COLUMBIA CLIMATE SCHOOL
Climate, Earth, and Society

CONGRESSIONAL TESTIMONY OF
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BEFORE A HEARING OF THE SUBCOMMITTEE ON ENERGY, CLIMATE, AND GRID SECURITY, U.S HOUSE COMMITTEE ON ENERGY AND COMMERCE, UNITED STATES HOUSE OF REPRESENTATIVES, 118TH CONGRESS

Good morning, Chairman Duncan, Ranking Member DeGette, and members of the Subcommittee. Thank you for your invitation to speak with you today.

My name is Melissa Lott. I am a Professor of Professional Practice at Columbia University's Climate School. I have worked as an energy systems engineer and advisor for 20 years in the United States, Europe, and Asia at organizations including the United States (U.S.) Department of Energy, International Energy Agency, and the Asia Pacific Energy Research Center. In addition to my roles at Columbia, I currently serve on the United Nations (U.N.) Council of Engineers for the Energy Transition, which is an independent advisory council to the U.N. Secretary-General. My full CV has been submitted separately to the subcommittee and it is from the insights I gained from those various positions that I will provide this testimony.

My testimony today will cover three topics. First, I will discuss the current role of the electricity system and potential impacts of emerging technologies and trends on electricity demand in the United States. Second, I will discuss the broad options that can be considered across the nation's electricity system in efforts to ensure a reliable, affordable, and increasingly clean electricity system. Lastly, I will cover actions the federal government could consider to support a reliable and affordable electricity system in the face of rising demand.

U.S. Electricity Demand is Poised to Grow

Electricity is already a vital part of the U.S. economy and that role is expected to grow, in part due to major investments in manufacturing and data centers along with broader electrification trends.

Today, electricity accounts for just under a quarter (22%) of energy end-use[1] and serves as a critical backbone of the economy. Net electricity generation grew tenfold to around four (4)

[1] https://www.iea.org/countries/united-states

thousand terawatt-hours per year (TWh/year) between 1952 and 2005, before largely flattening out[2]. Nearly two-fifths (39%, 1420 TWh/year[3]) of U.S. electricity consumption is for residential buildings for space heating and cooling, water heating, and other electric appliances. Around one-third (35%, 1370 TWh/year[4]) of electricity is used by the commercial sector. The industrial sector represents around one quarter (26%, 1010 TWh/year[5]) of electricity use. In addition, a small fraction (around 0.2%, 10 TWh/year[6]) of electricity is currently used in the transportation sector, primarily for public transit and pipelines.

Electricity demand is poised for growth at higher rates than the country has seen in several decades. This is due to a number of factors, including rising demand from data centers and industry as well as the adoption of devices such as heat pumps and electric vehicles driven by falling costs and policy supports at the federal, state, and local levels.

As highlighted in the memo for today's hearing, the rapidly growing deployment of data centers to accommodate the increasing use of new generative artificial intelligence (GenAI) platforms is driving up demand for electricity. According to analysis by the Boston Consulting Group, "data center electricity consumption was [2.5%] of the U.S. total in 2022 and is expected to triple to [7.5%] by 2030", with GenAI driving much of this growth[7].

Furthermore, according to the U.S. Department of Energy, since the Inflation Reduction Act (IRA) was passed in 2022 more than 200 new transportation and clean energy manufacturing facilities have been announced, representing over $100 billion in new investment.[8] These investments will be much more electricity-intensive than legacy factory designs and are highly concentrated in three U.S. planning regions -- the Southeast, Midcontinent Independent System Operator (MISO), and the Southwest[9].

Additionally, electrification is increasing for buildings and for transportation. Electrification of home heating systems is incentivized by many states and cities to help save consumers money and to reduce pollution. Multiple states have established deployment targets, which if successful

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[2] https://www.eia.gov/totalenergy/data/browser/index.php?tbl=T07.01#/?f=M&start=200001

[3]https://www.eia.gov/energyexplained/electricity/use-of-electricity.php#:~:text=Total%20U.S.%20electricity%20end%2Duse,3.4%25%20higher%20than%20in%202021.

[4] ibid

[5] ibid

[6] ibid

[7] https://www.linkedin.com/pulse/impact-genai-electricity-how-fueling-data-center-boom-vivian-lee%3FtrackingId=R1qLj6%252B8STaQuYg0aArwDQ%253D%253D/?trackingId=R1qLj6%2B8STaQuYg0aArwDQ%3D%3D

[8] U.S. Department of Energy, Building America's Clean Energy Future. https://www.energy.gov/invest.

