitive FOA.

Shifting the discussion to a new approach to EAC deliverables, Ms. Reder said that the Department would like to utilize the Committee beyond written work products. Ms. Jereza expanded on this. She cited the EAC's recent review of the draft cyber plan as an example feedback, and said this same approach would be welcome for a resiliency white paper series that Lawrence Berkeley National Laboratory will be undertaking. The suggestion is to have the EAC Members review the plan and provide feedback and comments.

In closing, Ms. Reder reiterated that the Leadership team will be thinking about Assistant Secretary Bruce Walker's top five priorities moving forward, and will have suggestions on how to better align work products in the future. Ms. Reder also noted that resiliency will be the focus of the in-person July EAC meeting.

Panel: Rate, Tariff, and Market Design for Energy Storage

Ramteen Sioshansi introduced the panelists: Hisham Othman, Quanta Technology; Scott Baker, PJM; Commissioner Carla Peterman, California Public Utilities Commission; and Arnie Quinn, FERC.

The first panelist, Hisham Othman of Quanta Technology, said he planned to share experiences from

Quanta Technology through their work with various utilities. He wanted to provide more clarity regarding the incentives for storage assets from a consultant's point of view. He said energy storage is building a lot of momentum; consumers talk storage mostly in the context of generation, but now more focus is also given to the role of storage in transmission and distribution (T&D) infrastructure. Mr. Othman shared that Quanta Technology has participated in a number of studies that examine these issues. Speaking to the competitiveness of energy storage systems, he said that, in the T&D context, storage technologies can provide a number of functions, such as reliability, market efficiency, and help in enabling renewables. However, it is also important to compare these functions to conventional solutions. For example, when comparing storage to wire solutions, wire solutions are much cheaper. Thus, an important consideration is the revenue streams that can be generated from storage and determining how to make them competitive with conventional solutions.

Mr. Othman provided an overview of a number of areas to consider when examining the cost of energy storage. The first is that the cost of energy storage is directly proportional to its size, which is related to the criteria for planning. He said it would be helpful to receive some clarity from industry, DOE, FERC, or NERC on the planning of storage systems. The second point to consider is how the storage asset will be used once it is built. The third is value stacking and determining advantages to conventional solutions. Finally, a unique aspect of energy storage that is not valued today is the value of incremental planning.

Mr. Othman provided additional details to the aforementioned cost components of energy storage, beginning with right-sizing the asset, which includes understanding the megawatts needed. He provided an example of this with PJM's 2016 market efficiency window. He mentioned that he had worked with a transmission owner to provide solutions for the FERC Order 1000 transmission planning process. The work included conventional solutions, as well as energy storage solutions. A big unknown when designing energy storage systems is how many hours PJM would accept, which is a huge cost component. Sometimes the utility will provide an estimate of the hours, but there is a huge impact on cost. The other component is the influence on the pricing of the market. There are multiple uses of energy storage in the T&D context and there are also various areas of uncertainty.

The second key point is the usage profile of the energy storage assets. For example, when considering frequency regulation in PJM, there is a question of whether that is the same as frequency regulation in other regions such as MISO or SPP. The challenge is understanding these differences, because it has impacts on capacity fading, asset management, replace of the asset, etc., which all adds cost that needs to be compared with conventional wire solutions. Thus, Mr. Othman believes that more clarity on the use profile of energy storage in specific markets can help industry insure the assets. The third component is value stacking. Recent announcements have provided more clarity in this area, such as the notices from the California Public Utility Commission (CPUC) and FERC, which have provided more information on how energy storage can participate in the market. There are also other aspects, such as resiliency value, that continue to require additional clarity. The last issue Mr. Othman addressed in assessing cost of energy storage is on the value of incremental planning. Energy storage is a flexible asset. For example, the planning of a transmission line requires load growth projections, needs, etc. for the next 20 to 30 years. However, when planning energy storage, one can plan for the first five years, then add to the asset later as the load materializes. This incremental planning and allowing for adjustments as new information emerges lowers the risk to the consumer. In Mr. Othman's work with a utility, they looked at conventional wire solutions vs. the battery solution. The battery solution was 80-120% of the cost of the wire solution, depending on its extent of participation in the market. When price and load uncertainty are included in the analysis, the range of the battery cost became much larger, at 30-120% of the wire solution. The challenge for the regulator is how to value this. There is the risk that a utility will pay more for the battery solution than the conventional solution, however, there is a greater chance that the battery solution will cost significantly less.

