United States House of Representatives
Select Committee on the Climate Crisis

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"Keeping the Lights on:
Strategies for Grid Resilience and Reliability"

Questions for the Record

Dr. Karen Wayland
Chief Executive Officer
GridWise Alliance

The Honorable Kathy Castor

1. **The United States is blessed with affordable and abundant renewable energy resources, but they are often located far away from densely populated cities. Upgrading and expanding our electric grid could help ensure that every American can access clean energy. The Biden Administration has already launched an initiative to use existing rights-of-way to site transmission to make this easier.**

    a. **How would upgrading and expanding the electric grid help your members improve electric grid reliability and resilience as we transition to a clean energy economy?**

The electric grid has been providing reliable and affordable electricity for over 100 years. However, the grid was designed for one-way flow of electricity from centralized generating units through the transmission and distribution systems to the customer. With the incorporation of distributed energy resources and highly digitized technologies, the grid now must accommodate two-way flows of energy and information. Upgrading and expanding the grid is critical to ensure more secure, resilient and efficient delivery of a necessary service.

To balance electricity supply and demand, especially as more renewable energy comes on-line, the grid must have system flexibility, which can be provided by a mix of supply- and demand-side options, including flexible conventional generation, curtailment of renewable generation, new transmission, and more responsive loads.[1] Grid technologies like controls, sensors, storage, data analytics and software-as-service (SAS) can provide flexibility by improving visibility of the system for grid operators, helping to quickly rebalance the system with autonomous controls, and facilitating the aggregation of distributed energy resources to serve as assets to grid operations. These technologies help integrate utility-scale and distributed renewables, can relieve transmission constraints and

[1] https://www.nrel.gov/analysis/electric-flexibility-storage.html

reduce the need for peak generation. These flexibility technologies also build resilience by providing back up power, automatically rerouting power around damaged lines, and self-healing grid damage.

b. How would upgrading and expanding the electric grid help consumers save money on electric bills?

Upgrading and expanding the grid allows for more effective and efficient delivery of electricity. These efficiencies are passed on to consumers. Modern grid technologies also significantly improve resilience to severe weather disruptions, which then reduces the number and duration of outages and speeds recovery. Outages have human and dollar costs for consumers, so grid modernization investments that improve resilience will save consumers money, not only on their electric bills. Most utilities in the United States have adopted energy efficiency programs as part of the services they provide but more needs to be done in the form of energy education. Most consumers have no idea how they use, generate and store energy. Technologies like Advanced Meter Infrastructure (AMI) can provide better transparency and education for consumers, but must be supported and enabled by the regulatory entities.

c. How would the Bipartisan Infrastructure Law and the initiative to use existing rights-of-way facilitate transmission development without compromising environmental protections?

The GridWise Alliance has not studied the impacts of rights-of-way policies in the Bipartisan Infrastructure Law or how developing new transmission in these rights-of-way would be treated under state or federal environmental statutes.

2. Energy efficiency is a critically important near-term strategy because it can help Americans save money on their household energy bills and on their transportation fuels as well as reduce carbon pollution. Could you please help us understand how energy efficiency also helps improve grid reliability and resilience to power interruptions and other disruptive events?

Buildings consume 76% of electricity generated in the United States.[2] IIJA includes significant funding for weatherization and energy efficiency improvements for federal, residential, and commercial buildings through updated building codes, funding for building retrofits, state energy grants, and other policy levers. Improving the efficiency of the nation's building stock will enhance resilience to energy disruptions in addition to saving energy. Well-insulated buildings reduce heating and cooling load during periods of high electricity demand associated with extreme weather and keep occupants more comfortable during power outages. Focusing resources for weatherization on underserved and low-income

[2] U.S. Department of Energy. "Quadrennial Technology Review, Chapter 5: Increasing Efficiency of Building Systems and Technologies." https://www.energy.gov/sites/prod/files/2017/03/f34/qtr-2015-chapter5.pdf, accessed March 22, 2021.

communities is critical to ensure that those populations do not suffer disproportionately during energy disruptions. IIJA funding will result in the weatherization and retrofitting of millions of public and private buildings across the country.

In my testimony I provide a dramatic example of how energy efficiency at the household level improves grid reliability as well as the consumer experience. GridWise member Bandera Electric Cooperative (BEC) in Texas has deployed technology to analyze energy use at the appliance level, allowing granular visibility into how the grid functioned during and after Winter Storm Uri, the 2021 freeze and described how households were affected in a paper entitled, "What was happening inside Texas homes during the February 2021 freeze?"[3] In this paper and a submission to the Public Utility Commission of Texas (PUCT, Docket 52373), BEC described the impact of energy efficiency on grid reliability and affordability. Average home power draw was almost 500% higher and average HVAC power demand 620% higher during the period of February 11-20 compared to February 1, 2021. However, the kWh/sqft of homes monitored by Apolloware varied by a factor of 21, meaning some homes were more cold-sensitive and used more energy the colder the outside temperatures relative to other homes.

