U.S. Senate Committee on Energy and Natural Resources
July 23, 2025 Hearing: *To Identify Challenges to Meeting Increased Electricity Demand*
Questions for the Record Submitted to Mr. Rob Gramlich

Questions from Ranking Member Martin Heinrich

Question 1: It's common to dismiss renewables because—as the refrain goes—the "sun doesn't always shine and the wind doesn't always blow."

- Can you explain how grid operators in states like California and Texas have managed to avoid blackouts not despite renewables, but because of them?

Response:
Yes, very often Texas and California have a majority of their peak summer air conditioning demand met with a majority renewable energy and storage. Solar in particular serves the hot afternoon hours, and then batteries serve load into the evenings. As I explained in my written testimony, systems do need firm power in addition to sources like wind and solar that provide low-cost energy. Short-duration batteries provide some firm power at certain times like summer evenings after solar energy has provided power through the afternoon. Other sources often including existing gas plants provide firm capacity at other times. Firm power sources need not operate very much, and consumers can save money by using low-cost wind, solar, and battery storage most of the time. My written testimony explained the different roles that are played by resources in balanced utility portfolios.

Notably, even while meeting reliability targets, at certain times over 75% of Texas' power comes from wind and solar.[1] In 2024, ERCOT connected 3.9 GW of new storage capacity, which represented nearly 45% of its 8.7 GW cumulative capacity additions.[2] At times, renewable resources have reliably provided over 90% of generation in the Southwest Power Pool, which operates the power grid for all or part of part of 14 Plains states.[3] In 2023, power from renewable resources made up 54% of California's in-state electricity generation.[4] California has paired this significant renewable energy penetration with high energy storage deployment. Energy storage resources have helped California avoid blackouts during extreme weather events like the September 2022 heat wave, providing power during critical hours of grid stress.[5] The result is that the reliability of the California grid has been strong the last few years. South Australia reached 75% renewable energy penetration in 2023 and has not faced significant reliability challenges since 2016.[6]

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[1] Electric Reliability Council of Texas (ERCOT), *Renewable Integration Report* (Apr. 15, 2025), https://www.ercot.com/mp/data-products/data-product-details?id=NP4-760-ER.
[2] American Clean Power (ACP), *Snapshot of Clean Power in 2024,* at 14 (April 2025), https://cleanpower.org/resources/clean-power-annual-market-report-2024-snapshot/?mrcid=1745999619#unlocked
[3] Southwest Power Pool, *SPP sets regional records for renewable energy production* (Mar. 29, 2022), https://www.spp.org/news-list/spp-sets-regional-records-for-renewable-energy-production/.
[4] EIA, *U.S. States: State Profile and Energy Estimates*, https://www.eia.gov/state/?sid=CA (accessed Apr. 15, 2025).
[5] California Independent System Operator (CAISO), *Special Report on Battery Storage*, at 4 (July 2023), https://www.caiso.com/Documents/2022-Special-Report-on-Battery-Storage-Jul-7-2023.pdf.
[6] International Energy Agency (IEA), *Electricity 2024 - Analysis and forecast to 2026*, at 100 (May 2024 Revision), https://iea.blob.core.windows.net/assets/18f3ed24-4b26-4c83-a3d2-8a1be51c8cc8/Electricity2024-Analysisandforecastto2026.pdf.

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Contrary to claims made during this hearing, each renewable generation plant does not require a baseload generator to back it up. Rather, the system needs the portfolio of power sources collectively to meet load at all times. It is true that firm sources that produce power when needed for extended periods of time are needed but not on a one-to-one basis or anything close to that. A diverse portfolio with large amounts of renewable energy can be the most affordable and reliable as well as sustainable way to meet electricity demand.

- Are there areas of the country where we're seeing electricity prices decline as the share of clean energy on the grid increases?

Response: One study[7] found $750 million in savings from recent additions of battery storage in Texas. Solar and wind tend to reduce the marginal clearing price, and those wholesale price reductions flow through to reduce retail consumers' bills. Many utilities around the country assemble "integrated resource plans" (IRPs) with generation portfolios required to reliably serve load, and many of those include significant amounts of renewable energy. The addition of those resources to utility plans reduce the overall cost, otherwise they would not be included.

Question 2: A recent study published in *Nature* analyzed 2,156 blackout events across the United States from 2001 to 2020 and found that a higher share of renewable energy did not increase blackout risk. In fact, it may contribute to outages being less frequent, shorter in duration, and more limited in scale.

