

S. HRG. 118–338

**THE OPPORTUNITIES, RISKS, AND CHALLENGES
ASSOCIATED WITH GROWTH IN DEMAND FOR
ELECTRIC POWER IN THE UNITED STATES**

HEARING
BEFORE THE
COMMITTEE ON
ENERGY AND NATURAL RESOURCES
UNITED STATES SENATE
ONE HUNDRED EIGHTEENTH CONGRESS
SECOND SESSION

MAY 21, 2024



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THE OPPORTUNITIES, RISKS AND CHALLENGES ASSOCIATED WITH GROWTH IN DEMAND FOR ELECTRIC POWER IN THE UNITED STATES

TUESDAY, MAY 21, 2024

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The Committee met, pursuant to notice, at 10:02 a.m. in Room SD-366, Dirksen Senate Office Building, Hon. Joe Manchin III, Chairman of the Committee, presiding.

OPENING STATEMENT OF HON. JOE MANCHIN III, U.S. SENATOR FROM WEST VIRGINIA

The CHAIRMAN. The meeting will come to order.

Today we are here to discuss the opportunities, risks, and challenges associated with the growth in demand for electric power in the United States. In the half century after World War II, demand for electricity grew steadily in this country, along with our economy, but in the decade following the implementation of the North American Free Trade Agreement, which was in the 1990s, annual electricity demand growth fell by nearly 45 percent—45 percent. And for the past two decades, electrical demand—or “load”—has been flat across the country.

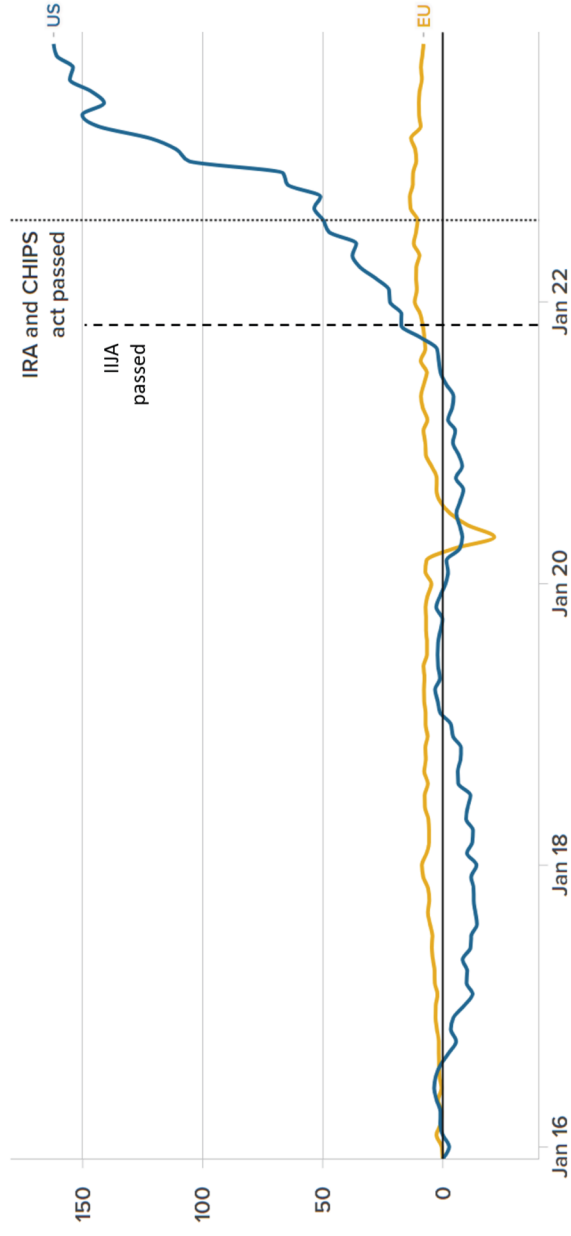
We are here today because that era appears to be coming to an end rapidly. With exponential growth in the domestic technology and manufacturing sectors, utilities and grid experts across the country are telling us that electricity demand is poised for truly remarkable growth. Meeting this demand growth may prove to be one of the greatest challenges—and also opportunities—that we will face in 21st century for our citizens, our economy, and the defense and security of our country.

I want to thank our witnesses for being here to share their perspectives on this historic load growth and what is at stake if we do not meet it. The load growth is being driven by three main factors as we evaluate it. First, it is the reshoring of industry and advanced manufacturing spurred by the Bipartisan Infrastructure Law, the CHIPS Act, and the IRA. Construction spending on manufacturing has more than doubled since we signed these bills—and I think you see this behind you—signed these bills into law as shown in the chart behind me.

[The chart referred to follows:]

Total Manufacturing Construction Spending

US vs EU, percentage change



Source: Eurostat, FRED, Author's calculations • 2015 = 0

The CHAIRMAN. This is unbelievable. Unbelievable. People don't realize how much is coming into the U.S. and how rapidly demand—that tells you the spread of energy that we need and what we don't have, maybe. So look, the EU has been flat as a pancake. Most of all, the world's been flat as a pancake, and here we are. We are seeing new factories to build advanced energy and semiconductor technology spring up practically every week.

Second, it is a revolution in advanced computing applications, especially artificial intelligence and the rapid growth in data centers to provide the processing power needed for those technologies. And I understand that they just have an unquenchable thirst for power as far as the data centers. And third, it is the push to electrify technologies across multiple sectors, like the administration's push to flood the market with EVs, which I think they are way over their skis on, and I have been cautioning and warning them from day one.

The North American Electric Reliability Corporation, or NERC as we know it, projects in its 2023 long-term reliability assessment that there will be 90 gigawatts of demand growth by 2030. Put that in perspective. That is over ten percent of this peak of the U.S. electrical demand, which is about 750 gigawatts. But even that number is likely conservative. NERC relies on data submitted in the previous year from industry and the forecast just keeps growing unbelievably faster than what they can keep up with.

This is unbelievable. Last month, the Texas grid operator revised its 2030 load forecast from last year to add 40 gigawatts of new expected load growth. One state. That is like adding the demand of the entire State of California to the Texas grid six years from now. That should be a wake-up call. I hope it is. We need to be prepared to meet this demand. Let me be clear: the load growth is an opportunity of a generation, and it is ours to lose.

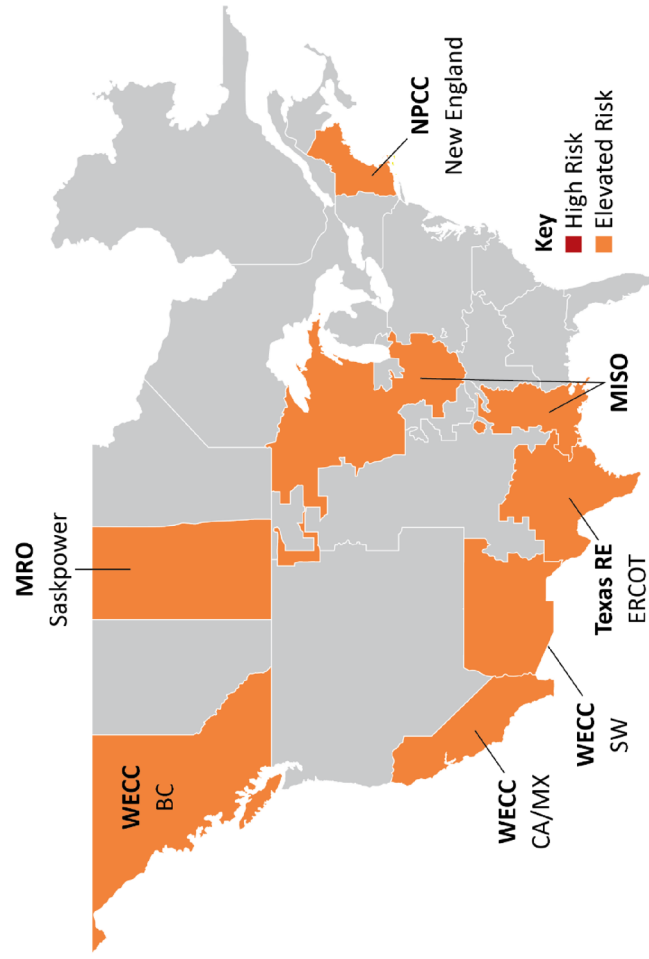
The reason we have the growth is that industries that will define the 21st century—chips, AI, advanced manufacturing—are tripping over one another to build in America. They are coming from all over the world, but there is no guarantee of success. To put it plainly, we can't be open for business if we can't keep the lights on.

If America can't build the energy infrastructure needed to support these industries with reliable and affordable power, we will be forfeiting the opportunity to be on the forefront of technologies of the future and ceding control to China and other nations that we cannot necessarily trust. And right now, between the Administration's policies and our inability to act in Congress, it seems like we may be in the real danger of doing just that.

We have heard from both FERC and NERC that our grid's reliability and affordability are at risk because we are retiring baseload dispatchable generation faster than we can replace it. They came in and spoke with me and told me that basically we are taking off dispatchable 24/7, whether it be coal, nukes, whatever it may be that we can depend on, and now even natural gas because of an environmental movement, trying to replace it with intermittent power. And they are very, very concerned across the board.

NERC's summer assessment came out last week. These are brand new numbers, and they show half the country at elevated risk of blackouts this summer, as shown in this chart.
[The chart referred to follows:]

NERC: 5 U.S. Regions at Elevated Risk of Outages This Summer



The CHAIRMAN. If you live in or represent one of these areas, tell them to watch out. They are going to be in trouble. The potential is great that they may be having rolling brownouts and even blackouts, and that should be concerning to everybody in this Administration and every Senator and Congressman who represents those areas.

