U.S. Department of Energy

Electricity Advisory Committee Meeting

National Rural Electric Cooperative Association Conference Center

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Meeting Summary

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Meeting Summary

This was the third Electricity Advisory Committee (EAC) meeting in 2019. On day 1 of the meeting, Assistant Secretary Bruce J. Walker of the Department of Energy (DOE) Office of Electricity (OE) and Alison Hahn, Program Manager in the DOE Office of Nuclear Energy, provided updates about relevant programs and initiatives of their offices. DOE's Eric Hsieh and Marcos Gonzales Harsha gave a joint presentation about innovations in energy storage devices and strategies that DOE is taking to increase research and development (R&D) efforts. They also discussed the Energy Storage Grand Challenge. Dr. Paul Denholm of the National Renewable Energy Laboratory (NREL) presented about the future of energy storage systems, which set the stage for the day's panel session about energy storage deployment. The panel moderator was Shaun Mann, of Tri-State Generation and Transmission, and the panelists were Lee Ragsdale of North Carolina's Electric Cooperatives, Clay Koplin of Cordova Electric Cooperative, and Andrew Levitt of PJM Interconnection. The panel was followed by a question-and-answer session.

Welcome, Introductions, and Developments Since June 2019 Meeting

Michael Heyeck, EAC Chair, welcomed everyone, covered several housekeeping items, and gave the floor to Christopher Lawrence, Acting Designated Federal Officer (DFO) to the EAC. Mr. Lawrence thanked and acknowledged the EAC members, DOE staff, and contractor support. He noted several housekeeping items, including that copies of all needed materials will be available on the EAC website. Mr. Lawrence proceeded to officially convene the meeting and turned it back to Mr. Heyeck.

All the members introduced themselves. Mr. Heyeck thanked all the attendees for their time and service. He provided an overview of the agenda, specifically pointing out the two panel sessions. Mr. Heyeck then invited Assistant Secretary Walker to present his update about DOE OE programs and initiatives.

Update on DOE Office of Electricity Programs and Initiatives

Assistant Secretary Walker introduced Chuck Kosak, the new Deputy Assistant Secretary for the Transmission Permitting and Technical Assistance (TPTA) division within OE. Assistant Secretary Walker described Mr. Kosak's background and said he looks forward to working with him. Assistant Secretary Walker noted that Mr. Lawrence has officially been nominated as permanent DFO, as opposed to remaining in his current "acting" role.

Assistant Secretary Walker gave an update about the North American Energy Storage Resilience Model (NAERM). He received an update from eight of the national labs that the static model includes the integration and interdependency of natural gas and the electrical transition system. These labs are working on having real-time updates once the model is implemented (FY 2020). DOE has been working with industry partners along with the Electricity Subsector Coordinating

Council and the Oil and Natural Gas Subsector Coordinating Council to solicit feedback. DOE has also partnered with the North American Electric Reliability Corporation (NERC) for implementing NAERM. As next-generation phasor measurement units (PMUs) come online, NAERM will be a valuable tool to further information-based decision-making processes.

The Assistant Secretary discussed the Grid Modernization Lab Consortium (GMLC). The GMLC brings together all 14 national labs and the five applied sciences offices to solve R&D challenges. Assistant Secretary Walker noted that DOE would make an announcement about the GMLC. Assistant Secretary Walker mentioned that Gil Bendewald, a director in the Office of Electricity, has been a key part in finding cross-cutting projects that push the industry forward.

A main focus for R&D within OE is energy storage. Assistant Secretary Walker said the House and Senate have both approved appropriations for a new facility in the Pacific Northwest that will focus on storage development. The belief from the top down, is that energy storage is the holy grail of the electric utility industry. Bills in both chambers of Congress have been put forth and DOE is currently working with members to consolidate these bills.

Assistant Secretary Walker then thanked the EAC for their time and dedication toward the Electricity Challenge. The winner was Southern California Edison Electric. He mentioned that DOE will be conducting a similar challenge in the spring of 2020. Also, he read both the Resilience Framework and Optimizing Reserves framework and looks forward to moving ahead with the recommendations.