- Do you know what the main causes of the outages were?

Response: Almost all customer outages are caused by local issues on the distribution grid, not on the bulk power system.[8] The study to which you refer did find that a high penetration of weather-dependent renewable energy sources did not increase the risk of blackouts and might in fact lead to less frequent, shorter, smaller outages. The study also found that, where blackouts occurred, renewable resources were not the main cause.[9]

- If maintaining grid reliability is the goal, where should we prioritize our investments?

Response: I recommend focusing Congress' attention on the high voltage regional and interregional links. Those affect the most people across the widest areas, whereas more localized cases have existing mechanisms with local utilities and regulators to invest in needed infrastructure. Also, as implied by this Committee's strong vote last year in support

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[7] *https://cleanpower.org/news/new-analysis-shows-energy-storage-keeps-costs-low-and-power-reliable-in-texas/)*
[8] https://gridstrategiesllc.com/wp-content/uploads/2024/05/customer-focused-resilience-final-050118.pdf
[9] Jin Zhao & Fangxing Li, Nature Energy, *Impacts of renewable energy resources on the weather vulnerability of power systems*" (Oct. 2024), https://www.nature.com/articles/s41560-024-01652-1.

of the Energy Permitting Reform Act of 2024, interregional transmission is clearly not currently being addressed effectively by current industry or regulatory processes.

Transmission supports reliability and resilience more than any other option. Transmission lines typically have at least 99.85% availability across all voltage levels, far higher than any individual generation source. Transmission networks are multi-directional, and once built they serve many needs that one could not have predicted ahead of time, moving power from where it exists to where it is needed, and it does so automatically and at the speed of light. With severe weather events in recent years, sometimes 10% of a region's needs are met by large scale movements of power across major regions of the country. That is why interregional transmission is so important and was the focus of a Congressional requirement for the North American Electric Reliability Corporation (NERC) to study the need, and NERC's report found a need for 35 GW of increased interregional transmission capacity.

Question 3: We often hear that natural gas and coal are "dispatchable" or "baseload," yet they sometimes do not perform when needed.

- Are those meaningful concepts for system operators? If not, which ones are more useful?

Response: I think the term "firm" most accurately describes the attribute of being available at all times. The term "dispatchable" conflates the fast-ramping attribute with the as-available attribute. Those are different attributes that provide different services. Sometimes power systems need more of one, or more of the other in their system, so it is not useful to lump them together into a general category. The term "baseload" is a description of the load (not generation) that is always present so that is not a useful descriptor of generators. I do believe it is important to have firm resources in addition to fast-ramping and high-volume low-cost energy. It is more important from an environmental standpoint to make sure the high-volume energy comes from low- or zero-carbon resources like renewables, because they will run a lot and produce the most energy. It is not very harmful environmentally to have fossil resources provide firm capacity because they operate when needed but don't necessarily operate (burn fuel) very often.

The current focus on "dispatchable" resources ignores the fact that those resources are: (1) not always reliably available, since they may malfunction or not have fuel available during the extreme weather events when they are most needed; and (2) are not as dispatchable or flexible as batteries. "Firm capacity" is a more meaningful term as it suggests availability at all times.

- Why might it be inefficient to run a power system using only nuclear or coal, even though they may have high-capacity values?

Response: The operating cost of these resources can be very high and much higher than renewable sources. Resources like nuclear and coal have high capacity values (highly likely to contribute to meeting peak loads), but are inflexible so it would be inefficient—if not impossible—to reliably operate a power system with generation from only those resources. Too much of any one resource only makes the system vulnerable to the same threats. This leaves the system susceptible to correlated outages that can pose significant reliability risks.

All generation types are vulnerable to forced and planned outages. During extreme events, especially when it is very hot or cold, conventional generation can go offline or have their output fall due to mechanical failure and fuel supply issues. For example, disruptions to natural gas supply and delivery during periods of extreme cold are common.[10] Similarly, coal piles at coal-fired power plants can become unavailable due to flooding or freezing, as was seen during Hurricane Harvey in Texas and Louisiana in 2017 and during the February 2021 cold snap in Texas and the South Central United States (i.e., Winter Storm Uri).[11,12] In addition, thermal generators, such as natural gas, coal, and nuclear generators, are frequently de-rated, or forced to operate below full capacity, and lose efficiency during heat waves, which can pose significant reliability risks.[13]

In addition, all generator types, including conventional generators such as coal, nuclear, and natural gas, are subject to planned outages for maintenance. In the past these planned outages could be performed in the spring and fall when there was excess capacity, but recently there have been shortages in these seasons.

