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US SENATE

ENERGY AND NATURAL RESOURCES COMMITTEE

Hearing: "Challenges to Meeting Electricity Demand"

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Good morning. It is an honor to testify on one of the most important issues facing the country to the nation's most important legislative committee.

My name is Rob Gramlich and I am Founder and President of Grid Strategies, a consulting firm providing research on the transmission grid and power markets.[1] I cut my teeth working for a Republican Chairman of the Federal Energy Regulatory Commission (FERC) where my job was to seek bipartisan consensus on electric industry policies. I focus here on what have been and still should be bipartisan points of agreement, as I have as both a Republican and Democratic witness in previous Congressional hearings.

I. Electricity demand growth is sudden and significant

After 25 years of flat load, a sudden shift occurred two years ago due to electricity's ability to power so many activities including oil and gas drilling, space heating, driving, and Artificial Intelligence (AI). Grid Strategies' aggregation of utility forecasts shows the nation needs 15% more capacity or 120 GW by the end of the decade.[2] Utility forecasts may be overstated because, as with generators connecting to transmission systems, there are many more requests from potential projects to connect than actual projects that will be built. There will also likely be a continued trend towards more energy efficient algorithms,

[1] Recent clients include large and small energy developers, large and small utilities and utility associations, advocates for large and small retail consumers, state utility commissions and energy offices, large technology companies, and clean energy and environmental NGOs.

[2] Grid Strategies, https://gridstrategiesllc.com/wp-content/uploads/National-Load-Growth-Report-2024-April-Update-Presentation.pdf .

chips, and cooling systems for these large loads. On the other hand, we could also see a large rebound effect where more efficiency leads to expanded use of electricity given large appetites for computing, expansion of air conditioning, and other power uses. On balance, the real observable evidence of very large loads moving forward with construction suggests we will probably experience 2% per year or over 100 GW of growth nationally and higher in certain hot spots of load concentration.

II. Electric bills are becoming unaffordable for many Americans

Unfortunately, retail bills are starting to rise for most utility customers around the country, because:

- Old transmission and distribution assets need to be replaced.
- Generation capacity is scarce, raising prices for capacity, energy, and the power plant equipment needed to meet demand.
- Severe weather (hurricanes, wildfires, high winds, icing, flooding, and other threats) requires increased investment in stronger towers, poles, cables, and other facilities.
- Electrical equipment (transformers, towers, cables, breakers, switches) and associated materials (aluminum, steel, and copper) are scarce and expensive.
- Tariffs are raising costs for these materials and equipment.[3]
- Termination of generation tax credits raises costs of the new generation that is in most utility resource plans.
- Delayed or denied project permits restricting supply.
- Depending on the outcome of DOE orders under FPA Section 202c, forcing old power plants to run more than the economics dictate will require funding from ratepayers.

Utilities and their state and federal utility commission regulators are having to raise electricity rates to enable cost recovery for these factors.

III. Grid investment is the best way to hold down consumer bills and reliably meet load

The transmission grid is the great integrator of all resources. While it may seem like transmission expansion is needed just for renewable energy, that is just because wind, solar, and battery projects made up almost all of the requests to connect to the grid over

[3] Import penetration of large power transformers is 82%. Page 198, https://www.bis.doc.gov/index.php/documents/section-232-investigations/2790-redacted-goes-report-20210723-ab-redacted/file . The critical element is grain-oriented electrical steel (p.6).

the last five years. Today, new large loads and natural gas plants are trying to connect and they are experiencing the same slow and complicated interconnection process that results from limited capacity. Soon we may see nuclear, advanced geothermal, hydro, thermal, and other resources connect and the constraints will affect them as well. Regardless of one's preference for generation type, one should support development of a much less constrained high voltage transmission grid.

