



**U.S. Department of Energy
Electricity Advisory Committee Meeting
Hosted Virtually Via WebEx
February 4, 2021**

Meeting Summary

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Meeting Summary

The second day of the February Electricity Advisory Committee (EAC) meeting began with a panel addressing the integration of energy storage into the bulk power supply. The panelists addressed the subtopics of resource planning, operational dispatch, and aggregation. A roundtable discussion among the EAC members, panelists, and U.S. Department of Energy (DOE) staff followed the panel. The Grid Resilience for National Security (GRNS) Subcommittee sponsored a briefing about the SolarWinds cyberattack. The panelists discussed how they were affected and the lessons they learned in order to be better protected against future events.

During subcommittee updates, Rob Lee, Vice Chair of the GRNS Subcommittee, introduced the subcommittee because this was the first full EAC meeting since the subcommittee had been activated. Mr. Lee provided an update about future projects the subcommittee will address. Tom Bialek, Chair of the Smart Grid Subcommittee, provided an update about the subcommittee's ongoing initiatives and outlook. The EAC unanimously voted to pass the Big Data Analytics recommendations, which were based on a series of presentations at previous EAC meetings. Lola Infante, Chair of the Energy Storage Subcommittee, provided an update about the subcommittee's ongoing initiatives and outlook. Their top priority is drafting the congressionally mandated 2021 Energy Storage Plan Assessment. Neha Rustagi, from DOE's Hydrogen and Fuel Cell Technology Office, updated the EAC about events occurring in their office since the October 2020 meeting.

All presentations and recordings from this meeting can be found at <https://www.energy.gov/oe/february-3-4-2021-meeting-electricity-advisory-committee>

Day 2 Opening Remarks

Wanda Reder, Grid-X Partners, shared the feedback she received about the Implementation of Federal Energy Regulatory Commission (FERC) Order 2222 panel from Day 1. She was pleased with the EAC participation, noting that the diverse backgrounds of the members led to a thorough, all-encompassing conversation. Ms. Reder said that the EAC will create a working group to develop formal recommendations for DOE to act on in response to the FERC Order 2222 discussion.

Integration of Energy Storage into the Bulk Power Supply – Energy Storage System Capabilities, and the Challenges of Resource Planning, Operational Dispatch, and Aggregation

Bob Cummings, Red Yucca Power Consulting, addressed emerging roles for storage. He reviewed the multiple roles for energy storage on “today's grid.” These were centered around frequency control, peak shaving, fast ramping, compensation for the variability of solar and wind resources, and resources for sustained periods of solar or wind unavailability. Mr. Cummings highlighted fast frequency response, walking through how fast frequency response applications impact the grid and provide benefits.

Mr. Cummings emphasized the need for energy storage systems to be put on the grid because their deployment is directly tied to the success of renewable energy goals. He spoke of the benefits resulting from the aggregation of distributed energy resources (DERs). The first benefit is the blending of dissimilar resources to produce some grid services, and the second is the grouping of similar device functionality. Mr. Cummings cautioned about the need to plan for the unintended consequences of

certain technologies. He concluded by expressing his excitement about the future of energy storage integration as a grid asset.

Allison Auld-Hill spoke about Southern California Edison’s (SCE) “Pathway to 2045: Achieving 100% Carbon Neutrality” roadmap. The roadmap is centered around three core components: (1) the decarbonization of the electricity sector; (2) increasing the electrification of transportation and buildings, along with transitioning to low-carbon fuels for “hard to electrify” applications; and (3) the need to rely on sequestration for the remaining carbon through natural and engineered solutions. Ms. Auld-Hill said that California will need 30 gigawatts (GW) of utility-scale storage and 10 GW of customer-sited storage to make its goals obtainable. She then reviewed how the California Independent System Operator (CAISO) load will look different in 2045 compared with today.

Ms. Auld-Hill walked through the planning process for making their 2045 vision happen. The challenges are divided into categories—customer, supply side, and climate. She discussed the different characteristics of foundational IT/operations technology (OT) layers and the physical layer that will need to be addressed. Ms. Auld-Hill concluded by reviewing a list of pilot programs that SCE is implementing. She highlighted a Virtual Power Plant program with Sunrun.