While capacity accreditations for individual renewable generators are often lower than those of individual thermal generators, a portfolio that relies on a diverse set of resources, including renewables, is the most affordable way to achieve grid reliability.

Questions from Senator Mazie K. Hirono

Question 1: The Trump Administration and Congressional Republicans are removing tax incentives for solar and wind, the cheapest sources of new power by many estimates, as well as rescinding federal funds for transmission projects and adding barriers to solar and wind projects on federal land. What do the reductions in federal support for renewable

[10] EIA, *Winter storms have disrupted U.S. natural gas production* (Mar. 13, 2024), https://www.eia.gov/todayinenergy/detail.php?id=61563.
[11] *NERC*, *Hurricane Harvey Event Analysis Report*, at 17 (Mar. 2018), https://www.nerc.com/pa/rrm/ea/Documents/NERC_Hurricane_Harvey_EAR_20180309.pdf.
[12] FERC, NERC, and Regional Entity Staff, *The February 2021 Cold Weather Outages in Texas and the South Central United States*, at 81 (Nov. 2021), https://www.nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf.
[13] NERC 2024 Reliability Assessment at 16 and 132-133.

power and transmission mean for the costs that households and small businesses will pay in the face of a rising demand for power?

Response: There would be a hole in many utility portfolios if wind and solar energy were removed by permitting, premature tax credit expiration or uncertainty, or other barriers. Reducing supply at a time of scarcity would increase costs significantly. Utilities need balanced portfolios with firm power, fast-ramping flexibility services, and low-cost energy, and no single resource provides all of these. Utilities need a diverse portfolio of supply sources that collectively deliver these services. Renewables provide low-cost energy, some flexibility, and some firm capacity on which utilities depend.

Question 2: The Trump Administration has tried to cast wind and solar power as unreliable. Can a grid with a high share of renewables be reliable and cost-effective with energy storage and a robust power grid?

Response: Yes, power systems can be reliable with something like 80% of the energy coming from wind, solar, and short-duration batteries, depending on the system and the resources available. Firm power is also needed for the times those resources are not available. Transmission is a key element because across wide areas "the wind is always blowing somewhere" as the saying goes.[14] That opportunity of integrating resources across large areas is of course not available to island systems like Hawaii, but Hawaii does have excellent solar and battery opportunities, and the alternatives to renewables are much more expensive than in most other states.[15]

Question 3: In 2021, Hawaii became one of the first states to use performance-based rates, in which utilities earn their revenues by meeting certain reliability and cost targets. Depending on design, such performance-based rates can serve to spur utilities to expand the capacity of existing transmission lines, make it easier for homes and businesses to connect solar power and storage systems, and incentivize energy efficiency. Are there additional steps beyond what you covered in your testimony that you would recommend state and federal regulators take toward grid upgrades and other investments to accommodate increased demand for electricity while keeping electricity affordable and reliable? Please feel free to include the titles of particular papers or studies you would recommend to the committee on the topic.

Response: Hawaii, Texas, and Alaska have relatively unique regulatory structures where full jurisdiction is at the state level, and for certain policies like performance-based regulation (PBR), that makes the job easier. For other states PBR is more complicated. There are opportunities for targeted PBR at the federal level for FERC. One such option is

[14] See pg 16, https://gridstrategiesllc.com/wp-content/uploads/GridStrategies_RAValueInterregionalTx_250601.pdf
[15] https://www.nrel.gov/grid/hawaii-integration-studies; https://www.esig.energy/resources/hawaii-solar-integration-study/

for a "shared savings" incentive that FERC could employ under its authority in FPA Section 219(b)(3). A shared savings model would allow utilities that deploy GETs to retain a portion of the cost savings (e.g., avoided transmission upgrades, reduced congestion costs, or faster interconnection timelines), while passing the rest along to customers. This creates a direct financial incentive for utilities to pursue low cost, high impact grid upgrades like GETs. This proposal is detailed in the WATT Coalition's FAQ on Shared Savings Incentives: https://watt-transmission.org/resources-2/shared-savings-faq/ . A similar approach could be adopted for High Performance Conductors.