High-voltage transmission investment is a great deal for consumers because it costs ¼ as much to build high voltage (eg, 765 kV) as it does to build lower voltage (eg, 230 kV) lines. This economic phenomenon of "economies of scale" has always been and remains present in some parts of the electric industry but especially the transmission sector (in contrast to generation where bigger is not necessarily lower cost). Investment in well-planned, high-capacity transmission could save residential consumers $6.3- 10.4 billion per year across the United States after accounting for the cost of the transmission.[4] Presently across many utilities and states, we are doing transmission in the most expensive way possible—reactive, incremental and small. Shifting to proactive, multi-purpose, and large investments would achieve more and cost less.[5]

Transmission expansion can be fast and help meet loads in the 2020s. While some lines will still take over 5 years to plan, permit, and build even with permitting and regulatory reforms, many types of transmission plans can increase capacity quickly. Approximately 90% of the first tranche of MISO Long Range Transmission Plans were upgrades of capacity over existing rights of way. High-performance conductors and grid-enhancing technologies can squeeze delivery capacity out of the existing network quickly and very affordably.[6] The sooner grid planners proactively plan for future load and generation the sooner capacity can be expanded.

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.[7] Transmission networks are multi-directional, and once built they serve many needs that one could not have predicted ahead of time, moving power

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[4] https://gridstrategiesllc.com/wp-content/uploads/GS_Transmission-Deployment-Saves-Consumers-Money_vf.pdf

[5] See Midcontinent ISO Long Range Transmission Plans for a good model at https://www.misoenergy.org/planning/long-range-transmission-planning/ .

[6] https://ampcoalition.org/wp-content/uploads/2024/10/amp-and-watt-unlocking-the-grid-with-advanced-transmission-technologies-3834050241-e1728271773755.pdf

[7] NERC Transmission Availability Data System. https://www.nerc.com/pa/RAPA/tads/pages/default.aspx

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.[8]

Federal regulatory policy is needed because the current US policy and legacy industry structure we have inherited are not well-suited for large-scale long-distance transmission. The 3000 transmission-owning utilities have well-established processes for investing in their local systems. But it has been requiring policies such as bipartisan FERC Orders 2000 (in 1999), 890 (in 2007), 1000 (in 2011), and 1920 (in 2024) to enable planning for the larger regional investments that matter so much for reliability and customers' bills.

The US is falling far behind global competitors. China built 80 times more high voltage transmission than the US in the second half of the 2010s, and in the 2020s, China has completed more than 8200 miles of ultra-high voltage lines while the US has built only 375 miles. European utilities are rapidly increasing the minimum transfer capacity between countries to move power back and forth. Over 125,000 miles of high-performance conductors have been installed in India, Europe, and China but the US has installed less than 10 percent of that.

IV. In addition to transmission, expanding the three basic types of generation are needed to meet growing load

Utilities have always said that a diverse supply is needed because each resource contributes and no resource does everything. Meeting growing load will require more of each of three general generation types: (1) low-cost plentiful energy, (2) firm power, and (3) fast-ramping flexible balancing.

1. Low-cost plentiful energy. Wind and Solar energy are quickly deployable and low cost, and are helping to satisfy energy demand in much of the country. They are in advanced stages of development all around the country with signed or nearly finalized interconnection agreements, are relied upon by most utilities in the country for their supply over the next few years, and can provide the most incremental addition to electric energy this decade of any source. China had over

[8] https://www.nerc.com/pa/RAPA/Pages/ITCS.aspx

1400 GW of wind and solar at the end of 2024 while the US had around 390 GW, and China's pace of renewable development is much faster.[9]

