Committee on Homeland Security and Governmental Affairs
Subcommittee on Government Operations and Border Management
Hearing: *Strategies for Improving Critical Energy Infrastructure*

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Before the United States Senate

Wednesday, October 27, 2021

Thank you Subcommittee Chair Sinema, Ranking Member Lankford, members of this subcommittee and esteemed colleagues for this opportunity. Talking about the important topic of grid resiliency and critical grid infrastructure is unfortunately not something that gets enough serious attention outside of often passing headlines. And I appreciate the opportunity to be with you to discuss this topic.

My name is Bryce Yonker and I am Executive Director and CEO of Grid Forward an industry organization of more than 100 members from electric utilities, technology companies, universities, national labs, non-profits, and other advanced grid industry stakeholders working to accelerate grid modernization and innovation.

Under-Investment in the Face of Overwhelming Changes
The establishment and expansion of the electric grid network for developed nations—not the Apollo moon mission, the internet, nor development of cars or airplanes—was named most important achievement of the 20th century by the National Academy of Engineering in 2000.[i] The electric grid is the backbone by which we build and sustain our communities, business and indeed society, especially given our digital-driven lives.

However, we are not investing in our grid nearly enough to meet the demands we place on it. As the briefing for this hearing notes, the Association of Civil Engineers gives our electric grid a rating of a C- and predicts that in less than 8 years we will have under invested in the grid by about $200 Billion.[ii]

With this reality, we are not surprised by the devastation to the grid over the last nine months from overwhelming events that brought new language into our vernacular such as polar vortex or heat domes.

- **Winter storms** in the Northwest[iii] and South[iv] U.S. caused widespread outages during frigid weather, costing billions in damages and a loss of hundreds of lives.
- **Unprecedented heat events** in the Western U.S. caused hundreds deaths and unprecedented need for air conditioning and energy demand[v].
- **Wildfires** in the Western U.S. disrupted transmission lines[vi], destroyed communities, and displaced thousands, burning 6.5 million acres to date[vii]—once again costing billions in damages and loss of many lives.
- A pipeline **cyber-attack**[viii] disrupted economies and daily lives across the East coast.
- **Storms** in Gulf States[ix] that tracked into the Northeast cost many lives, destroyed infrastructure—and are forecast to only get more devastating.

The National Oceanic and Atmospheric Administration (NOAA) reports that 2020 had the most weather related disasters in history from 22 events costing the U.S. $100 billion and that the U.S. has had 18 climate and weather disasters so far in 2021 that each cost the U.S. communities more than $1 billion in damages.[x] A detailed Washington Post article earlier this week outlined how states are struggling to keep up with grid resiliency investments, citing among other areas that the average American household is out of power 8 hours each year more than double the level only five years ago.[xi]

The price tag of climate impacts is enormous, and going up. The recent International Climate Change Partnership (ICCP) report did not mince words in the threats and impacts that lay ahead in the coming years.[xii] The cost of inaction will pay compound interest in the years to come.

Added to the climate pressures on our electric grid, market dynamics are changing faster than ever before[xiii]. Customers are buying into energy options[xiv] ranging from controlling their energy use with smart thermostats to getting new grid-connected electric vehicles[xv] and appliances such as heat pumps[xvi]. Economics and policy drivers are accelerating the energy transition faster than many would have imagined (though not fast as some are still calling for) which is accelerating the use of grid resources like wind, solar[xvii], batteries and others rapidly. In the middle of all this change, operators are trying to keep pace with 20th century assets that in many instances are well past their useful lives.

Answers to the Electric Grid Crisis
What can we do to increase the capabilities of our grid in the face of such challenging conditions? A great deal, actually. For the last decade, we have helped to promote and accelerate a toolbox of advanced grid applications that are ready to be implemented. We just need to pull out the tools and start using them more widely. I will summarize my remarks in four classes of capabilities: **forecasting, monitoring, planning and deployment**.