Question 4: Some states, including Ohio, have established unique rates and requirements for data centers, recognizing that they are much larger than a typical industrial power user. How do you think data center rates should be structured to ensure that the centers are not shifting the costs to other consumers?

Response: State regulatory policies are addressing this question in most or all of the states where significant data center load growth is projected. I do not believe "data centers" should be treated as a less valuable service than other large loads, partly because almost every American is using those data centers on our phones almost every hour of every day. However, large loads generally do impact the system differently than small loads like homes and small businesses. Most states experiencing large load interconnections are requiring firm financial commitments in order to 1) prevent cost-shifting to other customers, and 2) prioritize loads that are most likely to be built, thereby increasing the accuracy of load forecasts that are used to form the basis for investment plans.[16] Each state balances the various interests and equities in somewhat different ways. This is a state policy as opposed to a federal regulatory policy because these are retail (end-use) customers.

Question 5: The Independent Market Monitor for the grid operator PJM stated in a June 3, 2025 report: "The basic conclusion of this analysis is that data center load growth is the primary reason for recent and expected capacity market conditions, including total forecast load growth, the tight supply and demand balance, and high prices." If data centers were to agree to briefly reduce their use of power during periods of high demand for power on the grid, how much could such flexibility by data centers reduce electricity price spikes in a given region?

Response: Flexibility by data centers would help increase the pace of data center growth and reduce costs that might be shifted to other customers. It is easier said than done though. I have yet to see many non-cryptocurrency data center customers actually curtailing consumption in response to wholesale prices, mainly because the value of chips and computing is so much higher than the value paid to curtail consumption. But achieving even a little flexibility from all demand sources would significantly improve the efficiency of

[16] See slides 17-20, https://gridstrategiesllc.com/wp-content/uploads/National-Load-Growth-Report-2024.pdf

the grid, avoid excessive expensive investments, enable more economic development, and reduce the risk of cost-shifting to other resources. Significant attention from utilities, data center owners and developers, DOE, and national labs could help expand this opportunity. Sometimes the reason for expensive and time-consuming network upgrades is the very low probability of a certain "contingency" happening, meaning a forced outage of a transmission line or generator somewhere on the network. If data centers and other customers can reduce consumption in the event of this contingency, then physically they should be able to be connected quickly and for less cost.[17] What the data center industry values more than anything is the speed of connection. I expect we will see some creative temporary configurations before full network transmission service is available.

Questions from Senator Catherine Cortez Masto

Question 1: When considering tariffs, do you believe the U.S. is adequately investing in workforce programs and supply chains to support our rapidly growing power demand needs, both today and into the future?

Response: No, I believe the US can do more to develop domestic supply chains and manufacturing. This requires targeted incentives to these facilities but also a stable "demand pull" in the market for technologies of tomorrow. There is a small and limited role for tariffs, but they tend not to work by themselves without predictable supply incentives and demand. Tariffs may raise costs significantly for electricity consumers since significant supplies of aluminum and steel are needed.

There are also increasing constraints in ensuring adequate workforce to support transmission development, with transmission developers managing uncertainty in development timelines—especially around permitting—that make it difficult to secure labor for the moment construction can finally begin. Developers are also sharing the same workers across transmission projects, having to compete not only for supply and demand for the project and for supply chain queue positions but also for the labor required to actually construct the project. The Transmission Siting and Economic Development grants program established in the Inflation Reduction Act included grants to bolster workforce. For example, in the initial round of awards,[18] the U.S. Department of Energy's Grid Deployment Office awarded funds to Oregon to launch a Lineman College and Training Hub; to Oklahoma to build a workforce development center; to Michigan to invest in workforce development initiatives to support transmission construction; to New Jersey to provide pre-apprenticeship and apprenticeship training for electrical careers in partnership with an IBEW local union; to Colorado for workforce training; and to Virginia for the Hampton Roads Energy Workforce Development Initiative.

[17] https://nicholasinstitute.duke.edu/sites/default/files/publications/rethinking-load-growth.pdf
[18] https://www.energy.gov/gdo/TSED

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Question 2: Your written testimony highlighted the importance of sufficient staffing at federal agencies to support infrastructure permitting. How detrimental is the Interior Department's recent memo, specifying that the Secretary of the Interior has to personally approve wind and solar projects?

Response: It could be very detrimental to the energy development on which utilities are relying. The uncertainty alone can scare investors away.

How do you see it impacting the rapid deployment of new electrons to the grid?