Questions and Answers

Q1. Delia Patterson thanked the Assistant Secretary for the letter he sent to FCC Chairman Ajit Pai about 6-GHz infrastructure and the energy and water nexus. She asked if he received a response and what follow-up is DOE going to take.

Assistant Secretary Walker said he had a phone call with big tech companies (which he calls the "6-GHz Consortium") addressing the letter. The reason for the letter was because he is concerned about communication for 6-GHz technology, which is important to industry (specifically oil and natural gas). He conveyed to the consortium that DOE's national labs have the capabilities to help design and test this new technology. He is most concerned about cybersecurity and national security.

Q2. Chairman Heyeck thanked the Assistant Secretary for his engagement with EAC and running a smooth operation. He said that February's meeting will link representatives from national labs and the industry to discuss energy storage efforts and developments.

Assistant Secretary Walker thanked the EAC. He said it is important that DOE utilizes the EAC, given its interdisciplinary members and vice versa. He capped it off by saying the EAC does a great job solving real problems that exist.

Update on the DOE Office of Nuclear Energy Programs and Initiatives

Mr. Heyeck provided comments about nuclear energy and encouraged those in attendance to visit the U.S. Energy Information Administration (EIA) website. He mentioned how the world perception of nuclear energy has become more positive in recent years. For example, support for small modular reactors (SMRs) has gained a lot of traction. He then introduced Alison Hahn, Program Manager in the DOE Office of Nuclear Energy (NE).

Ms. Hahn gave a brief overview of NE and outlined its three priorities:

- Existing fleet
- Advanced reactor pipelines
- Fuel cell infrastructure

She discussed the five different branches that make up the Nuclear Energy office, along with the labs; Idaho National Lab is their central lab. The Office's five-year lab-directed R&D funding opportunity announcements (FOAs) have been highly successful, with $128 million already given away.

Ms. Hahn went in-depth about the existing fleet infrastructure. A large part of our nuclear fleet is still operating even though it is nearing or already past its operating license. Ninety-one of these facilities have received a special license that extends their operating time for at least another 20 years because there are no technical limitations holding them back. Even though, from a technical perspective, the facilities are good, there are other factors causing problems. These include economics; the plants are simply not modern enough for new technology; their efficiency has decreased; and nuclear is still limited in its uses.

The focus shifted to Light Water Reactor Sustainability program research pathways and focus areas. Ms. Hahn discussed the five-part framework to this process:

1. Data analytics
2. Machine learning
3. How to interpret data
4. Software application/ integration to other industries
5. Materials research

Ms. Hahn dedicated a substantial amount of time to R&D, and this plays a crucial role for next-gen nuclear and SMRs. These focuses align with the research pathways and focus areas. The only addition is taking into account physical security.

Ms. Hahn gave a high-level background of SMR technology. She explained that the R&D for SMRs accelerated in the early 2010s when fossil plants started retiring. DOE played a key role in SMR development through both technical and economic support, which decreased market risk and allowed for early adopters to succeed. One of these was NuScale. After a 46-month review, SMRs will be permitted in January 2021. NuScale's technology is unique because it operates using a steam generator and a helical coil that wraps around the generator. The generator is cooled by convection along with being in a pool of water that acts as a natural cooler.

Questions and Answers

Q1. John Adams asked about the makeup of the existing fleet and whether existing license applications are all for light water reactors.

Ms. Hahn said the fleet is still comprised of light water reactors and NuScale produces light water reactors. She said "small modular" is simply a reference to the size. There are advanced reactors that utilize sodium and gas, but the only applications that have been submitted to DOE NE have been for light water.

Q2. Clay Koplin asked if NE is doing any outreach to address the negative perception of nuclear energy.

The NE office does have a public affairs team and people who write articles to better inform citizens about nuclear energy in language the average person can comprehend.

Q3. Paul Cicio asked if there is a goal they are trying to reach for cost per megawatt hour. He followed up by saying the cost has to be economically competitive for manufacturers to buy this energy.

Ms. Hahn did not know the number they are aiming for and agreed to follow up.

Q4. Paul Hudson asked if load following on the new SMRs are superior to the existing fleet.

The current time takes 15–30 minutes, but SMRs have a more immediate reaction time, specifically regarding load following.

Q5. Bob Cummings made a statement about the physical location of SMRs. For example, you have to be mindful if the SMR is going to be somewhere like a steel mill in northern Indiana or used for something else.