Last July, NERC even added energy policy as a brand-new category of major risk facing our grid. When NERC, which is basically nonpartisan, says the policies that you are putting out in Washington—and only Washington can fix it—are basically putting us at risk, you should take heed. It is ridiculous that government action is creating new categories of grid risk instead of preventing the risk.

As if to prove NERC's point, EPA recently finalized four new power plant rules that, as far as I can tell, aim to kill coal completely and stop natural gas from replacing it. It's a double-whammy. I don't know what they are thinking. These dispatchable resources are essential for reliability. And I have said this to them: the transition is going to happen, but you can't take something off before you have something equally as good if not better to replace it with.

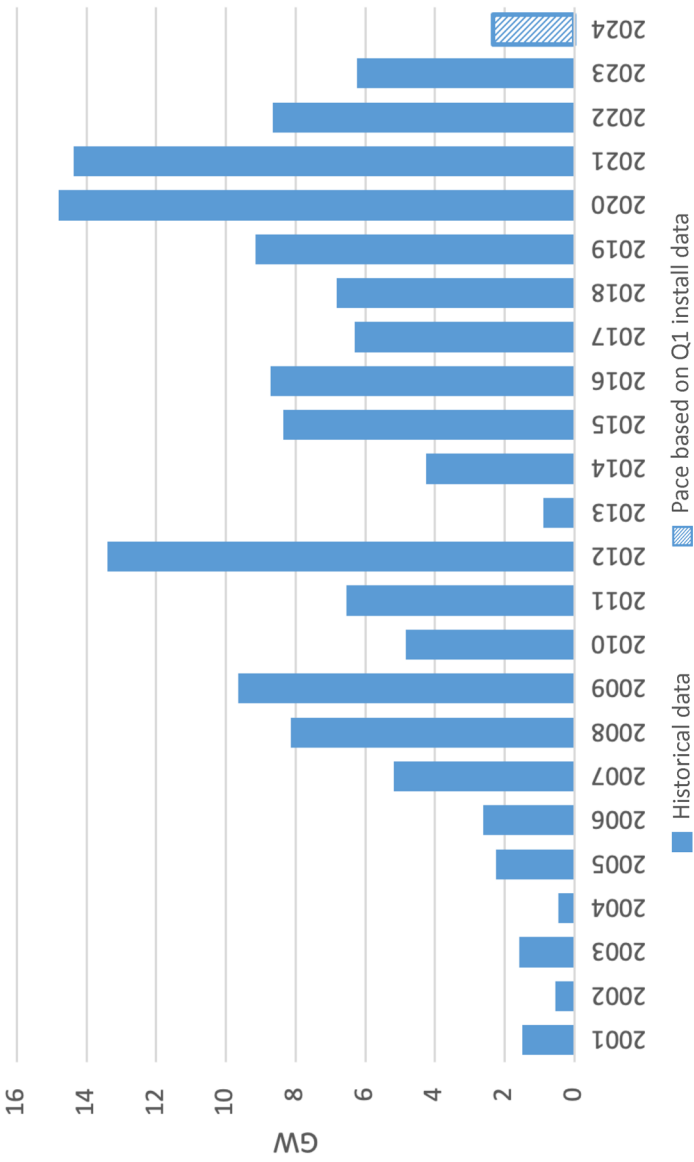
You might not like coal, but coal has built this country into what it is today. We are doing it better and cleaner than any place else in the world. And the transition is there, no one's fighting the transition. Just give us other jobs that we can do to take care of our families and make a living, and that's fine. The bottom line is, we don't have that technology yet. We are not there, but they are just damned to do it because of the political reasons. And that is what we are trying to make sure they understand, that it's not going to work.

These dispatchable resources are essential for reliability, I have said, and if this Administration were serious about onshoring critical industries, the ones driving the load growth, they would not be in a race to take power offline, they would be racing to bring new generation on. But instead, it is getting harder and harder to admit and build new energy infrastructure and connect new generation to the grid. It just is. We now have 2.6 million megawatts of generation waiting an average of five years to connect. Think about that. So 2.6 million megawatts waiting to go and nowhere to go with it.

For example, in West Virginia, in my little state, we have one plant over 1,800 megawatts, a state-of-the-art, combined cycle gas plant with carbon capture. The cleanest it can possibly be. The cleanest. But the company's telling me they have to wait half a decade before they even get the green light to even start the permitting. It's unbelievable. And to be clear, these are not just problems for fossil plants. It is as bad or even worse for wind. I can't believe this chart. This is where wind demand, this is what's happening in wind, how far it has gone down. They can't connect. There is nowhere to connect.

[The chart referred to follows:]

Wind Capacity Additions (GW)



The CHAIRMAN. Solar is doing much better because solar can get into the grid system faster. It's in areas where the grid's already there. Wind is coming in areas, whether it be offshore or whether it be somewhere out to where there is no grid system whatsoever, and they can't get there because they can't get permitting. And if the Majority Leader, Senator Schumer, believes that what was done cured all the problems, I got news, it didn't do it.

American Clean Power just published their 2024 figures, as you can see. We are on pace to install less wind in 2024 than we did during the worst year of the Great Recession, as shown in the chart. Here was the recession coming out of it here. Now we are down to there. We have to make it easier to build generation pipelines and transmission lines to meet the moment, and that is why the permitting is needed so, so desperately.

FERC finalized two rules last week, which in time may help build new transmission. But let me be clear, these rules are using the tools FERC currently has and are not a replacement for Congressional action. These rules help with one aspect of one part of a bigger set of the grid permitting problems. I know you all have looked into this, but as my friend Senator Hickenlooper said, "They are a Band-Aid on Congress's inaction," which you are totally right, Senator.

For example, the new rules took action on transmission lines within regions—transmission lines already within the regions, not for the interregional lines that truly have the most reliability and affordability benefits to offer. It didn't happen, did not affect them at all. And only if the rules prove durable in courts and under future administrations. They are all going to be challenged.

I want to quote FERC Commissioner Clements two days after the rules came out—and she is retiring in June—and she said: "Considerable work remains to be done both at the Commission and in Congress if we are to realize the modern electricity grid on which the continued vitality of the United States' economy and security increasingly depends . . . for some of these next steps, particularly in regional planning and permitting reform, Congressional action could be critical in providing direction and momentum to the commission."

And just so we are clear that permitting and transmission legislation is not a partisan priority, let me also quote Mario Layola, a senior fellow at the Heritage Foundation, who served in the White House during the Trump administration. He said, after FERC issued its new rules, "Transmission expansion has only become more difficult. These are problems only Congress can solve." I have to say I couldn't agree more. There are critical permitting problems for all types of energy infrastructure that only Congress can fix, and I remain committed to addressing that.

Myself and Senator Barrasso's team have been working diligently for quite a while. We finally have language. We are going to start sharing this language with everyone, so that people can see where we are and hopefully maybe we can all get our act together here. In fact, each of the industry witnesses before us today submitted testimony that speaks in stark terms to the permitting challenges facing new sources of electric supply and demand. I look forward to hearing more from our witnesses on this topic shortly.

With this, I am going to turn to Ranking Member Barrasso for his opening remarks.

**OPENING STATEMENT OF HON. JOHN BARRASSO,
U.S. SENATOR FROM WYOMING**

Senator BARRASSO. Well, thanks so much, Mr. Chairman. Thanks for holding today's important hearing. America's demand for electricity is expected to grow rapidly through 2030. In fact, we may be entering a period of sustained demand growth unlike anything we have seen since the two decades following World War II. As you said, Mr. Chairman, we cannot be open for business if we cannot keep the lights on.

The biggest source of new electricity demand is expected to come from data centers. Data centers enable cloud computing, Bitcoin mining, and artificial intelligence. How we meet this growing demand for electricity will have serious economic and security consequences for our nation. The stakes couldn't be higher. In fact, many believe that the race for artificial intelligence with Communist China will be more consequential than the space race with the former Soviet Union. And the AI race has already begun.

Data centers running artificial intelligence consume massive amounts of electricity. Some estimates suggest that electricity demand for these data centers will double between now and 2030. Whoever secures affordable and reliable electric power, China or America, will have a big head-start in the race for artificial intelligence. And right now, America is not positioned well.

Our grid is already strained. For years, the North American Electric Reliability Corporation, NERC, has raised alarm about grid reliability. It has warned that the premature retirement of coal and natural gas-fired power plants has increased the risk for blackouts and brownouts in much of the country. Yet the retirements continue, and President Biden is making the situation worse.

Last month, the Environmental Protection Agency issued new rules that will force the premature closure of even more coal and natural gas-fired power plants. These plants play a major role in ensuring electric reliability. They also help make electricity more affordable. President Biden doesn't seem to care at all. He wants the cost of complying with EPA rules to be high. He wants to force operators to shut down these plants before the end of their useful life. It is a disgrace.

We cannot regulate our way to more electric generation. When it comes to data centers, the quality of the generation source is as important as the quantity of electricity generated. Now, I acknowledge wind and solar can help, yet they are weather-dependent. Batteries, too, can help. Yet batteries are expensive and can't provide power for extended periods. They also require vast amounts of minerals from China, from the Congo, from Indonesia, and other countries with horrible human rights and environmental records.