1. Advanced Forecasting
Simulation, advanced algorithms, supercomputers, and other technologies are helping us forecast near-future events depending on a variety of factors. For the electric grid, the industry is getting better at forecasting customer demand for electricity — be it an hour, a day, or a week ahead. We are also becoming better at forecasting the electricity *supply* that will be available, based on what impact weather and other factors will have on wind, solar[xviii] and other generation resources. *Keeping customer demand and electricity supply dynamically in balance is the basic equation for reliable power.*

However 'outliner' events that have been considered statistically improbable are becoming more frequent. For example, the heat dome I experienced in Oregon this summer with temperatures in the 115 degree range beat our previous high temperature by eight degrees! With these high impact events increasing in frequency from once in 50 or 100 years to a once in two to five years, we need more sophisticated, higher resolution forecasting to keep the grid in balance.

Examples:

- Pacific Northwest National Laboratory (PNNL) and national lab partners have created GridLAB-D™ which is a new power distribution system simulation and analysis tool that provides valuable information to users who design and operate distribution systems, and to utilities that wish to take advantage of the latest energy technologies. It incorporates the most advanced modeling techniques, with high-performance algorithms to deliver the best in end-use modeling.[xix]

- General Electric (GE) has released grid analytics that combine artificial intelligence (AI) and machine learning (ML) to tackle pressing challenges in electric grid operations. The solutions help transmission and distribution networks maximize operational efficiency with storm readiness, network connectivity and effective inertia.[xx]

2. **Real-Time Monitoring and Automation**

Advanced sensing capabilities allow grid operators to see in near-real-time conditions of the grid that could previously only be determined through costly manual, in-person inspection. Operators can now know the health of assets of the grid including: rotting or damaged poles, abnormal electric currents, trees in contact with or too close to lines, and so on. These solutions include wireless low-cost sensors, geospatial mapping, advanced satellite, thermal and other imagining, drones for seeing hard-to-reach areas, and many other capabilities.

Yet having higher resolution data and acting on it are two very different things. We must move into advanced and automated controls of our electric grid systems so that real-time awareness leads to fast action for enhanced grid reliability.

Examples:

- New York Power Authority (NYPA) built a digital twin of its operations in New York. This model of transmission and generation assets feeds into asset performance management systems to optimize performance of the grid to assess constraints and grid expectations.[xxi]
- Hawaiian Electric has standardized interconnection processes for its customers and provides maps that show the locational value of distributed resources by circuits attached to their system.[xxii]
- GridWare is start-up company that installs wireless low cost sensors and uses situational awareness to decrease the threat of grid failures that can contribute to wildfire threats.[xxiii]
- The national labs and a California utility are testing a concept that detects falling lines and de-energizes those lines prior to ground contact, acting in just over one second to protect people, property, and forests. The approach relies on real time monitoring equipment that has been at the core of Federal demonstrations.[xxiv]

3. **Strategic Planning**

Detailed engineering plans have guided the evolution of the electric grid since its inception. As a result, the level of service our grid operators provide to communities across the country never ceases to amaze me, given the variables they encounter and the basic physics of electricity.

Today's planning frontier needs to consider such a large number of factors that it must to be approached as a living set of contingencies and adaptive strategies. Unfortunately, many if not most communities, do not have comprehensive resiliency action plans, let alone installed grid flexibility solutions to adapt to circumstances they are already facing. *Grid operators and communities need support to develop broader strategic plans with actionable roadmaps to meet tomorrow's challenges.*

Examples:

- Bonneville Power Administration (BPA) has developed and annually updates a wildfire mitigation plan. They had to put it into action this year when fires in Southern Oregon and Northern California took out transmission capacity and this plan helped mitigate the impact of this very disruptive event.[xxv]
- Central Lincoln PUD sits on the Oregon Coast and has created an earthquake and tsunami plan which lays out strategies to prioritize critical investments in the event this catastrophic event occurs.[xxvi]
- Salt River Project (SRP) in Arizona has completed the fourth annual update of its distribution enablement roadmap and is embarking on a year-long process to develop an integrated system plan. This holistic thinking will allow them to integrate gigawatts (GW) of new renewable generation, 100s of megawatts (MW) of distributed resources, and face the many changes they anticipate on their grid from the acceleration of electric vehicles to continued load growth.
- Dozens of manufacturers from Ford to Proterra are introducing vehicles that will allow customers to electrify transportation. Utilities, states, and other stakeholders are beginning to plan for this rapidly nearing transition.[xxvii]
- The North American Energy Resilience Model (NAERM) is a DOE initiative to develop a comprehensive resilience modeling system for North American energy infrastructure, which includes the electric, natural gas, and communications sectors. This model will provide real-time situational awareness and analysis capabilities for emergency events and make it possible to get ahead of emergencies before they happen.[xxviii]