Bud Vos, Generac, spoke about how Enbala is operating the clean energy transition within the residential storage space. Mr. Vos said that he sees the trend that the grid is beginning to invert due to a high-level renewable energy implementation. He demonstrated how their system monitors battery deployment through a “live” virtual power plant operation in Australia. Mr. Vos discussed how Enbala controls batteries within their live virtual power plants and that impacts the grid.

Mr. Vos provided three main takeaways about operating energy storage systems. He said that these are the three areas that need to be planned for when putting a system online: (1) designing for robustness, (2) being able to bring the data to the operations center because operators are working in real time, and (3) providing flexibility for system interfaces.

Erik Ela, Electric Power Research Institute, discussed the value of electric storage resources (ESRs) in providing grid services. Mr. Ela reviewed the different categories of ESR services and contributions. These categories consisted of installed capacity to ensure adequacy, energy arbitrage, flexibility, and rapid response; operating reserve and other reliability services; and transmission and distribution congestion management and deferral. Mr. Ela spoke about key challenges in valuing ESRs as a flexibility resource: (1) flat energy costs and prices limit arbitrage; (2) the resource adequacy contribution is limited by duration, ESR penetration, and forecast accuracy; and (3) thin ancillary service markets in independent system operator (ISO) regions are diminishing the value in non-ISO regions. Mr. Ela walked through a table showing the differences and the hierarchy of the state of charge management options. The main takeaway was to show the relationship of reliability and complexity, along with ESR asset owner responsibilities.

Discussion Between EAC Members and Panelists

Q1. Tom Bialek, San Diego Gas & Electric Company, asked Bob Cummings about what a large-scale fast frequency response implementation would look like.

Mr. Cummings sees fast frequency response as having a slow start to mass integration. He does not believe that people fully understand/appreciate the valuable services this type of application applies.

Mr. Cummings spoke about the early research that the North American Electric Reliability Corporation and the Institute of Electrical and Electronics Engineers are conducting regarding fast frequency response. He said that DOE's role can be to help identify how fast frequency response can be further enhanced when paired with other applications of frequency response.

Erik Ela said that regional transmission organizations (RTOs)/ISOs will start to implement and invest in fast frequency response mechanisms once they realize the cost-saving potential.

Q2. Mladen Kezunovic, Texas A&M University, asked how the panelists see the ownership of batteries (specifically for two-way batteries, such as electric vehicle chargers that they can sell back to the grid).

Bud Vos replied that this is a brand new field that is in its infancy. He noted that there are different parties (e.g., customer, grid operator, third-party financing entity, retailer—the one selling the kilowatt-hours) involved with different rules in each state. Mr. Vos said that, at some level, the wholesale market must value all of the services that a battery provides and add monetary values for the given services.

Bob Cummings replied that one of the greatest values of storage will be the provision of capacity, when needed, on a flexible basis. He sees a role for energy, but sees capacity as being more valuable.

Allison Auld-Hill added that SCE is piloting mobile battery storage systems because California is already seeing capacity problems.

Q3. Kimberly Denbow, American Gas Association, expressed concern that going “all in” on renewables limits resilience because it will lead to a less diversified energy portfolio. She brought up the implications of the lifecycle for batteries and renewable generation infrastructure.

Allison Auld-Hill replied that natural gas is included in SCE's Pathway 2045 plan for resiliency/backup generation purposes.

Q4. Paul Hudson, General Infrastructure, asked how to speed up the mass deployment of toolsets and how much thinking has been done regarding the supply chain.

Allison Auld-Hill replied that the factors of controls, communications, and cybersecurity are their greatest barriers to faster deployment. She recommended that utilities engage in further coordination so best practices can be shared across the electricity sector. Ms. Auld-Hill spoke about the interconnected relationship between technology implementation and supply chain. She noted how they influence one another.

Bud Vos said that an overall challenge is that utilities often focus on their differences; however, if they focused on their similarities/end goals then overall deployment would be expedited. He believes that the current supply chain issues being exacerbated by the COVID-19 pandemic are a sign of what is to come during “normal” times.

Bob Cummings said that DOE can help by utilizing its broad footprint to connect utilities. He also noted the importance of having multiple aspects of the electricity sector (e.g., transmission, distribution, generation) represented.

Q5. David Wells, U.S. Department of Energy, brought up the aspect about who will pay for infrastructure investment.

Bob Cummings replied that DERs help replace load. He said that new infrastructure is required unless a site already has collocation occurring between storage with renewables and it has the transmission to support the import and export.