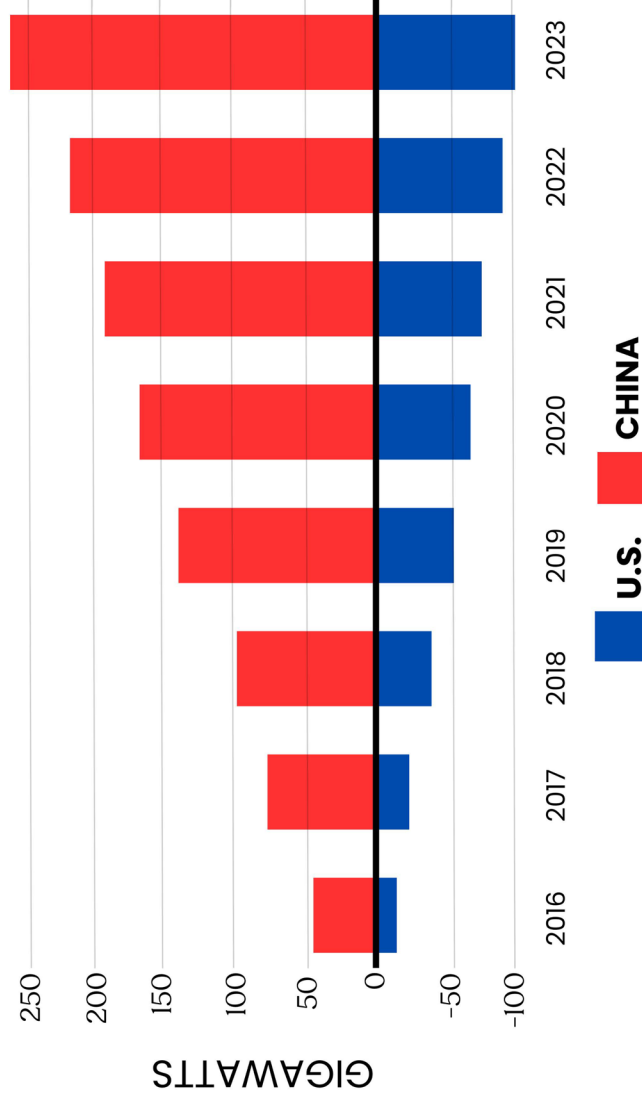
We need a reliable, steady, and balanced supply of electricity. Nuclear, coal, natural gas, and hydropower can provide that. With demand poised to surge, it only makes sense to keep our existing power plants operating while also building new generating capacity. Our goal should be addition, not subtraction. Mr. Chairman,

the 20th century was the American century. Which country will lead the 21st century is still up for grabs. Much depends on how America capitalizes on the potential of artificial intelligence. The president's opposition to coal, to natural gas, and even to hydro-power, the fuels that generate 65 percent of our electricity, is a white flag. It is a surrender, an act of surrender to China.

Mr. Chairman, this chart shows that China has added 262 gigawatts of coal-fired electric generation since the Paris Climate Agreement in 2015.

[The chart referred to follows:]

U.S. vs. China: Cumulative Change in Coal Power Since 2015 Paris Agreement



Source: Global Energy Monitor

Senator BARRASSO. The red lines show how much China has added from coal-fired power plants to electric generation. Meanwhile, the United States has shut down over 100 gigawatts of coal-fired electric generation. What does this mean? It means that when China's AI developers need electric power, the Chinese Communist Party is going to make absolutely sure that they will get it, and they will get it from coal. When America's AI developers need power, will it be enough, will it be reliable, will it be affordable? Right now, under Joe Biden and the Democrats, the answer is no.

The race for artificial intelligence is one America cannot afford to lose, and we cannot win this or any other race with China if we are unwilling to use the very energy sources that China is going to exploit to the fullest.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator. I would like to turn to our panel of witnesses. I am going to introduce you all and then I am going to go to Senator Risch, if I may.

Mr. Ben Fowke, he is interim CEO and President of the American Electric Power Company, one of our home-state utilities in West Virginia. Ben, it's good having you here. We have Karen Onaran, President and CEO of the Electricity Consumers Resource Council. We have Mr. Scott Gatzemeier, Corporate Vice President of Front-End U.S. Expansion at Micron Technologies, and we have Mr. Mark Mills, back again, Executive Director of the National Center for Energy Analytics.

At this time, I am going to turn to my friend, Senator Risch.

**OPENING STATEMENT OF HON. JAMES E. RISCH,
U.S. SENATOR FROM IDAHO**

Senator RISCH. Well, thank you, Chairman Manchin. I appreciate that, and to Ranking Member Barrasso, thanks to both of you for holding what is really an important hearing today, which covers a lot of ground and underscores some real shortcomings that we have but that we can address.

It is my privilege today to introduce to you a distinguished Idahoan, Scott Gatzemeier, who is Vice President of U.S. Expansion for Micron Technology. Micron Technology was founded in Boise, Idaho, and had a very humble beginning, to say the least. And it has grown today to be one of the top four semiconductor companies in the world. Idaho ingenuity drove this growth and continues to drive the company's innovation in advanced memory and storage technologies. Micron's advancements have given the United States a competitive edge in data storage, security, and supercomputing.

However, all is not well in the semiconductor industry. For those of us that serve on the Foreign Relations and Intelligence Committees and who work in the national security lane, over recent years, we have heard over and over and over again the shortcomings of the semiconductor industry. And it was driven by the semiconductor industry following the siren of cheap wages and moving production offshore. This has caused us some real difficulties, and it is very much a national security problem.

With semiconductors, I think everybody is aware, and no one more than the defense industry and the defense contractors, of how important microchips and semiconductors are in the construction of

certain products. They are in everything now. They are in refrigerators, TVs, and in automobiles. But very importantly, they are in just about everything that we manufacture that has to do with defense. Thus, those of us who saw this came up with the CHIPS Act, a \$52 billion addition to our budget to stimulate bringing this industry back to the United States. This was not driven by a desire to subsidize the semiconductor industry. It was designed to meet what was a great challenge in semiconductor production, and to bring it back here to the United States and close this gap in national security.

It appears to me it's working. We thought it would. No one ever knows until you actually try it, but right now, this is happening, and Micron is leading the charge in onshoring chip production again. The company recently broke ground on a new fab in Boise, Idaho, and has plans to build four additional fabs nationwide. Mr. Gatzemeier, who brings more than 25 years of experience across fab engineering, operations, and technology development, is Micron's leading expert on domestic expansion. His experience and expertise position him to offer a unique perspective on how Congress and industry must rise to the challenge of returning the American-born semiconductor industry to the United States.

A key component of meeting that challenge is sufficient and dependable energy. And it is no accident that companies like Micron continue to invest in Idaho. Our state's all-of-the-above energy policies and support for clean, reliable, affordable, always-on hydropower make it a prime location. This issue of national security and semiconductors fits very well with the subject of what we are talking about today because it does demand a tremendous amount of energy. And Mr. Chairman, I think you did a really good job of underscoring what the experts are telling us we are going to need for energy in the future.

So Scott, thank you for being here today, and we look forward to hearing your testimony on this important issue.

The CHAIRMAN. Senator Risch, thank you. I know you have a very, very important Foreign Relations Committee meeting that you have to be involved with coming up right now, so I am sure Scott will get you up to date as quickly as possible after you have to go.

Senator RISCH. Thank you.

The CHAIRMAN. With that, let's start with our testimonies, and Mr. Fowke, you are first.

STATEMENT OF BENJAMIN G.S. FOWKE III, INTERIM CEO AND PRESIDENT, AMERICAN ELECTRIC POWER COMPANY

Mr. FOWKE. Chairman Manchin, Ranking Member Barrasso, and Committee members, thank you for the invitation to testify at today's hearing.

My name is Ben Fowke, and I serve as Interim CEO and President of American Electric Power Company. AEP is one of the largest electric utilities in the United States, serving customers across an 11-state footprint. We have a diverse electric generation fleet, and we own and operate the largest transmission system in the United States. This is a significant moment for our country, our industry, and our company. We at AEP are excited about the oppor-

tunities and challenges ahead of us as we meet the growing demand for electricity in our regions.

Demand for electricity was almost flat for two decades. We are now beginning to see this trend reverse, driven by large customers such as industrial manufacturers, data processors, and others who require significant amounts of power. The efforts of Congress to support the development of these businesses have been remarkably successful and companies are now building and growing here in America because in part we have abundant and diverse energy resources and reliable and affordable power. However, in some areas of the country, the demand for electricity is growing faster than the available capacity. Just a few years ago, a large-scale industrial manufacturing facility might require 100 megawatts, or about enough to power 100,000 homes. A facility that size would typically be one-of-a-kind in a region and would be a major source of economic activity for that area. Now it is common for a single data center to require up to 15 times this amount of power for a single site.

As technology evolves, power demand from data processing is expected to double nationwide in three years. One small example of this demand surge, Open AI's Chat GPT, requires 2.9 watt-hours for a request. Now that is nearly ten times more power than a typical Google search. AEP currently has requests from large customers that would more than double the existing peak demand we serve on our system today.

It took over 100 years of planning and building to create our current system, and a step-change in infrastructure investment on an accelerated timeframe will be required to serve even a fraction of this future demand in a reliable manner. As demand is rapidly increasing, our nation's electricity system is transforming to accommodate new forms of energy. The pace of this transformation must not overtake the reliability needs of our system. Independent assessments by NERC find that the risk of electric power supply disruptions are steadily increasing. Our society depends on a reliable power system. As we embark on this era of economic growth and technological transformation, customers need an energy system that is available to deliver reliable, affordable, and environmentally sensitive power where and when they need it.

Continued development of the electric system must be a central priority of U.S. energy and economic policy, and we need to think bigger and more comprehensively to address the many opportunities and challenges in front of us. For your part, we ask that Congress work with regulators to ensure electric system resource adequacy and prevent premature retirements of dispatchable power plants. This includes considering the impact of recent EPA regulations, which could hasten the pace of plant retirements and diminish reliability; collaborating with FERC and other federal and state constituents to evaluate the establishment of a central planning authority focused on reliability; and directing FERC to ensure that viable reliability safety-valve mechanisms are in place to prevent premature plant retirements.