Q6. Mr. Adams asked if there is a plan for nuclear fuel cycle waste.

Ms. Hahn said they are looking at consent-based sites, but aside from that she could not make a comment.

Q7. Mr. Koplin asked if they are looking at more remote places, specifically the Arctic, in the United States and internationally.

SMRs and microscales (less than or equal to one megawatt) are being deployed, and they are looking at remote communities in Alaska.

Q8. Jeff Morris asked about the status of pebble-bed reactors.

Ms. Hahn said DOE is still moving forward with R&D, but she is unsure what utilities and other outside entities are doing.

Q9. Mr. Heyeck had two questions. The first was about fuel waste being less radioactive. The second was about what actions Europe is taking regarding SMRs.

DOE is currently testing system analysis R&D to decrease radioactive waste levels, but they are quite limited. Addressing the second question: There are several countries moving forward, in the UK, specifically. Outside of Europe, Canada has been taking steps and NuScale is in the early stages of the permitting process with Canada's regulatory body.

Q10. Arthur Kressner asked what outreach efforts are being taken directed toward young people.

The Nuclear Energy Institute puts on programs, and the Millennial Nuclear Caucus is highly active on Capitol Hill.

Q11. Sean Mann stated there has been a trend away from nuclear energy. He followed this up by asking what Ms. Hahn sees as a barrier to nuclear energy growing in the United States.

Ms. Hahn said scale and cost are the two major factors.

Q12. Flora Flygt asked what Ms. Hahn's vision is for the 2019 energy outlook and how DOE would like to see nuclear energy used in the future.

Ms. Hahn said there is an "all of the above" strategy and nuclear plays a big role in energy consumption. She would like to see nuclear energy have an increased ratio of our energy production given its many useful traits.

In closing, Mr. Heyeck said that gas and renewables are not going to be enough looking forward to our energy future and that nuclear should play a role. He brought up the need to think of other sources of energy. For example, hydrogen is a potentially great alternative for transportation, but the technology is not there yet. He emphasized the importance of electricity to our economy and national security.

Presentation about DOE Energy Storage Grand Challenge

Eric Hsieh, Director of Grid Systems and Components in OE, began the presentation by giving an overview of the team and task at hand for energy storage. He mentioned that the EAC and both chambers of Congress have given feedback that there needs to be better coordination for battery storage. Specifically, the focus should be on cutting down costs of development and working with other DOE offices. Mr. Hsieh then went through how the battery storage program has improved in the past four years. The underlying theme is that each year more offices have been added, to the point where each of the five DOE application offices are now involved.

The bulk of the presentation highlighted the complexities of addressing battery storage. The key question Mr. Hsieh asked was, "How do you create a coordinated strategy when both the underlying application and technologies are so different?" Mr. Hsieh showed the benchmarks of four different offices' uses and how complex this new technology is. For example, the Vehicle Technology Office has a target addressing density, while the flexible generation office is the only one that takes into account efficiency. Mr. Hsieh said it is imperative that the systems are technologically independent (able to connect with a wide scale of systems). He emphasized how broad and complex energy storage is because of the vast possibilities it can be used for.

Marcos Gonzales Harsha, Deputy Director of Partnerships and Investment within DOE Office of Technology Transition, summarized how his office plays a role in implementing technology. He emphasized the concept of finding a value proposition within all the projects DOE is working on. To do this, DOE should be seen as a technology development shop and even a business at times. The agency is putting forth cutting-edge technology, but there are instances the technology is not reaching its potential. Mr. Harsha said the Department is shifting, now more accurately taking into account market readiness and technology readiness levels. This means looking at factors such as manufacturing supply chain and workforce dynamics. According to Mr. Harsha, it does not matter if the U.S. has the best technology; without sufficient infrastructure, the technology is useless. Other countries (China, Japan, and South Korea) are all passing us in storage development. This is going to be a disadvantage in the long run. Silicon Valley companies are eager to invest, but they are forced to look elsewhere due to the United States' stagnation.

Questions and Answers

Q1. Bryan Olnick asked if there are things the U.S. is missing in the market that other countries are getting ahead on.