[9] https://gridstrategiesllc.com/wp-content/uploads/2023/12/National-Load-Growth-Report-2023.pdf

would facilitate the installation of at least 12 million new heat pumps by 2030.[10] In 2022, electric heat pumps outsold natural gas furnaces in the U.S. for the first time.[11]

Adoption of electric vehicles is also on the rise, which leads to substantial reductions in gasoline consumption and modest increases in electricity use in buildings (e.g., through home charging in residential buildings and office charging at workplaces) and throughout a growing network of public charging stations. This trend is largely a result of decreasing purchase costs and growing availability of electric vehicle options reinforced by the adoption of zero-emission vehicle (ZEV), clean car, and similar standards across many states[12]. Policy incentives at various levels of government amplify these trends and analysts anticipate ongoing growth in electric vehicle sales for personal transport[13].

These trends have two key impacts on electricity demand that should be considered when developing plans to meet this demand: impacts on **total** consumption (over time) and impacts on **peak** demand for electricity (at a particular moment in time). Whether electric vehicles strain the grid or improve the grid will depend on what time of day they are charged. If everyone charges their electric vehicles simultaneously, that would inflict enormous strain on the grid. But if vehicles are charged off-peak, then their use could lower costs for all consumers by amortizing the cost of the grid across more users. The same is true for many of the other technologies and processes that are driving increased electricity consumption in the United States.

According to analysis from Grid Strategies[14], forecasts for cumulative electricity growth over the next five years have increased from 2.6% to 4.7%. With regards to peak demand, in 2022 forecasts anticipated a summer peak demand of 835 GW by 2028. In 2023, these forecasts were revised to reflect a peak demand of 852 GW by 2028. It is reasonable to expect that this analysis underestimates future growth rates as multiple drivers for growth are happening in parallel.

Pathways for Meeting Increasing Demand for Electricity

This shift from relatively flat demand for the last 1-2 decades to rapidly rising demand will require additional supply for the bulk grid. However, the required amount of new supply can be reduced by stricter efficiency standards, smart charging programs for electric vehicles, expanding and modernizing the transmission and distribution system, accelerating the adoption of distributed energy solutions (e.g., virtual power plants), and deploying non-wire solutions (e.g., power flow control, demand response, etc.).

[10] https://rmi.org/millions-of-us-homes-are-installing-heat-pumps-will-it-be-enough/
[11] https://www.canarymedia.com/articles/heat-pumps/chart-americans-bought-more-heat-pumps-than-gas-furnaces-last-year
[12] https://theicct.org/wp-content/uploads/2022/02/clean-car-infographic-feb22.pdf
[13] For example, https://www.bloomberg.com/news/articles/2024-05-28/the-slowdown-in-us-electric-vehicle-sales-looks-more-like-a-blip
[14] https://gridstrategiesllc.com/wp-content/uploads/2023/12/National-Load-Growth-Report-2023.pdf

Simultaneously investing in the power grid, non-wire solutions, and diversified sources of electricity generation can help meet demand while improving reliability, reducing emissions, and protecting affordability for consumers[15].

Put another way, investing solely in additional energy supplies - without also investing in the power grid and non-wires solutions – will result in more expensive and/or less reliable electricity for consumers[16].

In particular, additional investments in inter-regional transmission can reduce the cost of meeting increasing demand for electricity by allowing power to be moved across regions. Investments in non-wires solutions including efficiency (to reduce overall consumption) and demand response programs (such as temporarily turning off water heaters when they aren't needed and providing financial incentives for consumers to shift the timing of their demand) can also bring down peak demand, lowering overall system costs and improving reliability.

Even without the anticipation of rapidly increasing electricity demand, the United States power grid is in need of modernization investments to ensure the delivery of reliable and affordable electricity. The recent forecasts for rapidly increasing power demand make these investments even more urgent and necessary.

In giving the U.S. energy system a C- grade in their 2021 Infrastructure Report Card, the American Society of Civil Engineers highlighted that "all three major components of the electric grid (generation, transmission, and distribution) have an investment gap" and that "transmission and distribution (T&D) systems still struggle with reliability [despite recent investments]. This problem is likely to accelerate as the impacts of climate change persist and the public's expectation of more reliable, "always-on" electricity increases".[17] This low grade - which was issued before the AI boom and accelerating adoption of electric vehicles - highlighted the need for rapid growth and investment in the grid.