Congress should also expedite the development of new 24/7 dispatchable and clean energy resources to meet the growing consumer demand. This could be done through encouraging FERC to

allow for fast-tracking of generation resources in the interconnection queues that have been selected by utilities to meet their obligation to serve customers; encouraging the development of advanced technologies such as next generation nuclear; passing a siting and permitting package that accelerates the development of critical infrastructure; and maintaining the Inflation Reduction Act and the technology-neutral and nuclear tax credits, which serve to reduce costs for customers.

Finally, Congress should encourage FERC's recent efforts to support the efficient development of necessary regional and inter-regional electric transmission facilities to ensure reliability and accommodate economic growth and development. The electric power industry will play a crucial role in helping the U.S. remain a global leader in advanced manufacturing and technology innovation. With the help of Congress and our federal and state regulators and agencies, we can serve this emerging demand and secure America's role as a leader for generations to come. To do so, we will need to work together to quickly build new sources of electric generation and high-voltage power lines to deliver electricity where it is needed.

Thank you.

[The prepared statement of Mr. Fowke follows:]



**Statement of Ben Fowke
Interim Chief Executive Officer and President
American Electric Power Company
Before the Senate Committee on Energy & Natural Resources
May 21, 2024**

Chairman Manchin, Ranking Member Barrasso, and members of the Senate Committee on Energy and Natural Resources, thank you for the invitation to testify at today's hearing. My name is Ben Fowke, and I serve as the Interim CEO and President of American Electric Power Company, Inc. (AEP). AEP is one of the largest electric utilities in the United States, serving customers across an 11-state footprint. We have a diverse electric generation fleet and we own and operate the largest transmission system in the United States.

I. Executive Summary

This is a significant moment for our country, our industry, and our company. We at AEP are excited about the opportunities and challenges ahead of us as we meet the growing demand for electricity in our regions.

Demand for electricity was almost flat for two decades. We are now beginning to see this trend reverse, driven by large customers such as industrial manufacturers, data processors, and others who require significant amounts of power. The efforts of Congress to support the development of these businesses have been remarkably successful. Companies are now building and growing here in America because, in part, we have abundant and diverse energy resources and reliable and affordable power.

However, in some areas of the country, the demand for electricity is growing faster than the available capacity. Just a few years ago, a large-scale industrial manufacturing facility might require 100 megawatts (MW) of electricity – enough to power about 100,000 homes. A facility that size would typically be one-of-a-kind in a region and would be a major source of economic activity for the area. Now, it is common for a single data center to require three times to up to 15 times this amount of power for a single site.

As technology evolves, power demand from data processing is expected to double nationwide in three years.¹ As one small example of this demand surge, OpenAI's ChatGPT requires 2.9 watt-hours for a request—nearly ten times more power than a typical Google search.²

¹ See <https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/datacenter-power-demand-to-double-in-three-years-8211-ica-80123428>.

² See <https://www.datacenterknowledge.com/energy/electricity-demand-data-centers-could-double-three-years>.



AEP currently has requests from large customers that would more than double the existing peak demand we serve on our system today. It took over 100 years of planning and building to create our current system, and a step-change in infrastructure investment on an accelerated timeline will be required to serve even a fraction of this future demand in a reliable manner.

As demand is rapidly increasing, our nation's electricity system is transforming to accommodate new forms of energy. The pace of this transformation must not overtake the reliability needs of the system. Independent assessments by NERC find that the risk of electric power supply disruptions are steadily increasing.³

Our society depends upon a reliable power system. As we embark upon this era of economic growth and technological transformation, customers need an energy system that is available to deliver reliable, affordable, and environmentally sustainable power where and when they need it.

Continued development of the electric system must be a central priority of U.S. energy and economic policy, and we need to think bigger and more comprehensively to address the many opportunities and challenges before us.

For your part, we ask that:

- Congress work with regulators to ensure electric system resource adequacy and prevent premature retirements of dispatchable power plants. This includes:
 1. Considering the impact of recent EPA regulations which could hasten the pace of plant retirements and diminish reliability;
 2. Collaborating with FERC and other federal and state constituents to evaluate the establishment of a central planning authority focused on reliability; and
 3. Directing FERC to ensure that viable reliability "safety valve" mechanisms are in place to prevent premature plant retirements
- Congress should also expedite the deployment of new 24/7 dispatchable and clean generation resources to meet growing consumer demand. This could be done through:
 1. Encouraging FERC to allow for "fast-tracking" of generation resources in the interconnection queues selected by utilities to meet their obligation to serve customers;
 2. Encouraging the development of advanced technologies such as next generation nuclear;

³ James C. Robb, "The Reliability and Resiliency of Electric Service in the United States in Light of Recent Reliability Assessments and Alerts," (June 1, 2023), [D47C2B83-A0A7-4E0B-ABF2-9574D9990C11 \(senate.gov\)](https://www.senate.gov/legislative/recordings/2023/06/01/robbs-testimony-on-electric-reliability).



3. Passing a siting and permitting package that accelerates the development of critical infrastructure and
 4. Maintaining the Inflation Reduction Act and the technology neutral and nuclear tax credits which serve to reduce costs to customers
- Finally, Congress should encourage FERC's recent efforts to support the efficient development of necessary regional and interregional electric transmission facilities to ensure reliability and accommodate economic growth and development

The electric power industry will play a crucial role in helping the U.S. remain a global leader in advanced manufacturing and technology innovation. With the help of Congress and our federal and state regulators and agencies, we can serve this emerging demand and secure America's role as a leader for generations to come. To do so, we will need to work together to quickly build new sources of electric generation and high voltage power lines to deliver electricity where it's needed. Thank you.

II. American Electric Power

AEP is one of the largest investor-owned electric public utility holding companies in the United States. AEP's electric utility operating companies provide generation, transmission, and distribution services to 5.6 million customers in Arkansas, Indiana, Kentucky, Louisiana, Michigan, Ohio, Oklahoma, Tennessee, Texas, Virginia, and West Virginia. AEP's subsidiaries operate an extensive portfolio of assets including approximately 225,000 circuit miles of distribution lines, approximately 40,000 circuit miles of transmission lines, including approximately 2,200 circuit miles of 765 kV lines, the backbone of the eastern interconnection of the United States. Additionally, AEP ranks among the nation's largest generators of electricity, owning nearly 23,000 megawatts of generating capacity in the United States.

AEP operates in four Regional Transmission Organizations (RTOs): PJM Interconnection (PJM), Southwest Power Pool (SPP), Midcontinent Independent System Operator (MISO), and the Electric Reliability Council of Texas (ERCOT).

III. The growing demand for electricity is unprecedented.

a. Increased demand is impacting nearly every American region and electricity market.

In a welcome sign for the American economy, the United States is experiencing power demand growth not seen in a generation. Power demand from data processing, manufacturing, and large industrial customers is expected to significantly increase in the future, with data



processing power demand alone expected to double in three years.⁴ Not only are the number of data centers increasing, but data centers are also growing larger. Prior to 2021, the electricity demand from a large data center was approximately 200 MW; today it can be 1,500 MW or greater. This is in part because the rising use of AI in various sectors is increasing the overall power demand of data centers. For contextual purposes, as the chart [Figure 1] below illustrates, the power demand for the AI portion of data processing alone is expected to grow over eightyfold from 8 TWh in 2024 to 652 TWh by the beginning of the next decade.⁵

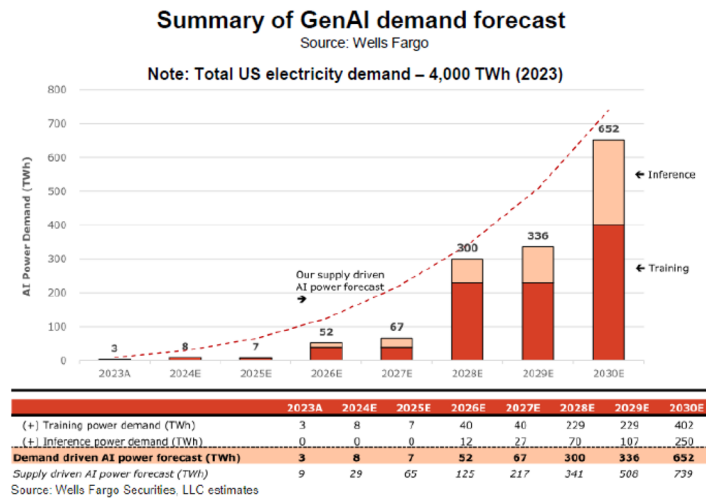


FIGURE 1

The construction cost of generation to serve this additional demand is expected to be in the hundreds of billions of dollars. For example, if half of this additional load were to be served from natural gas resources and half from wind and solar resources, the generation required could be 150 GW or more depending on the mix of resources. It is important to note that even more generation could be required to serve this demand because a) renewables have energy output that is highly variable by location, and b) the recently issued Environmental Protection Agency (EPA) regulations may make it more difficult and costly to build natural gas resources, requiring more

⁴ See <https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/datacenter-power-demand-to-double-in-three-years-8211-ica-80123428>.

⁵ Terawatt hours, abbreviated as TWh, is a unit of energy representing one trillion-watt hours. The average American home uses 10,791 kilowatt-hours (kWh) of power a year. One TWh is equal to one billion kWh.



lower capacity plants to be built. The capital cost of renewables and natural gas generation together could exceed \$300 billion and could be much more to comply with the recently issued EPA regulations.⁶

This growth is not isolated to only one part of the country. PJM, the regional transmission organization which covers thirteen states and the District of Columbia, predicted summer peak demand to increase 50% from 28GW by 2034 to 42GW by 2039 compared to 2024 levels.⁷ ERCOT, the regional transmission organization that serves most of the state of Texas, is also predicting significant demand growth – approximately an additional 70 GW in demand by the end of this decade, nearly doubling the demand in the entire region.⁸

b. AEP's service territory is uniquely situated to meet this growing demand.