Mr. Hsieh responded that Germany and France have programs that are extremely sensitive to sourcing materials. They take major efforts to create a close-looped system, and the European Union (EU) in general is adopting this strategy. The Europeans try to accommodate cross-industry polymerization. Germany was used as the example for how they utilize their automotive industry to help with battery storage.

Q2. Dr. Bialek asked what DOE is doing to jump-start our programs.

Mr. Hsieh said that many countries assume a future that is dominated by lithium-based technologies for the next decade and beyond. DOE spends a large part of R&D dedicated to lithium-based, but OE's chemistry research is also looking at non-lithium alternatives such as sodium and zinc.

Mr. Gonzales added that cobalt is also being looked at.

Q3. Wanda Reder asked about the outlook on IP strategy and tech transfers. She followed this up by asking what DOE is doing to increase engagement and get the right people at the table.

There is an IP reform initiative under consideration. The lab partnering service (labpartnering.org) was also launched as a Google-type tool to help people see which lab can best help them. With national security at stake, we are rethinking what technology can be made available to foreign competitors.

DOE is currently conducting a listening tour with various stakeholders and taking their comments to alter what we are doing.

Q4. Tom Weaver made a comment about identifying and addressing the barriers of installation. It is currently difficult to tap multiple benefit streams and they need help.

Mr. Hsieh referred him to DOE's policy team.

Presentation about the Future of Energy Storage

Dr. Denholm, Principal Energy Analyst at NREL, began by giving his background in researching energy storage. Within the last five years, the price for this technology has declined and energy storage is going to be a game-changer. A pricing turning point is projected within the next five years. Dr. Denholm said that a sizeable chunk of the United States' capacity is going to retire in the next two decades and that will have to be replaced. Energy storage will gain traction and growth as economies of scale kick in. A reason for this is that utilities are now taking a lifecycle analysis into account. Energy storage units are becoming more competitive and a better option compared to existing capacity infrastructure.

The presentation shifted to discussing what batteries are presently doing and how they are utilized. Dr. Denholm showed how the onset of renewables, and even batteries recently, are altering the energy grid. He showed a graphic demonstrating the effects solar energy has on peak load demand. Solar energy has the power to shift when the peak takes place, while also shortening its duration. When batteries are implemented, peak demand sees an even further drop in both intensity and duration. Dr. Denholm noted that storage performance isn't dependent on climate. For instance, storage works better in warmer climates than cooler climates. Dr. Denholm alluded to a vastly different energy future within the next decade or two as renewables and battery storage play bigger roles in both generation and capacity.

Panel Session: Energy Storage Deployment Case Studies

Shaun Mann, R&D Manager of Tri-State Generation and Transmission, moderated the panel discussion. Panelists were:

- Lee Ragsdale, Senior Vice President, Energy Delivery, North Carolina's Electric Cooperatives
- Clay Koplin, CEO, Cordova Electric Cooperative
- Andrew Levitt, Senior Business Solution Architect, PJM Interconnection

Mr. Ragsdale's Opening Remarks

Mr. Ragsdale gave an overview of utilities in North Carolina and where his cooperative fits into the grand scheme of North Carolina's utilities. He outlined one of his microgrid projects (Ocracoke). This site doubles as a research project because it allows them to view demand response, ancillary services, capacity, and other factors. Mr. Ragsdale used Ocracoke as an example in addressing infrastructure planning. This storage unit sustained little damage from Hurricane Dorian and expedited the area's recovery rate because of a raised platform design.

The co-op also runs a microgrid through a partnership with Butler Farms, a hog farm that utilizes biogas and solar power. Mr. Ragsdale's co-op installed a battery storage system at the farm that supports the farm along with 28 homes in the area. Mr. Ragsdale pointed out how the communication technology between batteries and the grid has gotten better. During a storm that knocked out the transmission line, the battery autonomously disconnected from the rest of the grid to power the farm and, once the grid was back, connected to the grid again. The co-op will have two more microgrids online in early 2020.