Paul Hudson said that the decrease in price for generation resources offsets some of the costs for transmission infrastructure.

Q6. Clay Koplin, Cordova Electric Cooperative, spoke about Cordova’s system, saying that nearly the entire load is already backed up on a battery. He said that Cordova Electric only utilizes about 1% of that battery’s capacity due to load balancing applications. Mr. Koplin walked through the current planning processes that they are assessing. He asked Bud Vos about the challenges he faced with manufactures to get battery energy storage (BES) systems.

Mr. Vos said that they designed all of their systems to handle that BES systems will come and go from a communications standpoint, and it will never deliver what it is able to deliver. He clarified the second part of the statement with the example that if a battery is commanded to provide 4 watts, in reality, there is a slight range around 4 watts that will be provided. Mr. Vos added that there are human factors that cannot be predicted. His takeaways are that the asset will not do exactly what it is asked to do, and the power of the network needs to be relied on. Mr. Vos compared batteries to fax machines—if there is only one fax machine, it is nearly useless; however, as more are put online, they become exponentially more valuable. The same is true for batteries.

Q7. Daniel Brooks, Electric Power Research Institute, asked if the right models are in place to properly represent the capacity contribution of storage being used in various applications from a resource adequacy perspective. He also asked about potential resources to be used for long-duration storage.

Allison Auld-Hill said that the challenge with modeling is that batteries’ broad uses cannot always be accounted for. She said that another challenge is that SCE does not have clear insight into what batteries will be doing because they are not utility owned. Utilities are ultimately responsible for reliability, so she does see batteries playing a central role because of their capacity benefits, even if the capacity is an approximation. Ms. Auld-Hill said that they let customers come to them and they try to be technology agnostic. She reiterated the need for long-duration storage.

Bud Vos replied that DOE can help by putting a value on bidirectional capacity. He said that customers with batteries are essentially participating in a demand response program because they are taking load off the system. Mr. Vos sees missed opportunities for additional net metering types of programs. He gave a potential solution for long-duration storage, saying that there is an option of using 4-hour batteries, but this would require many batteries that are allocated to different parts of the day. Mr. Vos said that Generac is in the process of making a DC battery that is essentially a 24-hour battery because it is tied to natural gas or propane generation.

Bob Cummings said that there needs to be a transition from a capacity standpoint. The shift must move from looking at 1-hour models to 8760 energy models to ensure that there is resource adequacy across all hours. He said that dispatch, distribution, and transmission should also be included in the modeling.

Erik Ela compared the differences between modeling several years ago versus today, highlighting that there are more factors that need to be considered nowadays. They are more complex, but lead to more

accurate or better results. Mr. Ela spoke about the importance of identifying the highest risk periods and ensuring that resources will operate as intended during these critical times.

Q8. Sharon Allan, Smart Electric Power Alliance, asked how utilities get insight into aggregator operations.

Allison Auld-Hill spoke about the importance of data asset systems and the communications of data analytics.

Bud Vos said that, in terms of their Australian system, there is little information sharing due to extreme competition. He discussed some of the nuances of their electric market, such as customers switching providers, on average, every 2.5 months. Mr. Vos said that certain pieces of data are required to be shared with the distribution system operator (the infrastructure wires business) in Australia.

Q9. Darlene Phillips, PJM Interconnection, asked Erik Ela about the implications of participation models and how hybrid resources impact these models.

Mr. Ela spoke about the inherent tradeoff between complexity and efficiency. A central question they are trying to address is “Do market customers understand the models well enough to capitalize on programs?” Mr. Ela emphasized the tradeoffs between models. He highlighted a table showing that more complex models led to more theoretical benefits, whereas simpler models lead to easy, short-term implementation.

Q10. Rick Mroz, Resolute Strategies, asked, given all of the complexities, on what geographic scale do panelists see approaches being implemented.

Allison Auld-Hill wants to see localized approaches, but coordination occurring on a regional basis.

Bob Cummings said that there needs to be North American standards, but companies, ISOs, and RTOs should also adapt to their localized footprint.

Bud Vos would like to see balancing authorities across multiple utility jurisdictions.

Erik Ela said to avoid a “one size fits all” approach. He said that DOE can help share best practices. Mr. Ela added that it is the responsibility of regional stakeholders to identify and implement what best suits their footprints and needs.