AEP has the largest transmission network in the United States, with over 40,000 line-miles of high voltage transmission, which is well suited to accommodate large customers. AEP is experiencing significant growth in demand due in part to the location, characteristics, and performance of our transmission system. As a result of the significant investments that AEP has made and continues to make in its system, AEP has been able to meet new demand to date. However, in some instances, the demand of new customers seeking to interconnect to our system exceeds the total amount of load currently served by AEP in those areas today. For example, AEP has received a combined 108 gigawatts of requests for interconnection in the near-term. This represents over 10 percent of the peak electricity demand in the entire United States.

Currently, the amount of load requesting to interconnect to AEP's transmission system eclipses the current peak demand of AEP's operating companies in our PJM and ERCOT regions. For AEP's Ohio, Indiana and Michigan utilities, the demand is over three times AEP's current peak load in these three states. AEP's West Virginia and Virginia utilities demand would more than double the current load of Appalachian Power Company. Finally, AEP Texas is experiencing demand over five times its current load today.

⁶ While the incorporation of additional nuclear energy could help reduce the total amount of GWs required to serve this load, new nuclear power is not expected to be a significant addition before the end of this decade and has capital costs which are much higher on a per GW of capacity basis than other generation sources. We believe new nuclear energy could be part of the long-term solution in the 2030s and beyond.

⁷ See [PJM Publishes 2024 Long-Term Load Forecast | PJM Inside Lines](#).

⁸ ERCOT, 2024 RTP – Load Review Update (March 2024), [PowerPoint Presentation \(ercot.com\)](#)

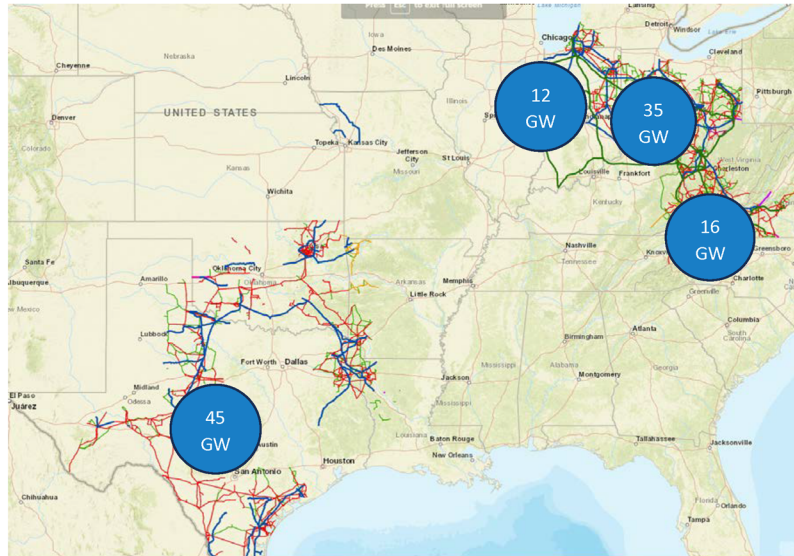


FIGURE 2

One example of large-scale growth on our system is in Ohio, where, due to investment in the semiconductor industry through passage of the CHIPS and Science Act in 2022, AEP Ohio is working in partnership with Intel to bring a \$20B chip production plant online in New Albany. This site was selected in part due to AEP's ability to serve large customers and meet Intel's unique power demands. AEP recently announced plans to bolster our transmission system in the surrounding area to support additional growing demand in the region, spurred by Intel's decision to locate there. Once complete, this facility is expected to create 3,000 jobs and will support production of U.S. manufactured microchips.

To have more success stories like Intel, significant investment will be required. We anticipate the need for billions of dollars of infrastructure investment on a rapid timeline to meet demand requirements and maintain reliability. To date, AEP has signed Letters of Agreement with large customers that will require multi-billion-dollar investments in transmission infrastructure across our service territory. However, far more investment will be required to meet our customers' current queued demand requests.



In addition to increased investment in transmission infrastructure, we will also need significant investment in a diverse set of electric generation resources. AEP supports the development of both renewable and dispatchable generation to meet this growing demand. A balanced and diversified mix of dispatchable and renewable generation resources that support grid reliability, customer affordability, and environmental sustainability will be important to the success of the U.S. economy on a going forward basis.

IV. Growing demand represents significant opportunities and challenges for the U.S.

The growth in areas such as AI and precision manufacturing is a generational opportunity and is important to our nation's competitiveness across multiple industries and technologies among the growing list of world economies. The ability of our industry to provide reliable and affordable power and the associated infrastructure to meet our country's needs drives broad sustained economic growth and development. The U.S. must create a robust domestic supply chain and supportive policy and power environment for these industries to thrive, ensuring our nation's security.

For AEP, this opportunity is particularly important as we are committed to advancing economic growth throughout our service territories. Our work, in partnership with state and local elected officials and economic development groups, has led to unprecedented investment throughout our footprint. We have helped bring billions of dollars of investment and new growth to our communities. These investments in the communities we serve have created over 90,000 direct jobs and over 107,000 indirect jobs over the last decade. We want to see this economic prosperity accelerate in the years to come. We share the same sense of urgency in working with our partners to take full advantage of these economic development opportunities for all our states.

Though growing demand will be beneficial for our country and our communities, it also presents significant challenges that we will need to meet, including reliability, affordability, the accelerated timeline to meet demand, and operational complexities. First, increased demand comes at a time when electric generation owners are, often in response to regulatory structures, closing 24/7 dispatchable generation facilities at a rapid rate. As an example, PJM recently highlighted regional generation resource challenges. More than 20% of the installed capacity in the region may retire by 2030, and new capacity additions may not be able to keep pace.⁹ PJM's analysis clearly demonstrates that if current trends continue, there will be an elevated risk of electricity shortfalls later in this decade.

Maintaining reliability requires providing adequate amounts of energy at all hours, rather than just during traditional peak hours or when the wind and solar resources are available. We

⁹ PJM, "Energy Transition in PJM: Resource Retirements, Replacements & Risks," p.5 (Feb. 24, 2023), [energy-transition-in-pjm-resource-retirements-replacements-and-risks.ashx](https://www.pjm.com/marketing/energy-transition-in-pjm-resource-retirements-replacements-and-risks.ashx).



must have sufficient generation available to provide energy on demand, and such energy must be delivered without being constrained by the limitations of the transmission grid during non-normal grid conditions, such as extreme weather events. Generation planning must account for more complex resource and energy adequacy considerations, recognizing that the grid's operational flexibility erodes as dispatchable resources retire. A significant amount of dispatchable resources, along with battery storage with sufficiently long output duration, will likely be required to maintain grid reliability at levels customers and regulators expect.

Second, in addition to providing reliable power to customers, we must also continue to ensure it is affordable. AEP serves a lower income customer base in many areas of its service territory. In fact, our customers are below the national median for household income in ten of the eleven states in which we provide electric service, and in many of those states, our customers are also below the state median for household income. We must ensure appropriate alignment between those who benefit from the expansion of infrastructure and those who bear the costs. Furthermore, we believe large customers should commit to long-term contracts for the use of the infrastructure to ensure that remaining customers, especially lower-income and residential customers, are not left paying the bill for potential stranded costs.

To help address this issue in Ohio, AEP has proposed a tariff for data center facilities with significant demand. This tariff, which was filed with Ohio regulatory authorities, will provide AEP with more certainty as we develop long-term plans for large pockets of demand connecting to our system. This tariff will also give large customers a clear understanding of how much power we are able to provide them and when we will be able to provide it. Other customers are also protected by the proposed structure because new large customers will be required to make financial commitments, which will encourage these customers to develop accurate forecasts and timelines for their energy use.

In addition to maintaining affordability, we need to be able to build new critical infrastructure as quickly as possible to reliably serve these new customers. There is a disconnect between the time needed to develop new transmission and generation and the timelines requested for supply by these new, large customers. These new customers typically expect to begin consuming energy in one to three years whereas the infrastructure upgrades necessary to serve them – new lines, substations, and transformers – can take far longer to put into service.

Nationally, the trends are moving in the wrong direction. To connect facilities with significant demand plus the generation to serve this demand in vertically integrated states, can sometimes take five to ten years. Transmission development has been slowing as interconnection requests are increasing. In the early 2010s, for example, the U.S. installed an average of 1,700 miles of new high-voltage transmission miles per year. That has dropped by nearly two-thirds to 645 miles on average in the second half of the decade. Regulatory approvals, siting, permitting, legal challenges and supply chain constraints have hampered our efforts to expand this vital



network.¹⁰ We need to expedite every aspect of the infrastructure timeline to meet this growing demand.

Finally, many of these large customers' consumption patterns are different from more traditional customers. Once connected, we must also ensure that we protect our grid equipment and infrastructure so that these large customers do not adversely affect grid reliability and stability as their demand may fluctuate resulting in sudden surges or drops in power consumption that, if unprotected, can lead to equipment damage and other wear and tear on generation facilities. Transmission operators and planners also continue to face challenges due to limited modeling of these large loads and their impact on the system as well as a lack of available tools to manage these significant power demands. We will need to address all of these challenges as we serve the growing demand.

V. Policy headwinds will make serving increased demand more difficult

a. The Environmental Protection Agency's power plant rules will exacerbate resource adequacy concerns.

The EPA recently issued several regulations impacting the power sector. The Clean Air Act (CAA) Section 111 greenhouse gas (GHG) rules have the potential to exacerbate increasing concerns about generation resource adequacy and maintaining reliability. Compliance strategies for the proposed rules will be expensive and are dependent in part on the development of technologies, like carbon capture and storage (CCS), that have not been fully demonstrated at scale.