Mr. Koplin's Opening Remarks

Mr. Koplin comes from Cordova, a remote town in Alaska that is not connected to the rest of Alaska's electric grid. His town's electricity is generated through nearby hydropower dams or a diesel generator. He provided context to the town's economy; industrial fishing is a major driving force. Mr. Koplin discussed how inefficient their setup was before an energy storage unit was recently put online this summer. When transitioning from hydropower to diesel-generated electricity, Cordova would lose one megawatt of usable energy. Mr. Koplin reviewed a few of the things he learned along the way about battery energy storage systems. This was highlighted by calendar aging (Cordova's system is estimated to be 0.5% compared to the average of 1.5% per year) and various costs associated with both startup and maintenance.

Mr. Levitt's Opening Remarks

Mr. Levitt gave a description of PJM Interconnection's footprint, including the 5 gigawatts capacity of energy storage. A large portion of that storage includes hydropower. He outlined the scenario that PJM faces on a consistent basis: Either they have too much power or too little at a given time. The system is not always in balance and they use an algorithm called "area control error" that shows how many megawatts a given system is off from where it should be. They use this outline to give operators the tools to ensure area control error is as low as possible.

Balancing authorities are spread across the country monitoring area control error. PJM has created a model that projects what the expected load will be 10 minutes into the future. This model runs every 5 minutes. Mr. Levitt outlined different ways their customers utilize batteries to show their potential. He reiterated how energy storage and renewables shift peak demand.

Questions and Answers

Q1. Ramteen Sioshansi asked what challenges the panelists have seen and areas for improvement in deploying storage solutions on microgrids.

Mr. Ragsdale said things are going well and keep improving as more devices are being connected to the grid. The major challenge he sees is that parts are still failing, causing reliability to be questioned. There are also questions about how a battery will hold up in the long term because this technology is still in its early phase.

Mr. Koplin replied that for the average consumer his battery would be great, but because the system they run is more complex it needs some extra features. Communication between the battery and grid is a problem he often encounters. This is where he believes the biggest area of improvement will be. It is imperative that devices are synched together so the system can operate effectively.

Q2. Dr. Bialek asked a series of questions, each for a different panelist. He started by asking Dr. Denholm his thoughts on battery storage for the grid versus commercial applications. He also brought up the point of when in the day a battery is used to address peak load changes. Dr. Bialek then asked Mr. Ragsdale about the planning of microgrids, and Mr. Koplin about joint use cases. Specifically, what are the impacts of being the only ones operating the grid compared to many stakeholders? He asked Mr. Levitt about the impact of faster responding devices in the New York reserves market.

Dr. Denholm responded that properly designed rate structures will dictate when people use more or less energy. He believes commercial and industrial (C&I), along with residential consumers, will act on free market choices. For electric vehicles (EVs), people charge their cars later in the night because that is when rates are lower.

Mr. Ragsdale said that microgrids are not going to be everywhere, rather they will be pooled together. We still need physical infrastructure (power lines). The aim of microgrids is to provide improved reliability and resilience.

Mr. Koplin sees independence as an advantage. His big takeaway is that customers own everything up to the generation, and they have a seat at the table to voice their opinions. Mr. Koplin said Cordova can look at a wide variety of use and value applications. As long as Cordova's engineers get through the technical barriers, the possibilities are endless. A big part of independence is the ability to act quickly and lack of red tape. At the end of the day they're masters of their own destiny.

Mr. Levitt referenced the 2008 split when they created two pools: a slow sustained portion and a fast portion. They both play central roles and are utilized for different purposes. At the very least, they saw an improvement in their baseline maintenance performance metric.

Q3. Mr. Cummings commented that DOE should look into modern pump storage devices. He suggested they would be especially useful in California, where they constantly have a high load.

Dr. Denholm agreed and said that DOE is starting to look into these pumps.

Q4. Mr. Morris first asked if the co-ops offered storage options to customers as another service through a third-party vendor. He then asked what challenges co-ops see because they operate differently compared to utilities/for-profit companies and have different laws.

Mr. Koplin said they did not offer this option because they were better off waiting for new technology to come online. When Alaska was giving out grants for this type of proposed idea, he saw a trend of companies receiving a contract but not following through with their obligations. Mr. Koplin responded to the second question by saying his point of emphasis was how to make the battery lifespan increase. The purpose is to maximize fuel life and savings while minimizing degradation.