Grid Resilience for the National Security Subcommittee Update

The subcommittee is tackling three initiatives: (1) implementing cybersecurity into already existing activities, (2) a black-start capability report, and (3) creating a resilience metrics framework. Rob Lee's major message is that cybersecurity needs to be a focal point across the electricity sector.

SolarWinds Incident Briefing

Rob Lee provided in-depth background on what led to the SolarWinds incident, along with the lasting effects in the context of the electricity sector. He said that the SolarWinds attack was not new, but it was more impactful because of its scope and scale. Mr. Lee said that industry did well mitigating the impacts of the cyberattack because many utility companies were already planning against this type of real-life situation for a few years.

Mr. Lee clarified that the hack began December 2020, and described the technical aspects of how the hack occurred. He was optimistic seeing that FireEye had come out with transparency about the attack to help inform the broader community. The main concern regarding the supply chain compromise is access to manufacturers, integrators, and vendors because they are all tied together with broad footprints. For SolarWinds, the hacker embedded itself in the SolarWinds software. SolarWinds represents a software that has access to a huge number of organizations, making it a vulnerable target.

Mr. Lee said that it will take months or even years to determine what was accessed from this hack. The supply chain aspect is complex in that software is white labeled by vendors to include other vendors' security applications in their security stack. This leads to a feedback loop of widespread compromise. It is often difficult to achieve visibility across global enterprise OT/industrial control systems (ICS) networks because companies do not have the correct data to know the state of their systems.

Mr. Lee noted that companies have taken extraordinary measures to secure North American infrastructure, with a heavy focus on Enterprise IT and prevention-based controls (i.e., preventing attacks). He warned that society is still missing fundamental visibility and forensics capabilities into OT networks and has not similarly invested in detection and response efforts to be resilient in the face of such compromise. Mr. Lee concluded by saying that he is optimistic overall about the electricity community's willingness and ability to take on these challenges, noting that we often have a "coalition of the willing"; however, leadership is required to evolve the cybersecurity practices of OT/ICS networks to where we are going, especially considering the digital transformation efforts underway.

Clay Koplín gave context to Cordova Electric's infrastructure and operations. He spoke about how they were impacted by SolarWinds software. Cordova Electric utilizes a backup software package using SolarWinds; however, their specific package was not impacted. His takeaway from the incident is that it raised questions about a path forward due to the implications of outages.

Rob Lee highlighted the transformations occurring at Cordova Electric as a microcosm for the innovation occurring across the electricity sector. Mr. Lee emphasized that cybersecurity is meant to complement technology and enhance overall operations. He does not want cybersecurity to be seen as a barrier or intrusive.

Cherylene Caddy, U.S. Department of Energy, described the role of the Office of Cybersecurity, Energy Security, and Emergency Response (CESER) and its Cyber Testing for Resilient Industrial Control Systems

(CyTRICS) program. Her presentation was centered around the subcomponent enumeration work of CyTRICS. This program uses a bill of materials approach to develop software and hardware to create components of critical industrial control systems. Through this, they are creating energy sector proofs of concept to help create supply chain standards for security. Ms. Caddy said that a digital bill of materials is better for managing sub-tier suppliers. CESER is looking to leverage CyTRICS to analyze the SolarWinds incident, then they will rethink how to further analyze software that may be embedded into one another.

Rob Lee said that the hard part about problem-solving is often the implementation aspect. He is optimistic overall because he has observed that the electricity sector is open and willing to implement new technology.

Questions and Answers

Q1. Mladen Kezunovic, Texas A&M University, asked the panelists how they evaluate the impact of compromised software.

Rob Lee said that he often tells people the threat is not as bad as one imagines it to be, but it is worse than people realize. He clarified that just because one has access to sensitive OT systems does not mean that the adversary knows what to do with them yet. Mr. Lee provided an outline about how to best plan cybersecurity for national security. It should begin with looking at the most critical sites, identifying interdependencies, and then providing government resources paired with private funding to enhance resilience. The government could then share best practices with grid operators for research or mass-scale implementation. Mr. Lee spoke about the importance of detection, noting that this is also the area that is most lacking.

Cherylene Caddy replied that CESER has a cyber consequences simulation team where they work with researchers emulating adversaries to see how they would hack into systems. This helps to identify vulnerabilities.

Clay Koplun suggested viewing investments in cybersecurity in terms of insurance or no different than having hardened infrastructure.