In his concluding remarks, Mr. Othman said there is still a learning curve for incorporating energy storage in the T&D context. There is still uncertainty in the role storage can play in addressing reliability, market changes, and enabling renewables integration. Thus, more clarity is needed in terms of planning criteria, use profile, and flexibility valuation, etc.

Mr. Nordstrom asked whether Mr. Othman is referring to batteries or more broadly defined energy storage. Mr. Othman responded that their experience has mainly been focused on batteries, which has been more applicable in today's context.

The second panelist, Scott Baker of PJM, began his presentation with historical context on energy storage in the PJM market. He said that PJM operates 5,000 MW of pumped storage today, and that about 265 MW of battery energy storage participates in the PJM regulation market. Battery energy storage has been participating in the market since 2010 and has pushed PJM to evaluate certain aspects of that specific regulation market that have not been considered previously. In particular, they are evaluating how regulation signal looks to batteries and how to pay and procure storage services. In conjunction with FERC Order 755, PJM revamped how that regulation market looks, which included accommodating energy storage and other resource types in a much different way than before. Mr. Baker considered this process of examining market operations and rules, and ensuring that energy storage is part of the solution as phase one of the RTO transformation process. He continued that now they are entering phase two, particularly with the final FERC rule that was recently released. Phase two will be ongoing over the next year and will require RTOs to focus more closely on integrating energy storage and its participation model.

On the topic of multiuse and using energy storage as a transmission asset, Mr. Baker said that energy storage is a new planning tool. There are more questions than answers in this area. However, now there are more solutions proposed through FERC Order 1000 competitive solicitations and PJM's Regional Transmission Expansion Plan (RTEP) process. Now RTOs must provide greater guidance on how storage resources can be part of the planning process. Planners do not typically evaluate transmission needs in terms of duration of a resource, so that is one area that would require more clarity and definition. Other topics for examination include technology risk and life expectation. FERC offered some guidance on this in a policy statement in late 2017. While that was helpful, it is important to continue to provide greater guidance. Internally from an RTO perspective, Mr. Baker said that there are lots of concerns on how existing modeling tools for existing resources might not be suitable for battery storage. He said that PJM has provided comments to FERC noting that PJM is open to exploring storage as a transmission asset, which is typically more prevalent at the lower voltages than the higher voltages. However, that might change in the future.

Mr. Baker continued by providing additional information on current PJM activities addressing energy storage. With release of the final FERC rule, PJM plans to organize a large stakeholder effort to evaluate all markets and the potential energy storage participation model. They will identify existing procedures, as well as the needs. Mr. Baker said most of the existing work is related to distributed energy resources (DERs). There also have been discussions on the multiuses of storage and its role in the wholesale and retail markets, as well as the resilience services it can provide. Mr. Baker said more details will need to be sorted out, such as questions involving jurisdiction and other uses.

Flora Flygt asked two clarifying questions: the name of the FERC final rule referenced, and the name of the FERC policy guidance. Mr. Baker said he was speaking of FERC Order 841, which is *Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators.* He said the FERC policy guidance he referenced has an associated docket, which he can distribute.

The third panelist, Commissioner Carla Peterman of the California Public Utilities Commission (CPUC), said this is her sixth year on the CPUC, and that she has been on the energy storage docket for past five years. She explained that the CPUC is seeing storage as a solution for some of the challenges that are seen in other spaces. In the last four years, the CPUC has approved contracts for 900 MW of advanced energy storage, which is an increase from the 2 MW approved from seven to eight years ago. In 2013, the CPUC established their targets for energy storage as a result of the work completed by working groups, two years of analyses on storage use cases, as well as legislative direction in 2010 that asked the CPUC to set storage targets.

Commissioner Peterman elaborated that the CPUC's storage targets support three main purposes: integrate renewables, defer investments in T&D, and meet California's greenhouse gas targets. The legislation requires that the storage procured be cost effective and viable, which are quite high standards for an emerging technology. In terms of California's mandate, she said they are primarily focused on technology that is electricity-in and electricity-out, excluding pumped hydro storage greater than 150 MW. Their solicitations have brought in technologies other than lithium ion batteries, such as fly wheels, but the majority have been batteries projects. This is largely driven by economics, particularly cost declines in lithium ion batteries.