Response: Much more clarity and speed will be needed to avoid a significant loss of some of the energy needed to meet growing demand over the next few years.

How are these hurdles compounded by ongoing employee terminations across federal agencies? Does this uncertainty put the U.S. at a competitive disadvantage for AI leadership?

Response: Yes, limited grid capacity already harms the US' position relative to other countries for AI-driven data centers, and slowing generation development of any type worsens the nation's competitive position.

Question 3: A recent report from Americans for a Clean Energy Grid determined that while new sources of generation are coming online, the U.S. is not building transmission projects to deliver that power fast enough and adhere to surging power demand. Can you highlight some of the existing federal tools that can be utilized or expanded to get new transmission lines built?

Response: There are several federal tools that can help advance needed large-scale transmission development, some of which are less certain today than they were a few months ago. First is the U.S. Department of Energy's Coordinated Interagency Transmission Authorizations and Permits, or CITAP, Program, established via rule in May of last year pursuant to Federal Power Act Section 216(h) and provisions of EPAct 2005. Under that program, DOE acts as the lead agency to coordinate all federal reviews and authorizations required for qualifying transmission projects. The effort to stand up the program followed from a memorandum of understanding among nine federal agencies, which coincided with Congress making changes to NEPA in the Fiscal Responsibility Act of 2023. There are currently at least two projects proceeding through the new process, which is designed to cut the average federal permitting timeline in half. But the staff implementing the program is significantly less than it was when DOE stood up the program, which calls into question how effective it will be, at least in the near term.

Another existing federal tool, also first established in the Energy Policy Act of 2005, are National Interest Electric Transmission Corridors, or NIETCs, as set out in Section 216(a) of the Federal Power Act. DOE attempted to use this authority once in the past, unsuccessfully, but revamped the program in 2023 and was in the process of designating NIETCs as of the change in Administration. The impact of NIETC designation includes not only triggering FERC's limited federal backstop siting authority under Federal Power Act Section 216(b) but also unlocking federal financial tools that Congress established in the Infrastructure Investment and Jobs Act in 2021 and the Inflation Reduction Act in 2022 (though their status changed as of Congress's passing of the OBBBA earlier this year).

Other federal tools to advance transmission development at DOE include several financial tools: third-party financing with Power Marketing Administrations (established in Section 1222 of the Energy Policy Act of 2005), Grid Resilience Innovation and Partnership grants (established in the Infrastructure Investment and Jobs Act of 2021), the Transmission Facilitation Program (established in the Infrastructure Investment and Jobs Act of 2021), , and direct loans from DOE's Loan Programs Office.

Federal tools at FERC to catalyze transmission development include FERC's transmission planning rules (Order Nos. 890 (2007), 1000 (2011), and 1920 (2024)), transmission incentives rule (Order No. 679), generator interconnection rules (Order Nos. 2003 and 2023), and backstop siting rule (Order No. 1977). FERC's authority over transmission planning and cost allocation, transmission incentives, and generator interconnection is critical, and some of these areas are ripe for further reform. For example, a strong "shared savings" incentive for advanced transmission technologies could be valuable for advancing smart, cost-effective grid expansion (under Federal Power Act Section 219(b)(3)). FERC's authority over permitting transmission lines is very limited; Congress should consider bolstering this authority through permitting reform legislation.

Adoption of DOE's Categorical Exclusion for reconductoring and rebuilding transmission lines by all federal agencies would be helpful.

Question 4: Are there ways that the U.S. can better incorporate inter-regional planning and power transfer capabilities in order to adhere to energy demand needs and prevent against threats to the grid?

Response: Yes, FERC could require best-practice transmission planning methods for interregional transmission as it did for intra-regional transmission in Order 1920. Congress could direct FERC to issue a rule doing that, as was proposed in the Energy Permitting Reform Act of 2024.[19] Another option is a minimum transfer requirement, as they have in Europe,[20] and that could be based on the recent NERC Interregional Transmission

[19] https://gridstrategiesllc.com/wp-content/uploads/EPRA-Transmission-Explainer-Grid-Strategies.pdf
[20] https://energy.ec.europa.eu/topics/infrastructure/electricity-interconnection-targets_en

Capability Study, which Congress required NERC to prepare in the Fiscal Responsibility Act of 2023.[21]

How critical is interregional planning for energy demand management and maximizing power load efficiency?

Response: Interregional transmission is one of the most important ways to maximize efficiency of the power system because it enables power flow between areas that have peak loads and generation supply output occurring at different times.