Q2. Wanda Reder, Grid-X Partners, asked what DOE can do to help bolster the workforce development aspect of cybersecurity.

Rob Lee has observed that people spend more time admiring the problem and pointing fingers than addressing solutions. A problem he sees with workforce development is that there are no national requirements for responding to problems. Someone needs to complete a rigorous certification process to become a grid operator. Once a problem occurs and someone needs to be brought in to assist, that person has no requirements in order to be qualified. Mr. Lee believes that there are limitations in government due to lack of coordination and strategy across government agencies.

Cherylene Caddy recognized that the Federal Government is still determining roles and responsibilities; however, progress has been made. She spoke about sector-specific agencies having closer relationships with the private sector. Ms. Caddy said that the convening role of DOE is important. She highlighted that the Security and Energy Infrastructure Task Force was recently stood up. Their first task is to develop a

cyber engineering strategy, which was mandated by Congress. She spoke about the importance of building a culture of security.

Q3. Rick Mroz, Resolute Strategies, asked what DOE should reinforce to the public about cybersecurity.

Rob Lee replied that there is a forensic capability missing to get to root cause analysis, which is fundamental to engineering discussions. He said that there needs to be a base level of forensic capability on networks. For resilience and recovery, there is a need to determine who is authorized to be part of cybersecurity (both internally and externally). Additionally, firms need to determine what scenarios to identify and plan for because most people cannot answer this.

Q4. Tom Bialek, San Diego Gas & Electric Company, asked about cybersecurity implications with the mass implementation of vendors and aggregators coming online with no standards in place.

Rob Lee believes that national critical infrastructure operators should have higher standards and a screening process when choosing companies; these standards must have substantive requirements. He sees that standards are lagging and do not push for progress.

Clay Koplín noted his displeasure with black box controllers and gave an example of the vulnerabilities they bring.

Smart Grid Subcommittee Update

Chair Tom Bialek reviewed ongoing initiatives, including the Grid Annual Assessment, Big Data Analytics recommendations, State-Federal Coordination, Advanced Grid Design, and Resiliency.

The full committee unanimously voted to pass the Big Data Analytics recommendations to DOE.

Some of the members discussed the expectation of electrification being a looming priority for DOE.

Energy Storage Subcommittee Update

Chair Lola Infante reviewed ongoing initiatives. Their top priority is drafting the congressionally mandated 2021 Energy Storage Plan Assessment. The assessment will align with DOE's Energy Storage Grand Challenge Roadmap. Other topics the subcommittee is looking to tackle are power to gas, energy storage operations and benefits, and evaluating DOE's energy storage programs under the new administration.

Clay Koplín spoke about various emerging technologies that can be utilized for energy storage.

Neha Rustagi provided updates about the Hydrogen and Fuel Cell Technology Office since the October meeting. Looking forward, their office is holding an annual merit review, which is open to the public and is a review of their office's activities. Her office is in the process of wrapping up analysis that characterizes the total cost of ownership of hydrogen fuel cells in Class 4 and Class 8 heavy-duty vehicles.

Public Comments

One public comment was received. Dick Brooks, Reliable Energy Analytics, applauded the panels for providing great information. He discussed North American SynchroPhasor Initiative events.

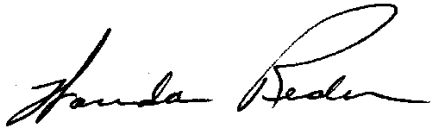
Wrap-Up and Adjournment of the February 2021 Meeting of the EAC

Mike Heyeck, The Grid Group, provided his takeaways from the 2-day meetings. He said that the missing piece of the conversation revolves around addressing grid edge, resulting from hydrogen impacts and the implementation of FERC Order 2222, with the explosion of aggregators coming online, more data, and increased cyber vulnerabilities. Mr. Heyeck also emphasized that energy storage is critical for mass-scale renewable deployment.

Wanda Reder, Grid-X Partners, reviewed the presentations throughout the meeting, and thanked everyone for their participation in putting this meeting together.

Chris Lawrence, EAC Designated Federal Officer, officially adjourned the meeting.

Respectfully Submitted and Certified as Accurate,



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

4/27/2021

Date



Michael Heyeck
The Grid Group, LLC
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Date



Christopher Lawrence
Office of Electricity
Designated Federal Official
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