4. Grid-Enhancing Deployment

Why aren't there more deployments of grid hardening solutions to help us alleviate the impacts of events we are increasingly seeing? From a technical standpoint, the answer is insufficient activity in the three categories above that lay the foundation. *These areas allow for the better optimization of historic and current data to project conditions in the future.*

But in reality, the much more complex answer includes regulatory and policy pressures. The payback of resiliency investments is often hard to quantify[xxix] and the benefits and impacts fall in realms outside those of agencies with direct responsibly.

The answer also includes other dimensions around the grid itself: changing cultural norms at large organizations; the lagging pipeline of talent in the industry; misaligned incentive structures for desired grid outcomes; complex approval and procurement processes and other factors.

It also includes how these energy assets interact in the market. Many grid resources run on systems that are not at high utilization factors, are in constrained corridors with difficult and expensive build times, or on assets that are nearing or even past their useful lives. Having sufficient access to the transmission system and using that efficiently plays a key role. In the west there are active considerations of the evolution of organized markets. Most entitles have joined or an in the process of joining the Western EIM[xxx] and considerations are in place for steps beyond that. Market access played an important role in the polar vortex disaster in ERCOT as well[xxxi]. Markets additionally are complicated -- the Western Interconnection for example has 38 different balancing authorities.[xxxii] When it comes to resource adequacy many stakeholders across a wide array of geographies hold varying preferences and perspectives. The wider the coordination the stronger the benefits, something the Western Resource Adequacy Program (WRAP) is trying to achieve.[xxxiii]

Even so, *investing in advanced grid deployments is the foundation for making progress for resiliency and working out the broader challenges.*

We have prepared a recent briefing document that illustrates the benefits and impacts from advanced grid deployments ranging from smart grid investments that have brought over $2 billion of added impacts in one community to single grid hardening projects that have decreased outages by 10% or more.[xxxiv]

It is not easy to articulate the variety of advanced deployment capabilities that help directly address grid resiliency, but a number of them include:

- Advanced controls (fault location, isolation and service restoration (FLISR), integrated core operating systems like outage management systems (OMS) with advanced distribution management systems (ADMS), distributed energy resource management systems (DERMS), expanded supervisory control and data acquisition (SCADA)
- Hardened infrastructure (redundant/looped lines, underground wires, upgraded substations and transformers, higher capacity lines, coatings)
- Modern hardware (smart fuses, faster switches, reclosers, smart inverters)
- Advanced software and grid analytics (including predictive maintenance, machine learning and artificial intelligence)
- Microgrids
- Advanced cyber security capabilities
- Next gen communications networks (including open protocols and interoperability standards)
- Modernized basic maintenance (vegetation management, routine inspections, scheduled upgrades, workflow tracking)

Additional Examples:

- In an LA Times interview last week the CEO of Pacific Gas and Electric Company (PG&E) in California said: "We've also developed a sophisticated algorithm that helps us pinpoint high-risk areas. If we'd had it in place in previous years, we would have prevented 96% of the structures that were damaged or lost due to utility-caused wildfires." The article mentioned the 10,000 miles of transmission and distribution lines the company is planning to place underground over the coming years.[xxxv]
- The National Renewable Energy Laboratory (NREL), in partnership with DOE EERE, has developed a globally unique Advanced Research on Integrated Energy Systems (ARIES) research platform. ARIES is designed to mirror the complexity and scale of real energy systems. Rather than evaluating new clean energy and energy efficiency technologies in silos, ARIES expands the research view to take in the full picture—from consumers to industry to utilities.[xxxvi]
- Our advisor, Steve Parker of EnergySec, shared, "By their nature, the advanced grid functions we seek to deploy present new risks, such as cybersecurity. Just as we would not accept new technology that was unsafe, or that failed frequently and unpredictably, we must not deploy solutions that cannot be operated

securely. Cybersecurity must be seen as an intentional, required design attribute that enables advanced capabilities to be deployed without threatening the reliability and resiliency we seek to enhance."