In many cases there is more generation and load diversity between regions than within regions, meaning there is more likely to be excess energy available to flow in times of need. Interregional transmission also provides substantial resilience value by bridging weather-related differences between regions. Demand does not peak in every region across the country at the same time. A grid that is "bigger than the weather"—be it a polar vortex or cloud cover—enables power to be shared from a region that is not peaking into a region that is, lowering consumers' costs in both regions. Interregional transmission can provide greater diversity in both load and generation across greater distances as well.[22]

Reports on the value of interregional transmission:

- *Resource Adequacy Value of Interregional Transmission*[23]
- *NERC's Recommended Grid Expansion Would Save Consumers Billions*[24]
- Quantifying a Minimum Interregional Transfer Capability Requirement[25]
- The Value of Transmission During Winter Storm Elliot[26]
- Transmission Makes the Power System Resilient to Extreme Weather[27]

[21] https://gridstrategiesllc.com/wp-content/uploads/2023/05/GS_Interregional-Transfer-Requirement-Analysis-final54.pdf

[22] https://gridstrategiesllc.com/wp-content/uploads/GridStrategies_RAValueInterregionalTx_250601.pdf

[23] https://gridstrategiesllc.com/wp-content/uploads/GridStrategies_RAValueInterregionalTx_250601.pdf
[24] https://gridstrategiesllc.com/wp-content/uploads/GS_NRDC_NERCs-Recommended-Grid-Expansion-Report54.pdf
[25] https://gridstrategiesllc.com/wp-content/uploads/2023/05/GS_Interregional-Transfer-Requirement-Analysis-final54.pdf
[26] https://acore.org/wp-content/uploads/2023/02/The-Value-of-Transmission-During-Winter-Storm-Elliott-ACORE.pdf
[27] https://gridstrategiesllc.com/wp-content/uploads/2024/05/transmission-makes-the-power-system-resilient-to-extreme-weather.pdf

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Question 5: As wildfires grow more frequent and destructive, how do you see this risk impacting the ability of electric companies to finance, build, and harden the infrastructure needed to meet rising electricity demand?

Response: Wildfire risk, particularly for utilities in the Western US, can harm utilities' ability to invest in new transmission that expands capacity. Significant capital will likely be needed to harden systems, install low-sag carbon and composite core High Performance Conductors and other types of technologies that reduce wildfire vulnerabilities, and quickly recover from any line outages that may result from wildfires.

Note that HPCs, which operate at lower temperatures and sag less than traditional wires, reduce wildfire ignition risk while doubling line capacity without requiring new corridors. Therefore, HPCs offer a dual benefit in supporting system hardening and capacity expansion with a single investment.

Question 7: From your perspective, are there certain Regional Transmission Organizations (RTOs) or regions of the country that you believe are taking an innovative queue management approach for interconnection – such as automation to process requests faster?

Response: The California Independent System Operator (CAISO), Southwest Power Pool (SPP), and Midcontinent Independent System Operator (MISO) have instituted reforms to speed up interconnection queue processing, beyond those required by FERC. Their efforts to simplify the process by shifting the complicated network planning needs over to the transmission planning process leaves less complicated processing for the interconnection process itself. SPP is developing an "entry fee" approach to provide much more clarity and certainty to interconnecting generators. CAISO is planning certain transmission zones to make interconnection available to the amount of demand expected there. Most of the RTOs are implementing automation and AI tools. It is not clear yet that these tools produce results that can be replicated by the interconnecting generators in a way that provides clarity and consensus on the upgrades needed.

Can you explain the significance of FERC Order No. 2023, as well as ways that Congress can complement or build on these policies to further reduce interconnection study delays and meet growing demand?

Response: Encouragement from Congress and specifically from committees that oversee agencies like FERC to address important policy priorities is generally welcome from my perspective. Interconnection is one of those recent important policy areas where FERC heard a message that it was important to fix some problems. By and large I believe important reforms are well underway at FERC and transmission providers on interconnection even if they have been slower than they should have been. The basic thrust

of FERC Order No. 2023 is moving transmission providers towards studying interconnecting generators in groups, called clusters, rather than on an individual generator-by-generator basis, as well as reforms to increase accountability and deadlines for both generation and transmission owners. While the reforms are still being implemented, early indicators suggest the changes are helping improve the interconnection process in many regions. Further reforms are needed beyond those FERC mandated through Order No. 2023. It will be important for FERC to continue spreading best practices. These reforms are necessarily mainly at the regional level, meaning what is needed depends on the region, because each system is different. FERC can encourage some general themes such as simpler processes including entry fee type approaches, as described here: https://gridstrategiesllc.com/wp-content/uploads/Exec-Sum-and-Report-Unlocking-Americas-Energy-How-to-Efficiently-Connect-New-Generation-to-the-Grid.pdf. To the extent Congress legislates, it will be important to make sure that agencies retain the flexibility to evolve rapidly based on successes and failures, in a way that is faster than legislation can address.