2. Firm power (capacity). While each individual generator and class of generation is subject to forced and planned outages, nearly 100% bulk system reliability is achieved through the pooling of a diverse set of generators on the system. One can calculate each resource's contribution to serving times of need. Few if any customers want power only 95% of the time, yet 95% is the highest capacity value for any class of resource (nuclear, as compared to gas combustion turbine capacity value 60% and offshore wind at 69% in the latest PJM Effective Load Carrying Capability analysis).[10] Nuclear energy provides particularly high capacity value (contribution to system power supply at times of scarcity) but the opportunities to expand it in this decade are minimal. Natural gas is the leading source of new firm capacity and has been in recent decades. It is likely to expand but its expansion is limited by the amount of new gas turbines that can be manufactured. The capacity value of natural gas (60% for combustion turbines and 74% for combined cycle in PJM's recent analysis[11]) is significantly lower than nuclear (95%) because of common mode failures that plague gas plants such as winter freezing of wells and pipelines. Gas-electric industry coordination and firm pipeline contracts will be critical to make gas plants more firm to the power system.[5] Coal provides firm capacity (83% capacity value in PJM) but there is no realistic opportunity to expand it because of the costs and risks to investors over their 50-year lifetimes. Renewables also provide capacity value, particularly solar and storage together meeting air conditioning loads on summer afternoons. Solar is currently regularly meeting 30-40% of summer afternoon peak demand in Texas, and batteries are serving load into the evenings on a daily basis.[12] Similarly, California has been keeping the lights on

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[9] https://www.spglobal.com/commodity-insights/en/news-research/latest-news/012425-infographic-china-solar-capacity-coal-electricity-renewable-energy-hydro-wind , https://www.energy.gov/eere/wind/land-based-wind-market-report . "The 277 GW of utility-scale solar capacity installed in China in 2024 alone is more than twice as much as the 121 GW of utility-scale solar capacity installed in the United States at the end of 2024."EIA, https://www.eia.gov/todayinenergy/detail.php?id=65064 .

[10] PJM, slide 6, https://www.pjm.com/-/media/DotCom/committees-groups/committees/pc/2025/20250313-special/2026-2027-irm-fpr-elcc-and-winter-risk.pdf .

[11] PJM slide 6 https://www.pjm.com/-/media/DotCom/committees-groups/committees/pc/2025/20250313-special/2026-2027-irm-fpr-elcc-and-winter-risk.pdf .

[12] There were 9600 MW added, including 5,395 MW of solar, 3,821 MW of energy storage, and 253 MW of wind last year. ERCOT CEO Pablo Vegas said recently, "The state of the grid is strong, it is reliable—it is as reliable as it has ever been and it is as ready for the challenges of extreme weather," Vegas said. "I feel confident that we are ready for this upcoming summer season." https://insideclimatenews.org/news/28062025/texas-battery-storage-solar-reduces-summer-blackout-risk/ . See Doug Lewin posts at https://x.com/douglewinenergy?lang=en and newsletter as well as ERCOT web site for more data.

over the last five years with a massive infusion of solar meeting afternoon air conditioning load and batteries powering the system into the evening.

3. Fast -ramping flexible resources. Battery energy storage systems (BESS) are also quickly deployable and are extremely versatile shock absorbers on any part of the system (generation, transmission, distribution, and load). Demand response can provide significant flexibility to the system, if retail rates and structures support its expansion. Advances in data center and other load flexibility will enable much greater and faster growth at lower cost to those loads and minimize impacts on residential and small commercial customers.

US power demand will require more of all of these sources that can be deployed in this decade.

IV. On-site behind-the-meter generation is a last resort option but is inferior to grid power

Reliable electric power has always come from the pooling of generation plants because no single power plant or resource type is always able to operate. All plants experience forced and unforced (maintenance) outages, and some require outages for refueling. On the grid, every generator backs up every generator on utility and regional power systems. Off the grid, or "behind the meter," it is extremely expensive to build sufficient supply redundancy on a customer's site, whether that customer is small uses 1 kW like a typical home, or 1 GW like a new large data center. On-site behind the meter supply is likely to constitute only a small portion of total supply.