AEP is uniquely positioned to comment on CCS based on our first-hand experience more than a decade ago with validation of the technology in an integrated configuration at an AEP coal-fired power plant in West Virginia. CCS is a technology we want to see work, but significant development challenges remain that will likely require years to resolve. A comprehensive review of those challenges, coupled with experiences of private and public entities developing the technologies reveals that CCS has yet to be demonstrated as the best system of emissions reduction (BSER). CCS development challenges that remain include technical, financial, regulatory, and practical concerns related to the capture, transport, and storage aspects of the process.

Even though significant investment has gone into advancement of CCS technologies, these technologies have not yet demonstrated viability for reducing CO₂ emissions at fossil fueled power plants. Simply put, not a single coal or gas power plant exists in operation today in the U.S. with integrated CCS capturing and permanently sequestering 90% of the CO₂ produced

¹⁰ John D. Wilson and Zach Zimmerman, Grid Strategies, "The Era of Flat Power Demand is Over," p.3 (Dec. 2023), subscriber.politicopro.com/f/?id=0000018c-5ade-d0cc-a98c-7efee7f30000.



by that plant. At the current pace of development and absent any existing commercial operations of generation-based CCS to reference, CCS will not be an adequately demonstrated, viable control option for many years, and likely not by 2032 as envisioned by EPA.

If the rule survives challenge or remains unaltered, coal-fired power plant owners will be forced to either convert their plants to natural gas, install unproven technology at a significant cost to customers or prematurely retire assets at a time when we need more electricity, not less. To meet the reliability and affordability requirements of our customers, utilities will likely build more natural gas plants. But we will have to operate them at a lower capacity factor to avoid having to install CCS due to the aforementioned current development state of the technology. The timeframes to accomplish this under the rules are unreasonable and may lead to the construction of more, not fewer, natural gas plants to meet growing demand to fill the gap left by the premature retirement of coal generation.

Finally, the EPA announced in March that it would delay issuing a proposal that will address GHG emissions from the existing natural gas electric generating unit (EGU) fleet. The existing natural gas-based fleet is diverse, from a size, technology, efficiency, emissions, and operations perspective, which will make it difficult to develop a workable regulation that maintains grid reliability and affordability.

b. Repealing the Inflation Reduction Act would make it more costly to serve growing demand.

AEP has invested significantly in our generation fleet, including in renewable energy resources. We have constructed or received regulatory approvals to own \$8.6 billion of renewable energy projects over the last four years. Between now and 2028, we plan to invest \$9.4 billion in renewable energy projects and \$2.4 billion in other forms of generation resources, including natural gas fired generation. This is in addition to procuring contracted renewable energy resources from third parties. These projects have all benefited from the IRA clean energy tax credits, the benefits of which are directly passed through to our regulated consumers, and are expected to provide our customers \$2.7 billion dollars of benefits through 2033.

Many components of the IRA, especially the technology neutral tax credits as well as the nuclear credits, are critical to AEP's commitment to managing costs for our customers. If the IRA is repealed, it would increase the cost of power and make it harder to serve increasing demand as large customers may look to other countries to serve their load at a cheaper price. Maintaining the IRA and the nuclear and technology neutral tax credits helps to keep America competitive.

c. Siting and permitting delays will negatively impact demand growth.

While most of AEP's infrastructure projects eventually receive the necessary approvals required in federal and state permitting and siting processes, these processes can take a



significant amount of time to complete and can involve lengthy and costly litigation. Siting and permitting reform will be essential to ensure the timely installation of infrastructure that will be required to quickly meet increasing demand during the next decade. Otherwise, these projects could suffer from extensive delays under the current permit system, ultimately delaying benefits to customers.

Today, it can take up to a decade to permit and build some transmission projects. Significant transmission investment will be needed to improve the resilience of the electric grid and meet future demand requirements. Without significant permitting improvements over the next decade, our nation's transmission system may fall short of the reliability standards our economy requires and will result in higher electricity costs to consumers.¹¹

VI. Congressional action can help the electric industry meet customers' growing demand

a. Congress should work with regulators to ensure electric system resource adequacy and prevent premature retirements of dispatchable power plants.

Increasing electric demand is outpacing the construction of new generation in many areas, and there are little signs of this trend slowing down. Dispatching generation to serve and cover expected large demand that may operate 24/7 is a challenge, particularly when environmental regulations and economics are forcing large amounts of the existing dispatchable fleet to close and limiting construction of new dispatchable resources. In addition, these large customers often have expectations for clean energy sourcing, and some want matching of the clean energy supply to their consumption on an hourly basis. This creates unique challenges, particularly when much of the clean energy supply will be sourced from solar¹² and wind generation which will not always be available.

Congress should work with FERC and other federal and state constituents to ensure reliability and resource adequacy. This includes carefully evaluating the need for the establishment of a central planning authority to review resource adequacy plans on a region-by-region basis with key federal, regional, and state constituents to ensure high degrees of system reliability. Though we recognize the difficulty of this, we think it is important. While there are many entities involved in decision making around resource adequacy – utilities, states,

¹¹ See Department of Energy's Draft National Transmission Needs Study, available at: <https://www.energy.gov/sites/default/files/2023-02/022423-DRAFTNeedsStudyforPublicComment.pdf>. The study finds that the highest value of new transmission is across the three electrical interconnections and during extreme weather events. *Id.* See also NERC 2023 Summer Reliability Assessment, available at: https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_SRA_2023.pdf

¹² "Solar accounted for more than 80% of new clean power capacity added during the [first] quarter of 2024." American Clean Power Association, "Clean Power Quarterly Market Report: Q1 2024," [24_Q1_Report_240507.pdf](https://www.cleanpower.org/cleanpower.org) (cleanpower.org).



regulators, legislators, FERC, NERC, RTOs, Independent System Operators (ISO), and the Department of Energy (DOE) – none of these entities is *wholly* responsible for resource adequacy under their current mandates. Forming a central planning authority solely focused on the issue could, among other things, provide large customers the confidence they need to grow their business while giving utilities and other interested parties the certainty that they can meet the new demand. Building the grid of the future must be a bipartisan effort to achieve our nation’s common goal—a safe, reliable, and affordable grid.

Congress should also ensure that electric balancing authorities have reasonable safeguards to protect system reliability. Such safeguards would allow system operators to require reasonable reliability-must-run (RMR) or “safety valve” provisions in all regions so plant closures do not impact grid reliability and the ability to serve all customers, including those with large electric demand. Reliability and cost must be viewed consistently and considered hand-in-hand with long-term environmental considerations. EPA also recognized, to a certain extent, the importance of reliability in its final Section 111 GHG rules,¹³ and we need to apply a similar viewpoint to existing plants. Congress should direct the Federal Energy Regulatory Commission (FERC) to require system operators to add these reliability solutions in their regions.

In addition to maintaining fossil fuel baseload resources for reliability purposes, Congress should continue to support the existing nuclear fleet. While providing financial and regulatory certainty for new advanced reactor technologies will be important, the continued operation and life extension of the nation’s existing nuclear fleet is critical to serving today’s demand and ensuring that the system can continue to meet growing demand. Nuclear generation provides 20 percent of our nation’s power and half of the country’s carbon-free electricity while supporting over 100,000 high-paying jobs nationally. Nearly all these plants could be relicensed for an additional 20, and in some cases, 40 years.¹⁴ Congress must continue to provide financial certainty for these existing resources.

b. Congress should expedite the deployment of new 24/7 dispatchable and clean generation resources to meet growing consumer demand.

As noted above, customers are seeking and expecting their power requirements to be met as quickly as possible, and often on timelines that are nearly impossible to achieve even under the best of circumstances. Congressional support will be needed to expedite our ability to meet this growing demand. First, Congress should require FERC to allow for the prioritization or “fast tracking” of generation resources in the interconnection queues selected by load-responsible

¹³ Environmental Protection Agency (EPA), “New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions from Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule,” p. 29.

¹⁴ Nuclear Energy Institute, “What is Nuclear Energy,” [What Is Nuclear Energy? \(nei.org\)](http://www.nei.org).



entities who need to meet their load and reserve margin requirements.¹⁵ This is important, as load-responsible entities have the obligation to serve customers and may need to access projects that are deeper in the interconnection queues to maintain reliability. Generator interconnection queues across the country are significantly backlogged, and non-dispatchable resources account for over 94% of the generation in the queues countrywide.¹⁶

Second, Congress should encourage the development and deployment of advanced technologies like next generation nuclear. One example is the bipartisan effort to establish secure fuel supplies for both today's reactors and the next generation and to reform the nuclear regulatory process through the ADVANCE Act and Atomic Energy Advancement Act. Congress should also stimulate the widespread adoption of next-generation nuclear through policies that bridge the cost hurdle for the first small modular reactors (SMRs) and mitigate the risk of cost overruns. Initial deployments of new nuclear energy technologies will face early mover costs that will not be borne by later projects. DOE has estimated that the first SMRs may cost twice as much as those that follow, without considering the potential for unanticipated cost overruns.¹⁷ The Secretary of Energy should be authorized to establish a program to mitigate the risk of cost overruns and establish grants for the first SMRs. Congress should also support the funding of early site permitting and licensure fees for a select number of early SMRs.