Question 8: Wildfire liability—particularly in the West—is starting to affect credit ratings, utility financing, and ultimately the cost and timing of those projects. What is your perspective on how those financial dynamics are influencing transmission investment?

Response: Utility credit ratings is a significant issue for many utilities and states across the country, and particularly in the West. Liabilities can affect utilities' ability to attract investments needed for reliability and affordability. State regulators and legislators across the West are actively evaluating options to address these liabilities, and Congress should consider the issue as well.

Questions from Senator Alex Padilla

Question 1: China is outpacing the United States in the deployment of high-voltage transmission lines and renewable generation. How has the current federal regulatory structure hindered the deployment of transmission and left us behind other countries like China? How can reforms in transmission permitting set us up to meet the moment?

Response: Lack of clear federal regulator requirements in the US compared to China and the EU hinder our ability to build the interregional capacity that global competitors are employing. We have essentially no interregional transmission policy presently. We have uncertain implementation of FERC Order 1920 for regional transmission. We do not have a clear federal regulator for transmission like we do for natural gas pipelines (FERC). We have an opportunity to put in place stronger regional and federal systems for regional and interregional transmission.

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There are lot of challenges to building linear infrastructure like transmission lines. These include the big three: planning, paying, and permitting.

Drilling down on permitting, it regularly takes over a decade to develop a large-scale transmission project, and for some, more like 15 years or more. Much of that time is spent in the permitting process. For most large-scale transmission, federal, state, and local permits are required. Sometimes county-by-county permits are even required, which can be incredibly time-consuming for transmission developers. For some permits, there is no required timeline for the authority to use the permit, and where there is a timeline, there are frequent delays. The average time for a federal agency to complete a NEPA environmental impact statement for a transmission project is four years, though it is usually longer for large-scale transmission and completing the EIS does not mean the project has yet secured authorization to begin construction—that sometimes takes several years longer.

To give you a couple examples, as I mentioned, in 2024, we saw over 800 miles of new high-voltage transmission built, which was a pretty significant increase from 2023, and even more from 2022. But to put it into perspective, 125 of those miles was from the Ten West Link project that CAISO first approved for inclusion in its transmission planning process in 2013—so over a decade before it went into service. Another 102 miles of the 2024 total came from the Cardinal-Hickory Creek project, which MISO included as part of its Multi-Value Projects portfolio in 2011—so over a decade ago. This project faced protracted litigation and permitting battles. And a third project that came online in 2024 is the Energy Gateway South line, originally announced by the developer in 2007, partially completed in 2015, and the last segment finally completed 17 years after its development was first announced. This is similar to the SunZia project, which is currently under construction after 17 years of development, as well as the Boardman to Hemingway project, which has been in permitting for going on two decades.

Questions from Senator Ruben Gallego

Question 1: Extreme heat is becoming more frequent and lasting longer across the United States. At the same time, on July 9th, Arizona's two largest electric utilities broke energy demand records. As you mentioned regarding air conditioning in your testimony, when temperatures rise, people reach for the thermostat—leading to surges in electricity demand.

Especially in rapidly growing states like Arizona, we have seen rising utility bills and lagging capacity growth to keep up with electricity demand. People across the country should not have to worry about astronomical bills, utility shutoffs, or the possibility of blackouts during times of high demand.

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Outside of rising costs, what additional electricity demand challenges are caused or worsened by extreme heat? What steps should be taken to ensure the nation's electric grid can keep up with rising demand during extreme heat, without passing the cost burden onto households or risking reliability?

Response: State regulators and utilities should be planning to ensure sufficient capacity is available to protect people from extreme heat. Heat related deaths are rising: https://www.epa.gov/climate-indicators/climate-change-indicators-heat-related-deaths . Air conditioning is a public health necessity at certain temperatures and heat index levels. Certain end-uses of electricity are less critical than others on extreme heat days. States should be evaluating ways to compensate users from reducing consumption at times of excessive heat.