Energy efficiency is good for the grid and consumers. Through adoption of technologies where consumers can see their energy usage in real time you are providing them actionable information to conserve and reduce energy. This is the first step in education and awareness. Numerous technical papers and research shows that consumers who are aware of the energy usage in real time save about 22% on their energy bills. This is accomplished by changing behavior. In Texas following Winter Storm Yuri, BEC saw firsthand how providing consumers information during the event dramatically changed their behavior. Technologies exist today that if adopted and utilized would reduce the number of power interruptions during disruptive events. This is how energy efficiency technologies can reduce power interruptions, reduce energy costs and thereby improve grid resiliency and reliability.

While the weather in Texas on Feb 3-6 of 2022 was not as severe as 2021, Bandera experienced only 10 outages and was able to utilize energy analytics to provide better transparency of real time energy usage to its customers. In its submission to the PUCT in November 2021, BEC concluded that "Having granular individual data tied to substation, feeder and phase is an important aspect of understanding energy use tied to weather… Having behind the meter visibility and transparency would help ERCOT with better grid planning and more importantly better understanding of how to minimize black-outs through the development of an intelligent demand response program based on fleet wide monitoring and control of HVAC, Water Heaters and Pool pump devices ties to wholesale market prices. If this type of program had been in place during Winter Storm Uri the impacts would have been minimal. With the right pricing signals (utilities) could incentivize voluntary load reductions thereby avoiding MANDATORY rolling blackouts."

[3] https://www.ideasmiths.net/wp-content/uploads/2022/02/BEC_TX_FREEZE_HOMES_APW_20220212_v2.pdf

BEC's CEO, William Hetherington, concluded in the PUCT filing, "We have the technology to operate an intelligent grid down to the appliance level, but we need energy efficiency programs and individualized demand response programs that tie directly to market pricing to keep the loss of power voluntary. If these programs had been in place last February, I believe that Voluntary load reductions would have been adequate to keep the grid for rolling blackouts on a statewide basis."

3. Could you please describe how deploying more electric vehicles helps improve grid reliability and resilience to climate impacts? How can EVs serve as a resource to a modernized, resilient grid?

The GridWise Alliance recently published a report entitled, "Near-Term Grid Investments for Integrating Electric Vehicle Charging Infrastructure."[4] The report describes grid services that electric vehicles can provide when fully integrated, from peak shaving to balancing to emergency power supply (See Table 1.)

Table 1. Grid use cases supported by transportation electrification (Source: Dell Technologies)

USE CASE	BENEFICIARY	CONTROL
Peak shaving and absorbing	GENERATION, TRANSMISSION	Central
Self-consumption increases	GENERATION, TRANSMISSION, DISTRIBUTION, CONSUMER	Local
Intra-daytime price arbitrage	GENERATION, CONSUMER	Central
Primary balancing power	GENERATION, TRANSMISSION, DISTRIBUTION, CONSUMER	Regional/Local
Building consumption	CONSUMER	Local
Emergency power supply	GENERATION, TRANSMISSION, DISTRIBUTION, CONSUMER	Local
Reactive power	GENERATION, TRANSMISSION, DISTRIBUTION	Central

Our report notes that "To enable these additional benefits, investments in hardening, upgrading, and modernizing the grid will be needed to ensure a safe, secure, reliable, and affordable electricity system. In this brief, we focus on investments that would be necessary to accommodate an initial exponential EV share increase. While we expect these near-term investments to include those that support managed charging and time-of-use pricing programs, they may not yet enable EVs to support aggregated grid services. It is important that any near-term grid-side investments are "no-regrets" investments that allow for and support the increasing integration of EVs."

4. How do your members think about public-private partnerships in the context of upgrading the electric grid?

Our members support public-private partnerships in the context of upgrading the electric grid. For example, the GridWise Alliance recommendations for grid investments in Bipartisan Infrastructure Law included cost-share programs for improving grid resilience and flexibility where private dollars would be leveraged by federal funding.

5. In your testimony, you mentioned the successes of the Section 48C Manufacturing Tax Credit when it was included in the 2009 Recovery Act. How would a tax credit for domestic manufacturing of grid technologies help your members?