With regards to power supply, a diverse mix of fuels and technologies appears to be more robust and secure than depending too heavily on any one option. A diverse mix will include a mix of zero-marginal-cost variable power plants (e.g., wind and solar), energy storage technologies (e.g., batteries, thermal storage), and firm, dispatchable power plants (e.g., nuclear, hydro, geothermal, and natural gas). Each option within these three categories comes with a set of tradeoffs in terms of performance features and risks.

[15] https://gridstrategiesllc.com/wp-content/uploads/2023/12/National-Load-Growth-Report-2023.pdf
[16] https://theconversation.com/two-years-after-its-historic-deep-freeze-texas-is-increasingly-vulnerable-to-cold-snaps-and-there-are-more-solutions-than-just-building-power-plants-198494?utm_source=twitter&utm_medium=bylinetwitterbutton
[17] https://infrastructurereportcard.org/cat-item/energy-infrastructure/

Actions for the Federal Government to Consider
Much of the U.S. regulatory framework for the electricity sector is overseen by state legislatures and public utility or service commissions. However, the federal government has a significant role to play. Recent examples of leadership from Congress include the Energy Policy Act of 2005, the Energy Independence and Security Act of 2007, the Energy Act of 2020, the Infrastructure Investment and Jobs Act (IIJA), CHIPS and Science Act, and the IRA.

Today, Congress can continue providing leadership.

First, Congress could take action to streamline rapid investment in the transmission grid (including inter-regional lines) as well as new energy supplies (including dispatchable sources such as nuclear, geothermal and hydroelectric power plants along with zero-marginal-cost variable sources (such as wind and solar) and energy storage). Supply technologies and infrastructure investments both face challenges when it comes to achieving rapid buildouts due to slow timelines for the reviews required to move a project from proposal to completion. Previous analysis by Columbia University in partnership with New York University has explored what actions could be taken by the U.S. Department of Energy and Federal Energy Regulatory Commission within existing federal authorities[18]. But, even if existing authorities are used proactively, they are unlikely to support the speed and scale of investment in the transmission grid that is needed to reduce the cost of meeting increases in electricity demand. Congress could consider not only reforms to the processes required by the National Environmental Policy Act (NEPA) – for example, the adoption of categorical exclusions[19] - as well as supporting efforts to build out processes and the workforce necessary to accelerate state and local permitting processes (e.g., technical assistance, training, education).

Second, Congress could consider taking action to ensure that demand response and other non-wires solutions are incorporated into power sector planning processes and market reforms. These technologies can help optimize the operation of the electricity system and better manage peak demand to drive down overall system costs. Furthermore, because these technologies are often small and modular, they can be deployed more quickly at the local level than the many years or decades currently required for large power plants far away.

Third, Congress could consider taking action to ensure access to the opportunities created by increasing electricity demand for rural and historically disadvantaged communities. As highlighted in the memo for today's hearing, the growth of AI data centers could bring economic development to historically disadvantaged regions including less developed rural areas. Congress could help by introducing and supporting programs that expand and increase access to opportunities (e.g., through technical assistance and education programs as well as targeted funding to support increased investments in these regions).

[18] https://www.energypolicy.columbia.edu/publications/building-new-grid-without-new-legislation-path-revitalizing-federal-transmission-authorities
[19] https://www.blm.gov/press-release/blm-adopts-categorical-exclusions-expedite-geothermal-energy-permitting#:~:text=The%20categorical%20exclusions%20will%20enable,BLM%20Director%20Tracy%20Stone%2DManning.

Conclusion

I would like to thank the subcommittee for holding this hearing on how to ensure that the U.S. power sector can meet the rising demand for electricity. Investments over the past century have created an electricity system that supports both our health and the economy. However, additional investments are critically needed if the electricity system is going to adapt to a new paradigm of rapidly growing demand. The choices made today will set the course for how this system will evolve and can help ensure a reliable, affordable, and increasingly clean electricity sector in the face of a changing climate. Streamlining the permitting process and accelerating the changes already underway in energy markets can help to accelerate the investments needed. Thank you again for inviting me to be a part of this important discussion. I look forward to your questions.