- *Energy storage resources have helped California avoid blackouts during extreme weather events like the September 2022 heat wave, providing power during critical hours of grid stress.[28] The result is that the reliability of the California grid has been strong the last few years.*
- *In addition, thermal generators, such as natural gas, coal, and nuclear generators, are frequently de-rated, or forced to operate below full capacity, and lose efficiency during heat waves, which can pose significant reliability risks.[29]*
- *In 2022, CAISO even put together a short documentary to show how their grid operators are using batteries to support grid reliability, especially during extreme heat.[30]*
- *During an August 2024 heat wave, ERCOT leveraged complementary resources to keep the state's air conditioning on while keeping prices reasonable. Low-cost solar generated significant power during peak hours. Batteries, charged on cheap, excess wind and solar generation during off-peak hours, met the demand during peak hours after the sun had set. The renewable generation kept strain off of natural gas plants and avoided the need to run more expensive units.[31]*
- *Between August 31 and September 9, 2022, when a prolonged heat event hit California, solar generation met much of the daytime load while energy storage*

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[28] California Independent System Operator (CAISO), *Special Report on Battery Storage*, at 4 (July 2023), https://www.caiso.com/Documents/2022-Special-Report-on-Battery-Storage-Jul-7-2023.pdf.
[29] NERC 2024 Reliability Assessment at 16 and 132-133.
[30] CAISO, *From Idea to Reality - Battery Storage Comes of Age on the California Grid* (Mar. 2022), https://www.youtube.com/watch?v=waY4yQkTeHA.
[31] Paul Denholm, et al., National Renewable Energy Laboratory, *How the U.S. Power Grid Kept the Lights on in Summer 2024* (Nov. 2024), https://www.nrel.gov/docs/fy25osti/91517.pdf.

resources met soaring demand into the evening. CAISO indicated that these contributions were crucial in avoiding blackouts.[32]

- *In Texas in June 2023, a record-breaking heat wave led to peak electricity demand exceeding 75 GW. While many fossil fuel generators faced operational issues, including mechanical failures and fuel supply constraints, renewable and energy storage resources overperformed, keeping the grid reliable and minimizing price spikes associated with high demand.*[33]
- *During the heat waves that hit the Western U.S. in July 2024, CAISO relied on its diverse portfolio of renewable and energy storage resources, along with demand response programs, even as demand soared in response to sustained record temperatures. California's grid performed so well that it was able to export power during key hours to neighboring systems, which had fewer renewable and energy storage resources on which to rely while facing similar extreme temperatures.*[34]

Question 2: In your description of firm power generation, you mention that nuclear energy has the highest capacity value for any type of resource at 95%. This means that nuclear energy is very good at providing power supply at times of scarcity. However, you also say that opportunities to expand nuclear within the next decade will be minimal, in contrast to fast-deploying wind and solar or fast-ramping battery storage.

How do you propose balancing near-term demand with the need for longer-term reliability and efficiency? How do we ensure that a range of renewable energy sources work well together?

Response: A balanced portfolio of wind, solar, short-duration batteries, along with firm sources can provide an affordable, reliability, and more sustainable supply to meet growing demand in the near term. I expect many older units will remain on line longer than previously expected in response to the signals from markets and utility planning processes that their capacity is needed over the next few years. Keeping such units on line and available to provide firm capacity does not necessarily reduce state, consumer, and utility environmental goals because being available to provide capacity does not necessarily mean the plants run very often. In the next decade, "clean firm" sources such as advanced geothermal, large and small nuclear fission plants, nuclear fusion, and other sources may become economic. The government has an important role to play in developing and commercializing these technologies.

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[32] CAISO, *2023 Special Report on Battery Storage* (July 2024), https://www.caiso.com/documents/2023-special-report-on-battery-storage-jul-16-2024.pdf.
[33] Arpan Varghese & Scott Disavino, Reuters, *Wind, solar help Texas meet record power demand during heat wave* (June 2023), https://www.reuters.com/business/environment/wind-solar-help-texas-meet-record-power-demand-during-heat-wave-2023-06-30/.
[34] CAISO, *Managing the July 2024 heat wave with our partners in California and the West* (July 2024), https://www.caiso.com/about/news/energy-matters-blog/managing-the-july-2024-heat-wave-with-our-partners-in-california-and-the-west.

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