Commissioner Peterman said that California's overall target is 1.325 GW of energy storage, which is broken down by individual targets for each of California's three investor-owned utilities, and which is further broken down into storage connected at the transmission system, distribution system, and behind the meter. Specifically, that is 700 MW in the transmission system, 325 MW in the distribution system, and 200 MW of customer-size storage. California's solicitation process occurs every two years. The first solicitation went out in 2014 and will run through 2020. The typical process is that utilities will submit their procurement plans, which will be reviewed by the CPUC. Once approved, the utilities will release a request for offer (RFO). The proposals received also will be submitted to the CPUC for final approval. The CPUC is currently considering utility procurement plans from 2016.

Commissioner Peterman provided a general suggestion when approaching energy storage: being mindful of what is known and what is unknown. It is important to not over-regulate and limit innovation. Therefore, California allows for flexibility in the targets, such as allowing the shifting of targets between grid domains, allowing utilities to defer up to 80% of a target in a given year if cost-effective projects are not emerging, and being flexible with ownership models. Utilities are not allowed to own more than 50% of their energy storage, but they can own in any grid domain.

Commissioner Peterman continued by discussing cost assessments and cost recovery. To assess cost effectiveness, the CPUC allows utilities to use proprietary models. The CPUC also requires the RFO results to be run through a common evaluation protocol so that the CPUC can compare projects on a more "apples-to-apples" basis. The cost-effectiveness evaluation is a mix of quantitative aspects, which is net present value of the assets, and qualitative aspects, which includes technology and supplier diversity, project safety, and contract terms. The cost recovery for storage is based on ownership model and grid domains. The CPUC allows the utility-owned storage to be rate-based. If the storage is providing transmission reliability service, that is collected through the transmission charge. If the storage is a wholesale market service, it is collected through the generation part of the bill. If it is a distribution service, then it is part of the distribution component of the bill. Third party-owned storage is not rate-based, but the owners are allowed to pass those costs through a CPUC fund, which are then passed through to customers. The CPUC has historically incentivized behind-the-meter storage through the Self-Generation Incentive Program, which provides a kW incentive for energy storage projects.

Outside of this framework, Commissioner Peterman said that the CPUC has also looked more broadly at bringing in DERs as non-wire alternatives. She explained that they are piloting a project in which the utility would receive some compensation for behind-the-meter access as a non-wire alternative. They are allowed to receive 4% pre-tax accommodation on the capital cost of a particular project. The CPUC expects to see the results of this pilot later this year. Commissioner Peterman explained that the CPUC developed these rules for multiuse applications because one of the promises of energy storage is that it can deliver multiple benefits, particularly in California where there are a lot of constraints in siting; thus, it is a very valuable proposition. The CPUC looked at how to identify these multiple services and were able to develop 11 overarching rules for utilities that want to develop a storage project with multiuse application. These rules identify the criteria that utilities would have to meet. For example, resources interconnected in the customer domain must also provide services in any other domain. Overall, Commissioner Peterman said that these rules are easy to understand. Initially, CPUC did two joint papers on this issue with CAISO and solicited a large amount of industry feedback. One challenge faced was regarding the practicality of these use cases. Some are possible, but most are just theoretical. There was discussion about establishing a rule for each use case, but ultimately they decided to develop 11 overarching rules for all use cases. Commissioner Peterman continued that, in addition to these 11 rules, they also looked at multiuse issues in terms of reliability vs. non-reliability services. They also looked at multiple services and divided them into service domains, including both the physical connection point and the jurisdiction. Service domains include the wholesale market, the customer side, resource adequacy market, and transmission.

Commissioner Peterman spoke about rules five and six in detail because they are related to reliability services, which were where most of the effort was focused. Rule five says that if one of the services provided by an energy storage resource is reliability, then that service must have priority. Rule six explains what it means to have priority. The initial proposal was to have a rule that was restrictive, with the idea that one cannot have an asset that is providing more than one reliability service. However, when they considered this, there was already an existing exception to that rule: the CPUC does allow resources that are resource adequacy requirements to participate in the wholesale market. Other stakeholders also raised other exceptions to this rule. Thus, they moved to a rule that was more permissive. The idea is that everyone that is part of the contract is responsible for ensuring that reliability services are met. The new rule says priority means that a single storage resource must not enter into two or more reliability service obligations such that the performance of one obligation renders the resource unable to perform another obligation. New agreements for such obligations, including contracts and tariffs, must specify terms to ensure service availability, which may include but should not be limited to financial incentives. The CPUC received feedback from the storage industry that a system of financial incentives and technologies will be sufficient to ensure reliability.