In addition to encouraging the development of advanced technologies such as next generation nuclear, Congress should pass a siting and permitting package that expedites the development of infrastructure critical to meeting growing power demand. Infrastructure projects frequently require federal permits and are therefore subject to environmental reviews under a variety of federal and state statutes, including the National Environmental Policy Act (NEPA), Clean Water Act (CWA), and Endangered Species Act (ESA), among others. Not only can these required environmental reviews take years and significantly slow down progress, adding unnecessary costs for critical energy infrastructure, but these statutes have increasingly resulted in protracted litigation that further disrupts infrastructure deployment, delays the creation of clean energy jobs, and adds time and cost to these critical infrastructure projects. Every decision in the multi-faceted, multi-agency, complex siting and permitting process should have a statutory

¹⁵ AEP advocated for this solution during FERC's proceeding entitled *Improvements to Generator Interconnection Procedures and Agreements*, "Moreover, entities with a reserve margin obligation must have the ability to prioritize the interconnection of needed capacity in the generator interconnection process. This ability is especially important as the nation transitions to meet clean energy goals while also seeking to provide the resilience needed to address increasingly extreme weather." Federal Energy Regulatory Commission, Docket RM22-14-000, "Initial Comments of American Electric Power Service Corporation," p. 19.

¹⁶ S&P Global Commodity Insights, "2024 US Interconnection Queue Analysis," p.4 (April 2024), available at, [Interconnection queues show swelling volume but FERC reforms slowly taking hold | S&P Global Market Intelligence \(spglobal.com\)](https://www.spglobal.com/commodityinsights/insights/2024-us-interconnection-queue-analysis)

¹⁷ Department of Energy, "Pathways to Commercial Liftoff: Advanced Nuclear," p.5, April 2023.



timeline associated with it to ensure deadlines are met, and litigation review should be limited to provide much-needed certainty to applicants.

Furthermore, while this Administration has made some progress on expanding the use of categorical exclusions under NEPA for certain transmission projects in limited regulatory contexts, categorical exclusions can and should be deployed more frequently by all federal agencies for critical infrastructure projects that will have a minimal impact on their surrounding environment.¹⁸ AEP supports environmental processes that are clear, transparent, and as efficient as possible.

Finally, Congress should maintain the existing IRA nuclear and technology neutral tax credits. A diverse energy resource strategy is important from both an environmental and cost standpoint, and the IRA supports this through tax credits for various technologies. These credits are necessary to accelerate growth in innovative technologies to not only meet U.S. electricity demand but keep the U.S. globally competitive.

c. Congress should encourage FERC’s recent efforts to support the efficient development of necessary regional and interregional electric transmission facilities to ensure reliability and accommodate economic growth and development

Significantly more regional and interregional transmission will be needed to efficiently deliver electricity to customers. The issuance of FERC Order No. 1920 is a positive first step. It reforms the regional transmission planning process and includes standardized and expansive planning scenarios, incorporates longer-term planning time horizons, and considers a wide range of benefits over a long time to better reflect the value of the life cycle of the assets being placed into service. Order No. 1920 also creates a bigger role for states to play in both the planning process and cost allocation, includes transmission technology alternatives, and increases pathways to meet long-term transmission needs, while doing so affordably and equitably.

Many of these reforms are necessary to ensure reliability and accommodate the nation’s growing demand. Long-term regional transmission planning reforms will allow transmission providers to go beyond the current “just in time” approach to planning that focuses on addressing specific system needs as they occur. Instead, transmission developers can now plan projects that address a multitude of needs that are anticipated to develop over a long-term horizon more efficiently and cost-effectively for customers. Proactive, scenario-based long-term planning assists planners to consider the many ways the future may unfold and how to respond effectively

¹⁸ Department of Energy, Docket DOE-HQ-2023-0063, “National Environmental Policy Act Implementing Procedures.”



and flexibly as the future becomes reality. This allows for “least regrets” transmission planning and will better enable us to ensure system reliability and meet the demand growth.

While FERC’s Order No. 1920 addressed regional transmission, the lack of interregional transmission can create bottlenecks that prevent the transmission of lower-cost power to customers, and can leave regions needlessly vulnerable to shortages and outages during peak demand and extreme weather events. Establishing a durable framework for interregional transmission requires Congressional action. AEP appreciates efforts by Senators on this Committee to address this issue but strongly advocates for regional flexibility in setting any potential minimum transfer requirements for interregional transmission.

d. Congress should recognize the other factors that will impact or could result from growing demand.

While less directly impactful to growing demand, Congress should be mindful of other policy areas that could affect large customer demands or that could result from interconnecting such significant demand centers to the nation’s electric grid. For example, we need to ensure that we have the supply chains and the workforce necessary to build the infrastructure needed to meet this increased demand. AEP has long partnered with our labor unions like the International Brotherhood of Electrical Workers (IBEW) and the Utility Workers Union of America (UWUA), to build our infrastructure. Congress should continue to support workforce development and educational partnerships with high schools, trade schools, and community colleges.

We must also acknowledge that large, rapid electric demand increases can pose additional risks to the bulk power system that need to be addressed and mitigated. Demand from certain large customers can be unpredictable and can pose grid stability challenges for real-time operators. Utilities also need to obtain critical information for modeling as well as potential risk assessments from large customers. Creating and implementing preventative risk mitigation strategies while partnering closely with legislators, regulators, and other industry partners will strengthen the reliability and resilience of the grid while supporting large new customers driving economic growth for our communities.

VII. Conclusion

As discussed above, AEP identifies the following priorities for Congressional action:

- Congress work with regulators to ensure electric system resource adequacy and prevent premature retirements of dispatchable power plants. This includes:
 1. Considering the impact of recent EPA regulations which could hasten the pace of plant retirements and diminish reliability;
 2. Collaborating with FERC and other federal and state constituents to evaluate the establishment of a central planning authority focused on reliability; and



3. Directing FERC to ensure that viable reliability “safety valve” mechanisms are in place to prevent premature plant retirements
- Congress should also expedite the deployment of new 24/7 dispatchable and clean generation resources to meet growing consumer demand. This could be done through:
 1. Encouraging FERC to allow for “fast-tracking” of generation resources in the interconnection queues selected by utilities to meet their obligation to serve customers;
 2. Encouraging the development of advanced technologies such as next generation nuclear;
 3. Passing a siting and permitting package that accelerates the development of infrastructure; and
 4. Maintaining the Inflation Reduction Act and the technology neutral and nuclear tax credits which serve to reduce costs to customers
 - Finally, Congress should encourage FERC’s recent efforts to support the efficient development of necessary regional and interregional electric transmission facilities to ensure reliability and accommodate economic growth and development

In summary, the utility industry needs Congressional support as we rise to meet the challenges of delivering reliable and affordable energy to serve the future needs of our county. It will take a diverse mix of resources and supportive policy to serve this increased demand while continuing on the path to a clean energy future and maintaining affordable and reliable power. We must move fast and with purpose. We look forward to the challenge.

The CHAIRMAN. Thank you.

Ms. Onaran, we have you next, if you will.

**STATEMENT OF KAREN ONARAN, PRESIDENT AND CEO,
ELECTRICITY CONSUMERS RESOURCE COUNCIL**

Ms. ONARAN. Chairman Manchin, Ranking Member Barrasso, and distinguished members of the Committee, thank you for the invitation to appear before you today.

My name is Karen Onaran. I am the president and CEO of the Electricity Consumers Resource Council, or ELCON. ELCON is the trade association for large industrial consumers of electricity. Our mission is to ensure that we have reliable and affordable power, and so we support the development and adoption of rational and coordinated policy to ensure electric reliability at low cost. The purpose of my testimony today is to represent the industrial sector as one of the drivers of the electricity demand that we are speaking of today.

So after decades of decline in manufacturing, domestic manufacturing is seeing a resurgence in the U.S. According to a recent report from the Deloitte Research Center for Energy & Industrials, the number of manufacturing facilities in the U.S. grew by over 11 percent between the first quarter of 2019 and the second quarter of 2023. Construction spending on manufacturing has nearly tripled since June 2020 and was up 37 percent year over year in January 2024, when construction spending reached a high of \$225 billion. As a result, the industrial sector is projected to add 36 gigawatts of additional power by 2030. Bringing manufacturing back to U.S. shores has many implications and benefits, as we have talked about. This is bringing investment into communities that have been neglected in the past, bringing thousands of jobs, whether that be through construction, the permanent jobs to run the operations and manufacturing, and the secondary jobs to support those workers, including retail and food and housing.

According to the National Association of Manufacturers, the industrial sector contributed at a yearly rate of \$2.9 trillion to the U.S. economy in the third quarter of 2023, and it projects that we will need approximately 3.8 million manufacturing workers in the next decade. We have already heard about the national security implications. We can no longer rely on hostile foreign nations to supply our critical infrastructure, our critical minerals, and our computing power. And we saw the devastating impacts during COVID of supply chain interruptions. It behooves us to create more and manufacture more here on our shores.

So at this point, we must right-size our grid, and we must meet this demand by reducing some of the regulatory barriers that we are seeing. We all know the risks. We have heard them today, from varying energy supply to extreme weather like we saw in Houston last week. So we cannot take any options off the table right now. We need all-of-the-above resources, and we need the infrastructure to support those resources. We need an agile and flexible grid that can manage variable supply as well as variable demands. Demand is going to change their profiles.

So we really, really implore this Committee and the Congress to pass significant permitting reform for transmission infrastructure

and other energy infrastructure. We have seen that the Federal Energy Regulatory Commission has taken some measures to address interconnection backlogs and transmission, but we still have a lot more work to do. I really ask everyone to come to the table and work on solutions. Take nothing off the table now.

And finally, even though we all appreciate and wish to be good stewards of the environment, the EPA rules that recently came out further complicate a tenuous situation on our grid. And so we cannot be further impeding our reliable and safe and affordable electricity. Electricity underpins our national economy, our national security, and the prosperity and ingenuity here in the United States.

Senators, again, I thank you so much for your invitation. I will conclude my remarks and look forward to your questions.