[4] https://gridwise.org/wp-content/uploads/2022/02/GWA_22_NearTermGridInvestmentsEVChargingInfra_Final.pdf

Section 48C Advanced Manufacturing Tax Credit in the 2009 American Recovery and Reinvestment Act (ARRA) originally provided a 30 percent investment tax credit to 183 domestic clean energy manufacturing facilities valued at $2.3 billion and was extended to provide an additional $150 million in 2013. The tax credit helped build a U.S. manufacturing capacity and supported significant growth in U.S. exports. Almost three times as many companies submitted applications for the 48C tax credit as were approved by DOE, demonstrating significant interest by the clean energy industry in investing in domestic manufacturing. Qualifying manufactured clean energy products in the statute include electric grid equipment to support the transmission and distribution of electricity, which would include technologies manufactured, sold, purchased and deployed by GridWise Alliance members.

6. **High-voltage direct current transmission lines could help connect transmission interconnections and transmission regions, which would allow more Americans to access clean energy. What Federal investments could ensure that these HDVC transmission lines are themselves resilient to the unavoidable impacts of climate change?**

The Bipartisan Infrastructure Law includes two programs that will catalyze investments in grid resilience:

- **Preventing Outages And Enhancing The Resilience Of The Electric Grid.** This funding will be administered by the new Grid Infrastructure office created during DOE's recent reorganization. IIJA divides the $5 billion funding into two grant programs—one at DOE and the other to states and tribes—to support utility resilience investments. The DOE grants will carve out 30% for small utilities (annual sales less than 4 million MWh), and the state carve out will be based on a percentage of customers served by small utilities.
- **Electric Grid Reliability and Resilience Research, Development, and Demonstration.** This $6 billion program, which will be administered by DOE's new Clean Energy Demonstration Office, will provide grants to demonstrate innovative approaches to enhancing resilience across the transmission and distribution systems. Congress included a carve out for rural and remote areas of $1 billion.

Both programs could support improving the resilience of existing HVDC transmission lines. However, given the limited mileage of HVDC transmission in the United States, resilience demonstration funding is the more likely funding stream for exploring how to make HVDC lines more resilient to climate change.

7. **Why is it important for the federal government to invest in recycling and reuse of critical minerals that are important inputs to batteries and other clean energy technologies? For instance, the Bipartisan Infrastructure Law invests $7 billion in critical mineral supply chains, including a $140 million program recently announced by the Department of Energy to develop a first-of-a-kind refinery to**

extract rare earth elements from coal ash waste. How could these efforts complement new mining and processing domestically and around the world?

The GridWise Alliance recently responded to a Department of Energy Request for Information (RFI) on supply chain issues.[5] In our submission, we note the importance of recycling critical minerals used in batteries and other grid technologies:

> "Whether directly connecting to the grid as a resource, being paired with home solar panels to support system operation, or connecting to the grid as the engine in a electric vehicle, the quantity of energy storage on the electric grid is increasing year over year. Lithium-ion (li-ion) batteries are a dominant energy storage technology today. A primary vulnerability of this technology is battery cell manufacturing and a strategic opportunity could lie in second battery life manufacturing (recycling) in the U.S. In short order, thousands of li-ion batteries from both electric vehicles and other industries will be reaching their end of life. Investment in the research of technology and production methods is needed to understand optimal ways to reuse the materials in batteries with minimal pollution. Beyond li-ion batteries, there are a variety of other energy storage technologies both in use and under development. Other energy storage technologies include:
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> • other batteries (using different electrochemical technologies),
> • hydrogen and its various transport/storage mediums (such as ammonia),
> • thermal,
> • compressed air, and
> • pumped hydro.
>
> **For most of these technologies, the greatest supply chain vulnerability lies in the mining and refining of rare earth elements and critical minerals."**

The Honorable Veronica Escobar

1. **Can you please talk a little more on how investing in an aging transmission system can benefit states like Texas, and why it is important that local governments take advantage of federal funding that would advance grid resiliency.**

GridWise Alliance member Bandera Electric Cooperative notes that as a transmission owner in Texas, the ERCOT model has numerous benefits, but it also has flaws. One of the flaws is the process of how transmission projects are reviewed and prioritized in Texas. By investing in more transmission you are improving the grid capacity. One of the contributing factors to inadequate supply during Winter Storm Uri was the capacity constraints on the transmission grid. Most of the resources are in west Texas and most of the load is in east Texas and therefore a robust transmission grid is vital to avoiding future power interruptions due to extreme events.

[5] https://gridwise.org/wp-content/uploads/2022/01/GridWiseAlliance_EnergySectorSupplyChain_DOERFI.pdf