Concluding with rule 11, Commissioner Peterman said it focuses on how to compensate projects. Fundamentally, people do not want to give money to do something that already has been done. Rule 11 says that in paying for performances of services, compensation and credit, may only be provided to those services that are incremental and distinct. The CPUC does not define these terms, but the utility must. The CPUC has organized a working group is that continuing to define the meaning of those terms, thinking about how to address metering solutions, and how to move forward in a way that is least costly. The CPUC has already received some proposals involving some multiuse applications. There was one project proposal for a distribution asset that would also participate in the wholesale market. The question is how to do cost recovery for that, so the CPUC has asked the utility to propose a dual cost recovery mechanism. The utility in this case proposed recovering the cost as part of the rate base, but also receiving revenue from the wholesale market. They would create an account that collects those revenues, which are then used to offset distribution rates. This ensures that the ratepayer sees some benefit from these multiuse services. Finally, Commissioner Peterman highlighted the importance of coordination with the grid operator. The CPUC conducted all this work with CAISO, and is looking forward to continuing to develop those participation models.

The fourth panelist, Arnie Quinn of FERC, started by providing a brief history of FERC Order 841 on energy storage. Since 2009, FERC has been working on broad barriers to entry for energy storage. Mr. Quinn said that initially they were focused on compensation for one of the services that can be provided by energy storage: frequency regulation. However, they soon learned that that service did not fully compensate the value of energy storage services. Thus, they required a reform to those rules in Order 755 to ensure that RTOs/ISOs are paying for both the amount that a resource provides in terms of frequency regulation and the capacity. In terms of other barriers, Mr. Quinn said that they also asked questions about multiuse, but between 2009 and 2015, they did not do much on wholesale. By 2015, more storage was on the grid, partly in response to the reform on frequency regulation and some of the storage initiatives in California. This elicited FERC to hold a panel in November of 2015 to discuss other barriers for energy storage.

Mr. Quinn continued that in 2016, FERC issued a data request to explore the nature of those barriers in more detail. The issues considered included the eligibility of storage in participating in wholesale markets, bidding parameters for participating resources, and the qualification and performance requirements for energy storage, specifically whether they are appropriately tailored. Moving forward to the November 2016 NOPR, FERC accepted the services as they were defined by the RTOs and the nature of the technical requirements to provide those services. There was recognition that some of those technical requirements are legacy requirements for a set of resources that existed historically.

Regarding the NOPR on Electric Storage Participation in the Organized Wholesale Electric Markets, Mr. Quinn said that they proposed two main items: 1) requiring the RTOs to establish a participation model consisting of market rules that, recognizing the physical and operational characteristics of electric storage resources, accommodates their participation in the organized wholesale electric markets; and 2) allowing distributed energy resource aggregators, including electric storage resources, to participate directly in the organized wholesale electric markets. Moving on to the Final Rule, Mr. Quinn said that it looked very similar to the NOPR on the storage side, but made one qualification: the Final Rule makes clear that the storage participation model is for energy storage that injects back onto the grid. That could include standalone energy storage that connects at transmission or distribution, but it must inject back onto the grid. With that definition, Mr. Quinn said FERC requires that: 1) electric storage resources be eligible to provide all capacity, energy and ancillary services they are technically capable of providing; 2) electric storage resources be able to be dispatched and set the wholesale market clearing price as both a wholesale seller and wholesale buyer; 3) RTO/ISO tariffs account for the physical and operational characteristics of electric storage resources through bidding parameters or other means; 4) RTO/ISO tariffs establish a minimum size requirement for electric storage resources not to exceed 100 kW; and 5) the sale of energy from the organized wholesale electric markets to an electric storage resource that the resource then resells back to those markets be at the wholesale locational marginal price.