Mr. Ragsdale replied to the second question that they are utilizing partnerships for tax purposes. He suggested that co-ops make an extra effort when it comes to retention and maintenance of their system. His co-op owns the resources/infrastructure so they can ensure completion and a certain level of quality.

Q5. Mr. Adams asked a series of questions for different panelists. He started with Mr. Ragsdale and his four projects online mentioning risk factors. Mr. Adams asked if they have a cookie-cutter analysis process for development, or if each one acts as its own pilot. Mr. Adams followed this up by asking how they go about finding new projects. He then asked Mr. Levitt if his price collapsed and if he was oversubscribed. Last, Mr. Adams asked Dr. Denholm if it holds true that solar always narrows peak length.

Mr. Ragsdale said each one started as its own pilot program. Originally, they were losing money, but through their experience they are at a point where each is profitable. A key skill they learned was how to talk to different groups of people. To Mr. Adams' follow-up, he said they are actively seeking new projects and have a team dedicated to this.

Mr. Levitt replied they are fully subscribed and emphasized how complicated the market is. A turning point for them was the 2008 splitting of fast and slow markets. They had to cap the fast-paced regulation as a stop measure because it was causing short-term duration to suffer. Mr. Levitt sees fast and slow markets being overtaken by batteries in the coming years. He concluded by saying slow regulations set the price.

Dr. Denholm said it is virtually across the board that solar will always narrow the peak. There will be obscure outliers though.

Q6. Ms. Reder asked what is next to make things easier and more scalable. Also, how can DOE help?

Mr. Levitt responded that regulations are the main factor holding them back. The Federal Energy Regulatory Commission (FERC) has done a good job addressing resource policy, open access, and both retail and distributed wholesale value stacking.

Mr. Koplin half-jokingly remarked that no commission or regulations would be nice. He mentioned how their battery is already saving a lot of energy because when their system transfers

from diesel to hydro, or vice versa, the energy is no longer wasted. He also went into detail about the potential of using their battery as a main power source or as an asset to complement the grid.

Mr. Ragsdale said the most urgent need is for control of regulations, energy storage devices, and the sites themselves. In the future, every battery and microgrid has to have control. He also reiterated that as more batteries come online there must be better communication technology for battery to battery and battery to grid.

Q7. Mr. Heyeck said the world energy level is currently between 10,000 and 12,000 gigawatts and in 2050 we are projected to have 500 to 600 gigawatts of energy storage. He then mentioned the fast rates for both commercial and residential solar are growing. He asked the panel what direction they see the future heading toward (micro- or macro-level) and what impediments with respect to science and technology are going to hold us back. He also asked if they should move forward with making a fourth asset class at a FERC level.

Dr. Denholm differed to the other panelists because his lab has its own research agenda.

Mr. Ragsdale believes macro-level storage development will come first. Economies of scale will allow larger populations to be helped at a faster rate. It is a matter of preference. From his co-op perspective, cost is the major driver holding them back.

Mr. Koplin said his focus is on customer choice and transparency. Piggybacking off Mr. Ragsdale's point about choices, customers are willing to pay more money to ensure deliverability and reliability, while others might take this risk to not pay more. Mr. Koplin agreed that controls are a major problem that needs to be addressed. He concluded that swarm behavior is a highly effective.

Mr. Levitt predicts the grid will be nearly the same in 10 years as it is today. He also believes batteries will cost half as much as they do now. Even as batteries grow and become more cost-effective, infrastructure still has to be dealt with and therefore cannot be overlooked. He also sees EVs gaining in popularity and the natural growth of micro battery storage will continue.

Q8. Mr. Mroz asked what advice the panel has for DOE to assist states on developing policies. He also asked if it is possible to look at some type of grand scale across the country or if things can only be done regionally due to complicated regional regulations.

Dr. Denholm started by saying microgrid projects are becoming more cross-competitive. He would like to see DOE regulators help with the front-end of the analytical process to increase standardization.

Mr. Levitt mentioned how IEEE P2800 is a standardization that will set technical rules for how inverter-based generators connect to transmission lines. He is seeing a trend that deregulated states let the utility company own the battery.

Mr. Ragsdale replied that their microgrids have been able to preserve regulatory constructs. A main role they play is to form partnerships between utilities and customers, especially making sure customers are well-informed with new technology coming online. Challenges arise as different stakeholders get involved.