V. Generation supply can be managed with existing processes

Short- and medium-term supply is adequate for reliability. The bulk power system has been extremely reliable outside of a couple recent extreme weather incidents.[13] No region in the 2025-2029 NERC Long-Term Resource Adequacy Report[14] is at high risk at this point. A recent DOE study[15] provides useful information and analysis but the dramatic conclusions in the summary overstate the shortage numbers in the underlying report. Moreover, in the underlying report, retirement estimates are likely over-stated and supply additions are likely under-stated. The 104 GW of assumed retirements by 2030 in DOE's analysis is double EIA data tallying 52 GW of retirements planned by 2030. Supply growth is also likely

[13] https://docs.nrel.gov/docs/fy24osti/87297.pdf
[14] NERC LTRA updated July 15, 2025. https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_Long%20Term%20Reliability%20Assessment_2024.pdf page 6.
[15] https://www.energy.gov/sites/default/files/2025-07/DOE%20Final%20EO%20Report%20%28FINAL%20JULY%207%29_0.pdf

much greater than DOE's study finds. DOE assumes only 56 GW (22 GW "baseload" + 34 GW battery storage) of firm generation capacity will come online by 2030 while EIA forecasts 109 GW (43.4 GW non-renewable, non-battery + 65.5 GW battery) will. The DOE did not consider generation resources presently under consideration which aims to connect to the grid in the 2027-2030 timeline (what NERC terms "tier 2" roughly); instead they only considered generation that is under construction or with signed interconnection agreements (what is termed "tier 1").

There are processes to ensure resource adequacy in the industry, operating mostly at the state level, so micro-management of specific power plants using policies such as FPA 202c at the federal level is not necessary.

For states and utilities that rely on utility ownership and state-overseen resource planning (as opposed to independent generation and markets), the ones experiencing growth have in most or all cases revisited their resource plans and adjusted demand upward and changed their retirement and addition plans accordingly.

For states and utilities that rely instead on independent generation and wholesale power markets (as opposed to utility ownership and state-overseen resource planning), current capacity prices are high which is a strong signal for existing generation to stay on-line and for new generation to be added. Stock markets are rewarding any company that can expand supply in these power markets in this decade. Supply response is happening very fast through the intended mechanisms in these power markets. States and utilities in these regions can help by placing responsibility for generation procurement with whomever is responsible for serving load.

VI. Congress can help expand the grid

A. Permitting reforms. Clearly we need to be able to build supply and delivery capacity in this country faster than we have been able to in recent years. Without infrastructure expansion to alleviate scarcity, we will have an increasing affordability problem showing up in consumers' electric bills. This Committee deserves praise for passing EPRA last year in such a bipartisan and decisive fashion. That is a great platform on which to build. EPRA clarified some issues related to allocating the costs of transmission which could helpfully foster consensus between diverse states. Greater parity between linear infrastructure including transmission and pipelines would improve national reliability and our ability to meet growing load. Unnecessary process steps such as the double NEPA required by current backstop transmission siting policy should be removed. Expansion of categorical exclusions and lead agency coordination of permitting can help.

B. Expand and support tools this committee generated. From the DOE lead agency role for transmission lines in FPA Section 216h that this committee developed and passed in EPAct 2005 to the Transmission Facilitation Program this committee developed and passed in the IIJA in 2021, this committee's policies have been helpful and should be supported and expanded.
C. Staff the permitting agencies. By and large, federal permitting agencies and career staff are trying to get infrastructure permitted while following the rules. Shortcuts only create legal vulnerabilities. The agencies need sufficient staffing to support infrastructure permitting to execute their responsibilities in legally sustainable ways. Project approvals for the wide variety of federal permits needed at the staff level should continue to be allowed rather than blocking or clogging approvals on the desks of top political appointees.
D. Keep independent agencies independent. Investment in 50+ year assets requires regulatory stability that comes with independent agencies like FERC remaining independent.
E. Congress can support the development of domestic manufacturing for electrical equipment.

Thank you for the opportunity to testify.