The Final Rule provides some specification for meeting those requirements. While, FERC did not change any of the technical requirements for providing services, they did provide some flexibility. For example, if an energy storage resource needs to de-rate so that it can be technically capable of providing services, it is allowed to do so. FERC did not finalize the proposal for aggregated distributed energy resources; instead, they started a second proceeding to gather more information. FERC received comments on DER participation and decided to initiate a technical conference on April 10-11th, 2018 instead of issuing a final rule at this time. They will discuss DER eligibility to participate in the organized wholesale electric markets through a distributed energy resource aggregator and the implementation details of DER participation, including coordination of wholesale activities with distribution system operations. Additionally, they will also discuss some reliability issues. FERC will discuss technical issues, and also provide opportunity for state commissioners to discuss issues of interest to states.

Mr. Quinn continued by discussing the FERC policy statement on cost recovery for energy storage resources. In 2011, FERC received a proposal from Western Grid, a storage resource in California that asked for clarification on whether the storage resource would be eligible for cost recovery through the CAISO transmission access charge if the resource were able to go through CAISO transmission planning. There was increasing interest in receiving cost-based and market-based compensation. Therefore, the FERC policy statement provided clarity that energy storage resources can recover costs through both cost-based and market-based rates. It provided the basis for FERC to consider proposals that provided for both. Mr. Quinn explained that although the policy statement provided some details on implementation, it was intentionally kept high-level. Essentially, the policy statement identified three high-level issues that would have to be addressed to the extent that an ISO wanted to move forward with a proposal that would allow a resource to get cost-based recovery and also participate in the market. The first detail is determining how to get double recovery of costs from cost-based ratepayers. FERC notes that one way of doing so is by crediting the market-based revenue back to customers so that the customer is paying no more than the cost-basis of the resource. One issue that came up was that, in the transmission planning process, for a competitive solicitation, resources are providing a cost estimate that is the basis for the selection. If there is an energy storage resource that had not been built yet, there are only projections of what their market-based revenues would be. Thus there are some open questions about what the energy storage resource is held to: the estimate of their market revenue, or crediting back. FERC left these details open to the proposals from ISOs, but notes that these are issues that they would have to address.

Mr. Quinn continued that the policy statement says that FERC is not convinced that there are adverse market impacts. The last issue that the policy statement raised was on RTO/ISO control of electric storage resources and RTO/ISO independence. This relates to Commissioner Peterman's fifth rule that was mentioned for California. If the resource is getting cost-based recovery for providing a service, the policy statement recognizes that the ISO must have priority use of the service. The ISO must also have some confidence that the resource is available when expected. This raises a question for ISOs and whether they are required to or should be allowed to charge the resource for reliability services. Mr. Quinn said there was vague commission precedence for what is allowed. For instance, Mr. Quinn noted that PJM has the ability to decide when to pump their pumped hydro resource and when to discharge that. However, in another case in California, there was concern that the more frequently the CAISO operated the resource, the more likely it was going to be seen as a market participant rather than an independent agent. The policy statement, therefore, lays out that some degree of the control by the ISO is not going to cause any concerns about independence. With this high-level guidance, the idea was that ISOs would come to FERC with proposals that use the guidance for their filing.

EAC Discussion of Rate, Tariff, and Market Design for Energy Storage Panel

John Adams asked, in the discussion of lack of market impact, if there was any discussion on energy-only markets. Mr. Quinn said that some of the cases they received talked about cost-based recovery being a subsidy, which means a resource going into the wholesale market would have an unfair competitive advantage. To the degree that there are lots of subsidies in the wholesale market, Mr. Quinn said they were not concerned that this cost-based recovery subsidy would constitute a greater concern than the others. With regards to adverse market impacts, Mr. Quinn said there were two major considerations. First, has one induced entry by a resource that might not otherwise enter based on just the market revenues they would get? If one induces entry by a resource that could not recover its costs from just market-based services, then all the other resources that cannot do that would feel disadvantaged. Second, what should the resource bid in the markets once it has entered? The conversation during the Western Grid proceeding was more focused on once the resource exists, whether it should bid in at zero or a marginal cost.