Mr. Koplin suggested DOE should think more holistically, mentioning that electricity is not the only form of energy. His main point was that social barriers are often the biggest challenge they face. He initiated a program that utilizes excess energy for an air to air heat exchange that allows people to retake some of the ownership power. One of the best things that can be done is to give people ownership. That way they will have a stake and be more invested.

Q9. Dr. Bialek asked what it would look like if all batteries were uniform and had the same standardizations. He then asked if the panel could speak about cybersecurity. Last, he asked how NERC compliance applies for small devices.

Mr. Koplin replied that DOE is already doing great work in terms of leading standardization. The main point he talked about was that even if units can properly communicate with one another that does not mean they will mesh well operationally. He mentioned that there is still work to be done in testing batteries to failure.

Mr. Ragsdale reiterated Mr. Koplin's point that standardization of communication is the main challenge they are facing. There is currently a disconnect that standardization would cause limitation to reading meters.

Mr. Levitt discussed that there would be major challenges to cybersecurity and overall operations if he, for example, were to operate a lot of small units producing 100 megawatts compared to only a few producing that same amount of energy. He plugged the IEEE 1547 for being great to look at for communications standards. Mr. Levitt suggested an all-your-eggs-in-one-basket approach, where you take the device that has the most momentum and pour a vast amount of resources into that one. He concluded by saying how the energy industry has a much higher standard for security because if customers lose power for even a few seconds there will be consequences.

Q10. Dr. Sioshansi first asked for clarification from Dr. Denholm's presentation. Is his assumption that solar and storage will be built by the same manufacturer, or will we get to a point where the battery can be customized to a specific amount to match potential? Dr. Sioshansi also asked about the operational planning and dispatch of assets.

Dr. Denholm said that the value of storage relies on the assumption that solar will be built. At the moment, solar does not provide capacity value and it is not taken into account on the grid unless it is paired with a storage device. This is something that has to be addressed because there needs to be a compensation mechanism in place.

Mr. Levitt said connection management and reducing the size of interconnection are two factors to look at. He also suggested that projects be built bigger to capitalize on economies of scale to bring down marginal costs.

Mr. Ragsdale brought up there are multiple layers of control. His key point was that whoever owns the asset wants to control it, but they should also know they are the ones responsible for its connection to the grid. He ended by saying he sees local optimization becoming more realistic, but technology still needs to progress.

Mr. Koplin added that there are different types of transaction on the grid constantly happening. He believes that aggregation may be a necessary layer. We do not control the grid; we just manage it. At the end of the day, each individual customer is deciding how they use their energy and the amount, so it is the providers' responsibility to be prepared.

Q11. Mr. Cummings did not ask a question; he provided a comment. He started by giving an overview of IEEE and mentioning that he is working with one of their working groups too. He emphasized the hive mentality and brought up difficulties in different systems communicating with one another. Mr. Cummings went over the diverse portfolio of an IBR plant. He said we have now gotten to the point where we can define a mixed resource plant and an IBR plant.

Q12. Ms. Denbow clarified an earlier comment from Mr. Levitt. She said there is enough natural gas production. The challenge is that there are constraints from building sufficient transmission.

Wrap-Up and Adjourn

Mr. Heyeck thanked the panelists from today and all the other people who also gave presentations.

Mr. Lawrence discussed the relevancy metric TPTA will be working on along with EAC support. He mentioned changes that were made and the process moving forward.

Assistant Secretary Walker said he is glad the EAC's outlook aligns with DOE initiatives for storage. He said DOE is aware of control issues that were brought up and R&D is working on addressing this through further conversations. He thanked everyone for their participation.

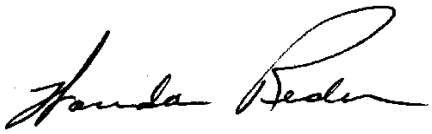
Ms. Reder said we are in an exciting time where things are moving quickly. She was encouraged to see DOE making a strong effort to work across the agency.

With Mr. Lawrence's consent, Mr. Heyeck closed the meeting until 8 a.m. Thursday.

Respectfully Submitted and Certified as Accurate,

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

12/05/2019
Date



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

12/05/2019
Date

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

12/05/2019
Date