- The nearly 100 projects of the Grid Modernization Lab Consortium have demonstrated the vital capabilities that advanced grid solutions in partnership with industry play for the future of our energy systems[xxxvii]
- The Smart Grid Investment Grants from 2009-2013 provided $3.4 billion in projects that directly brought $7.9 billion of resources to advanced grid capabilities. Many utilities accelerated their grid modernization plans by as many as 10 years, and other advanced capabilities were accelerated about 5 years in the market place[xxxviii]

The role of the federal government in accelerating advanced grid capabilities is a critical one.

- **Leadership:** The national labs play a central role in conducting foundational research and demonstrating early capability of breakthrough solutions as well as partnership with industry in research efforts that bring together various parties with advanced solutions as they scale up
- **Standards**: Coordinated support for standards, permitting, and codes ensures that energy resources meet criteria required for the system and ultimately the strongest benefits for energy customers
- **Coordination**: Programs and projects of federal agencies bring together numerous stakeholders for open discussion and shared efforts to solve complex issues
- **Appropriation**: The Energy Act of 2020 was an excellent piece of legislation to accelerate R&D on many aspects of energy innovation and grid modernization. However nearly all of the authorized aspects of that work (including the entirety of title VIII on Grid modernization) have not been appropriated so they are not doing the industry transformative and accelerating purposes they intend
- **Infrastructure**: The Bipartisan infrastructure act that this wider body passed earlier this year provides nearly $100 billion in energy and grid related support to further much needed capabilities of the system. Notably the energy title starts off with multiple sections that provide resources to states, utilities and other sector stakeholders for grid resiliency projects and programs. Those $11 billion in resources are at the top of the list of why we support this package and feel it needs to move as soon as possible. However, the true need for hardening the grid is far more than even what is included in that package. Oregon Senator Wyden has outlined the Disaster Safe Power Grid Act[xxxix] that calls for $50 billion in grid investments to address wildfire threats alone.
- **Distribution**: I will not get into details of the reconciliation spending package being considered now beyond saying that critical investment in the advanced capabilities of our distribution system is absolutely necessary to accommodate the energy transition already in motion, let alone that may be accelerated by Federal policy actions.

Summary: Make Resiliency the Hallmark of the 21st Century Grid

Our electric grid is becoming more complex and so are its challenges. With a diverse set of integrated grid assets, flexibility and adaptability of both supply and demand resources become especially high priorities. This is now increasingly possible because of the capabilities we have walked through in this briefing.

Resilience is no longer a matter simply of energy supply. Instead, we must consider the capabilities of all grid-connected resources, and look beyond simple physical capacity. Central to harnessing these interconnected resources for resilience (and other grid benefits) is access to and participation in wide markets that enable coordination and maximize value. However, technology, markets, policy, or any factors alone will not solve the issue. It will take dedicated coordination at many levels and jurisdictions rowing in the same direction to get the outcomes we really need.

Technology providers, utilities, national labs, and many other stakeholders of the electric grid community have significantly advanced the frontier of capabilities on our grid. We must accelerate the work to get these solutions in widespread use. They include established solutions in commercial adoption such as distribution automation, advanced meters, demand side management, grid storage, and distributed resource optimization. They also include cutting-edge solutions just coming out of labs and into early commercial testing, such as real-time system controls, transactive energy platforms, electric vehicle to grid optimization, and real time monitoring.

We believe the bipartisan infrastructure package passed earlier this year through the Senate and the Energy Act of 2020 together provide an urgently needed down payment to accelerate critical grid infrastructure support and advance much needed resiliency capabilities.

Furthermore, it is critical that Federal resources align with local realities to ensure that our electric grid can remain safe, reliable, and affordable. Looking ahead, we must also prioritize and ensure that our grid is increasingly flexible, efficient, clean, equitable, secure and, as we are talking about today, resilient. If we do, it may be among the greatest achievements of the 21st century following in the footsteps of what the 20th century grid helped us achieve.

Thank you for the time to share these remarks. I am happy to field questions and look forward to the discussion.

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