Laney Brown posed a question to Commissioner Peterman. As New York develops its energy storage roadmap, Ms. Brown asked for Commissioner Peterman's thoughts on lessons learned from California and any barriers from the policy and utility perspectives. Speaking to the lessons learned, Commissioner Peterman reiterated the importance of working with the grid operator. She said some of the issues for storage also are likely to be issues for DERs. For example, they are seeing solar with smart inverters proposing to do multiuse applications as well. Therefore, she said thinking about the roadmap in terms of a broader perspective and ensuring that DERs also are part of the conversation would be valuable. Commissioner Peterman noted that the storage industry has identified all the services that storage could provide, but they are not all market services right now, so it would be important to be mindful of what is available currently. Additionally, it is important to be mindful of what is jurisdictional for the public utility commission vs. the grid operator. If certain services are not offered right now, it would be important to consider how an asset might be able to participate in the future. Metering was also a big issue in California that they are still working on. In California, Commissioner Peterman said they will continue to work on next steps in developing their roadmap.

Jeff Morris asked about the challenges of mandating storage vs. developing aspirational outcomes with regards to getting the technology to develop to an advanced stage. He continued to ask about the role of the California public utilities and their position being non-FERC and non-commission jurisdictional. Commissioner Peterman responded that the work on energy storage was a good example of legislative and PUC cooperation because the legislation said to consider setting targets and laid out the criteria for doing so. The publicly owned utilities received the same direction. They did not adopt targets on the same timeline initially, but they have begun to in the past couple of years. Commissioner Peterman noted that when they initially put out targets, they heard from the storage industry that they needed to develop 6,000 MW of storage, but the utilities said they need none, which was a big gap. However, when California started to set the targets, they saw that the utilities and industry started to work together. This meant that having the targets forced stakeholders to examine this issue. Initially, there was no perfect storage contract because people simply did not have the experience. Commissioner Peterman said that, moving forward, they will require storage to participate in integrated resource planning (IRP). The PUC has released its reference, but each utility must develop their own IRP that fits into the statewide development. She said that their modeling shows that they will need 2,000 MW of additional energy storage by 2030 to deal with intra-hourly needs. This type of guidance is helpful for utilities and industry to understand because people need to know what operational profile the PUC is looking for.

Paul Hudson said it seems like the vendor community plays a very important role in these discussions. There is a number of different interests that interact with PUCs and ISO/RTOs. He asked whether the panel can speak to any potential conflicts in those interactions and how sophisticated the vendors are at developing technology that is applicable to all states. Mr. Quinn responded that it is hard for regulators to respond to hypothetical situations. For example, Western Grid has a specific proposal. FERC would essentially provide more detail to vendors on what they would consider acceptable. Regulators would develop policy incrementally in response to specific situations. The precedent is then developed over a series of cases. Tension arises when there is need to move forward on emerging technologies before the barriers present themselves, but it is hard to determine what exactly needs to be done since the industry is so young. Thus, this entails managing the hypothetical situations and aligning situations as they develop.

Commissioner Peterman said she agrees with Mr. Quinn’s assessment. She said the vendor industry is quite sophisticated; there is a lot of variation in terms of the size and experience of companies. The biggest challenge for vendors is figuring out how to work with utilities in developing contracts. However, she said it is also important to have technology diversity and incentivize entry of smaller, less experienced companies. In her view, the tension is around expectations of how much support vendors should receive. For California, storage is a solution for integrating renewables, not a means to itself. Thus, they must find the balance of incentivizing storage just to have it exist even if it is not cost effective. Commissioner Peterman said they have experienced some backlash from storage vendors who ask why the state cannot support storage in the same ways they have supported solar. She said the point is not to have indefinite targets, the point was to provide this asset class an opportunity to work through some of its issues and have it participate in broader RFOs. It is important to ensure there are long-term contract opportunities for storage, not just incentives.

Tom Weaver posed a question to Commissioner Peterman on the control of energy storage resources, specifically whether they are autonomous or called upon. Commissioner Peterman said it is typically a mixture of both. There is not a requirement on how it runs on the customer side, so they have been considering refining incentives in terms of price signals. On the other end, there are assets that are controlled by utilities. Recently there has been legislation that directs the utility to control the asset. Commissioner Peterman said utilities do not necessarily have to own the asset, but they are required to control it. Utilities are required to procure 500 MW of energy storage on top of the state targets and they must exercise control. Mr. Baker added that the issue of control depends on what the service is. In general the owner of the resource must control the asset, which is dispatched by the ISO if it participates in a wholesale market. Mr. Weaver said one of the bases of his question was the issue of the ramp rate and how energy storage can help that, which would require a level of control. Commissioner Peterman said that part of California's storage initiative is to make sure they have proper wholesale prices. There are also economic dynamics that need to be worked out, because as storage supply increases revenue also decreases. Thus, the industry will need to decide how much is actually needed.

John Adams said that there is a lot of variety in electricity rates across different regions. In Texas, natural gas supply is lowering the rate of electricity. Mr. Adams believes that each of these proposals should lower cost over the long term. He asked if there has been a study on the source of differences in electric rates in different regions. Mr. Quinn said there was a study that compared the cost of electricity in ISO vs. non-ISO markets to examine why cost was higher in some regions vs. others. However, the conclusion of that study was not definitive. From the wholesale regulator perspective, Mr. Quinn said it is their job to lower the barrier of participation and review the set of services that are compensated so that people can all compete on a leveled playing field. He said they need to ensure the lowest cost resource wins. Commissioner Peterman agreed and said they aim to move to an attributes-based system. However, she said only examining cost does not cover the total value. For example, there is a lot of investment that goes into rates, low-income assistance, etc., so higher costs do not always reflect the value to the ratepayers. In California, they are looking at cost trends and where rates are going up. She said that is why they have been looking at storage and how it can help mitigate cost increases.

Wanda Reder noted that, in the past 10 to 12 years, they were struggling with the technology side. Now, the focus is on figuring out the value proposition. Thinking ahead for the next five years, she asked the panelists what they think the focus for DOE should be and how the EAC can help remove barriers. Mr. Quinn said it would be important to determine how to coordinate resources on the distribution system that are participating at the wholesale level, so that they are not disturbing the distribution system and vice versa. He said DOE National Labs have done good work on grid architecture. The New York model, unlike the California model, is more centralized, where there is a distribution system operator (DSO). The distribution system aggregator is connected to the operator as well as to the ISO. Mr. Quinn believes the grid architecture issue is critical for integration of DERs. Mr. Baker said coordination between the transmission system operator (TSO) and the DSO is the frontier for grid operation and where DOE can be helpful. Commissioner Peterman said she does not believe the technology issues have been fully resolved. She said it is also important to support storage technologies other than lithium ion batteries, because the need for storage will only increase. Two initial issues with lithium ion batteries are life-cycle impacts and scalability, particularly how many batteries are required to meet goals. Things to consider include the opportunities for manufacturing, battery recycling, etc. Commissioner Peterman also mentioned the communication protocols for integrating storage devices and DERs. Another concept is power to gas, which Commissioner Peterman does not see fitting into the rules and construct for energy storage because it faces different issues. However, it should not be left out in exploration. Mr. Othman mentioned information gathering as an important issue, and focused on the issue of how to plan these resources and improve the capabilities of planners. Commissioner Peterman also mentioned that there is a learning curve in terms of integration with the distribution system and modeling expertise that is needed. However, the technical expertise can be very costly, so standardizing analytical tools would be important. The billing systems and software requirements for utilities also would need to evolve.

Mladen Kezunovic said, in terms of technological experience, there has been lots of investment in test beds. He asked the panelists whether DOE should examine these test beds and determine whether they should do more. Mr. Baker said the value of the test beds is a good question for the vendor community. However, from an RTO perspective, he said they learn more from real world demonstrations. Mr. Kezunovic said vendors are making components and asked whether market operators have a complete understanding of how these items actually will perform. He asked about the level of confidence market planners have in the ability of a resource to provide a certain service. Mr. Baker said they gain confidence by doing demonstrations to understand how physical resources respond to the regulation signal. However, there are cases where there are technologies that can be really valuable. Commissioner Peterman said it also depends on the timing. In California, the majority of storage contracts do not come online until 2020, so there is not much real world experience. The use of storage as part of a microgrid has become a big area of interest, so there is also opportunity there.

Chris Shelton said the panelists have all done great work on integrating energy storage. As AES works on energy storage in a new market, they sometimes run into a need for change. In some markets, there would be a hard line of rules that restricts AES from implementing storage. Turning to Mr. Quinn, Mr. Shelton said that in some of the RTO markets, there were exceptions to the rules, which were typically for incumbent technologies. He asked whether there has been examination of these exceptions and whether they are unreasonable. For example, in the zone around Manhattan, there is a whole class of generation that has only a one-hour performance requirement to meet full capacity treatment in New York, while other generators have to meet four hours. He asked how the industry should approach these exceptions. Mr. Quinn said that is an important question that is being considered. They do examine all the technical requirements and see if something is a legacy requirement or a natural system need. However, this can be difficult to figure out and requires a detailed understanding of all markets. Having a FERC mandate on the capacity of energy storage would be more impactful, but the level of work involved prohibited them from pursuing this further. Mr. Shelton said it seems implicit in FERC's proceedings to have one resource with one set of requirements and other resources with different requirements. The incumbent resource typically has more loose requirements. He said going back and putting all these resources on a level playing field would help all of the resources in the long run. Mr. Quinn said this issue has definitely been raised, but it has been difficult to figure out. If a company has experienced an issue, they can file a discrimination complaint with the Commission. There also has been interest in moving from participation models toward technology-neutral tariffs, but that would take a lot more effort. Mr. Baker said he has seen work on comparing storage with other assets to make sure rules are equitable. He believes this storage Final Rule can provide the opportunity to really examine this issue.

Armond Cohen commented on storage's role in enabling high penetration of variable renewables. Part of the narrative on storage is that it will enable renewables to become more dispatchable. He asked the panelists whether there will be more clarity on this issue and whether storage should be priced in now. Mr. Cohen said that what happens to storage also depends on what else is happening on the grid, so it would be important to model the value of storage on certain levels of renewables. Mr. Baker said he agrees that it is an evolution of pricing under various conditions, such as high variable renewables scenario. Commissioner Peterman said that in California, storage is seen as a value add in a high renewables future. However, currently curtailment still remains the most cost-effective way to integrate renewables. She agrees that the value of storage is affected by other occurrences in the market, particularly what is happenings with electric vehicles. Five to ten years ago, they lacked the ability to even put the attributes of storage into a model and compare storage to demand response, curtailment or other services. In the coming years, they will need more flexible resources as the penetration of renewables increases.

Ramteen Sioshansi noted that most of the conversation has been around parts of the countries with structured wholesale markets. He asked the panelists about the challenges they have seen in parts of the country without restructured markets. Dr. Sioshansi also asked Mr. Quinn if he believes there will be a companion to Final Rule 841 that addresses some of the issues around storage and DERs in non-ISO/RTO parts of the country. Mr. Quinn said FERC has had some experience in the non-RTO regions on market-based rate authority for sales of ancillary services amongst bilateral transmission service providers. FERC's goal was to make it easier to sell ancillary services from one utility to another. There was a question as to whether they can extend Order 755 into this framework, and they decided that it was not really possible due to limited levers of FERC outside of the RTOs. However, the Policy Statement might be helpful for framing storage use. Commissioner Peterman noted that there have been valuable experiences from vertically integrated utilities. They have a lot more control in how they use their assets. She believes that growth and success in any grid domain will have a positive impact on other grid domains, because it will lead to cost declines. Thus, she thinks vertically integrated utilities can be leaders on multiuse applications. Mr. Quinn followed up that that is an area where experience outside of the RTO markets would be valuable in conversations about breaking up various services, which makes it harder for one resource to provide more than one service. The more experience in the vertically integrated utilities and the better understanding of how storage operates, the more value there is in information sharing and comparison.

Mr. Weaver said that energy storage projects are still very expensive and ancillary markets remain important for offsetting costs. He wanted to know where storage is on the saturation curve and, when saturation occurs, if there will be another curve with another market that will provide some outlet to help develop these projects. Mr. Baker said he does not like to think of the saturation curve in the regulation market as a saturation curve. There is now a regulation requirement that has become more dynamic. There is a limit to how much can be procured in each regulation market, and that is the saturation curve. Outside of regulation, synchronized reserves is another ancillary market that storage can participate in.

Dr. Sioshansi and Ms. Reder thanked the panelists.

Wrap-up and Adjourn Day One of February 2018 Meeting of the EAC

In concluding remarks, Ms. Reder noted that the Smart Grid Subcommittee will be convening for Dutch breakfast tomorrow at restaurant Pinzimini in the Westin Hotel at 7:00 AM. Tonight, EAC Members will be having a Dutch dinner at the same restaurant. After the conclusion of the EAC Meeting tomorrow, the Energy Storage Subcommittee also will be meeting starting at 1:00 PM. There were no closing comments and Ms. Reder declared a recess until the next morning.

Respectfully Submitted and Certified as Accurate,

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The Grid Group
Chair
DOE Electricity Advisory Committee

6/7/2018
Date

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