[The prepared statement of Ms. Onaran follows:]

Written Testimony of Karen Onaran
President and CEO, ELCON
Before the
U.S. Senate Committee on Energy and Natural Resources
“Opportunities, Risks, and Challenges Associated with Growth in Demand
for Electric Power in the United States”
May 21, 2024

Chairman Manchin, Ranking Member Barrasso, and distinguished members of the Committee, thank you for the opportunity to provide testimony this morning examining the opportunities, risks, and challenges associated with growth in demand for electric power in the United States.

My name is Karen Onaran and I am the President and CEO of the Electricity Consumers Resource Council (“ELCON”), the national trade association for large industrial consumers of electricity. ELCON’s mission is to promote by all lawful means the development and adoption of coordinated, rational and consistent federal, state and local policies and regulations regarding generation, transmission and distribution of power that will ensure an adequate and reliable supply of electricity for its members and other users at rates that are just and reasonable and not unduly discriminatory or preferential. In support of this purpose, ELCON advocates for (a) efficient and competitive electricity markets and pricing, (b) resource neutrality, (c) reliable and sustainable service at least cost (d) cost allocation based on the principle of beneficiary pays, and (e) elimination of barriers to self-supply and sale of any surplus on fair terms.

Large Industrial Load Growth

The purpose of my testimony this morning is to provide the large industrial consumer perspective, as one of the drivers of growing demand for reliable and affordable electric service. Manufacturers, on average, use one third of the nation’s energy.¹ After decades of declining domestic manufacturing, the industry is seeing a resurgence due to the onshoring of previously outsourced industrial operations as well as expanding domestic exploration of new technologies and supply chain opportunities. According to an April 2024 article from the Deloitte Research Center for Energy & Industrials, the number of manufacturing facilities in the United States grew by more than 11% between the first quarter of 2019 and the second quarter of

¹ National Association of Manufacturers, “Facts About Manufacturing: The Top 18 Facts You Need to Know,” <https://nam.org/manufacturing-in-the-united-states/facts-about-manufacturing-expanded/#~:text=1..U.S.%20economy%20in%20Q4%202023.&text=2..%242.69%20to%20the%20overall%20economy>.

2023. Construction spending in manufacturing has nearly tripled since June 2020 and was up 37% year over year in January 2024 when it reached a record high of \$225 billion.² See Figure 1.

Figure 1. Total Construction Spending: Manufacturing in the United States



As a result, energy usage by the industrial sector is projected to grow by 36 gigawatts (“GW”) by 2030³ which is the equivalent of the electricity necessary to power over 25 million homes. These projections not only take into account new manufacturing facilities, but the electrification of existing facilities and operations to achieve greater efficiencies and lower carbon-intensive production processes. As part of the move to lower carbon processes, industrials are considering hydrogen technologies to generate the electricity necessary for their manufacturing operations. However, hydrogen production itself is an electricity-intensive process that will contribute to growing load forecasts. Traditional oil and gas production is also expanding with a projected 24 GW of load projected to be added in the Permian Basin, the nation’s largest oil-producing region.⁴

² Deloitte Research Center for Energy & Industrials, “Taking charge: Manufacturers support growth with active workforce strategies.” (April 3, 2024); <https://www2.deloitte.com/us/en/insights/industry/manufacturing/supporting-us-manufacturing-growth-amid-workforce-challenges.html>.

³ Bruce Tsuchida, Long Lam, Peter Fox-Penner, “Electricity Demand Growth and Forecasting in a Time of Change,” The Brattle Group (May 2024); https://www.brattle.com/wp-content/uploads/2024/05/Two-Pager_Electricity-Demand-Growth-and-Forecasting-in-a-Time-of-Change_May-2024.pdf.

⁴ Tom Kleckner, “ERCOT, PUC Face Huge Tx Needs in Permian,” RTO Insider (April 15, 2024); <https://www.rtoinsider.com/76054-ercot-puc-face-huge-tx-needs-permian/>.

As large industrials increase their presence in the US and contribute to growing energy demand, the nation is experiencing a confluence of complicating factors affecting the electric sector including rapid changes to the energy supply mix, accelerated fossil-fuel plant closures, the electrification of transportation and the economy, electric vehicles and supporting charging infrastructure, Artificial Intelligence and data centers, extreme weather, and insufficient and aging energy infrastructure.

Opportunities Provided by Growing Demand and Right-Sizing Infrastructure

Outside of the energy sector, the manufacturing resurgence is providing tremendous benefits and opportunities for economic growth in US communities. New and expanded industrial operations provide thousands of new job opportunities for communities including construction, operation, and indirect employment from services to support these new employees from food to retail to commercial and residential construction. According to the National Association of Manufacturers, manufacturers contributed \$2.89 trillion to the U.S. economy in the third quarter of 2023.⁵ These manufacturing facilities and their employees inject money into their communities through direct spending on goods and services and the related tax revenues. Manufacturing jobs represent one of the largest sectoral multipliers in the economy in that for every \$1.00 spent in manufacturing, there is a total economic impact of \$2.69 to the overall U. S. economy.⁶

Onshoring manufacturing and industrial processes also provide national security. The country can ill afford reliance on hostile nations for supply chains of critical minerals, infrastructure materials, energy resources, and sensitive computing components. COVID-19 and the Russian war in the Ukraine have demonstrated how precarious our global supply chain is. Domestic investment guarantees that we continue to thrive independent of global instability and threats.

For the energy sector, domestic manufacturing bolsters investment and production of the nation's rich energy supplies including oil and gas, fossil-fired generation, hydrogen, nuclear, hydropower, as well as the components to capture and store wind and solar resources in conjunction with the infrastructure necessary to reliably harness and deliver that power.

Now is the opportunity to right size our electric grid to ensure this prosperity and American ingenuity continue for decades to come. We, as a nation, must take the initiative now to guarantee reliable, resilient, and abundant electric service in the face of rapid changes in electric supply and demand. This will include

⁵ <https://nam.org/manufacturing-in-the-united-states/facts-about-manufacturing-expanded/#~:text=1..U.S.%20economy%20in%20Q4%202023.&text=2..%242.69%20to%20the%20overall%20economy.>

⁶ *Id.*

investing in our current, and in many cases aging, energy infrastructure to take advantage of its full potential through upgrades, modernization, reconductoring, and other grid enhancing technologies that will save consumers millions of dollars. Coordinated and well-planned transmission expansion will be necessary to meet the demands of the expanding industrial sector and the electrification of the nation's economy. It is imperative that we harness, rather than reject, the energy solutions that are abundant in this country. As the industrial sector seizes the opportunity to invest in and secure the economic independence and prosperity of our nation, we look to those states and regions that are working to alleviate the bottlenecks and red tape that hamstring energy development and grid resiliency.

The Risks of Maintaining the Status Quo

There is no question we are at an inflection point in our energy's security and affordability. If we fail to plan and invest in our energy sector to meet the multitude of compounding challenges, we risk devastating not only the economic potential of our country but the health and wellbeing of our citizens and environment. In addition to energy demand growth that we have not experienced in decades, the nation's rapid transition to more weather-dependent supply and resulting premature retirements of 24/7 dispatchable energy resources, strain grid operators' ability to balance the system to ensure power is delivered exactly where and when it is needed. Not only does our energy supply act differently and sometimes unpredictably, energy demand can also be variable with needs changing rapidly as large consumers turn their operations on or off to chase price signals, batteries quickly transition from supplying energy to taking energy from the grid to recharge, and behind-the-meter customers turn to the bulk power system when their local distributed energy resources become unavailable.

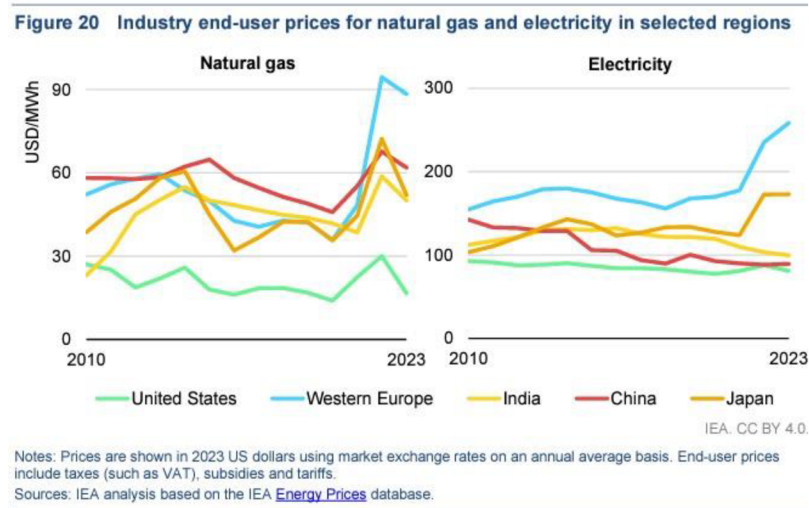
Inadequate energy reserves and extreme weather can result in extended blackouts unless we invest in resilient infrastructure that can withstand adverse conditions and import resources from other less-impacted regions. Degradation of power quality can interrupt industrial processes and damage sensitive equipment resulting in millions of dollars of lost revenue.

In short, one of the unique strengths of the U.S. from the perspective of our energy is our geography. The U.S. is a large nation blessed with abundant fossil and renewable resources and it is the ability to move these resources around through pipelines and transmission lines—making our energy system larger than the weather—that makes us globally competitive. A recent International Energy Agency (“IEA”) report shows that the U.S. has long held an advantage over its peers and rivals in both electricity and natural gas prices.⁷

⁷ International Energy Agency, *Advancing Clean Technology Manufacturing: An Energy Technology Perspectives Special Report*, p. 61 (May 2024).

See Figure 2. More robust interstate and interregional transfer capabilities of both molecules and electrons will help us maintain that advantage well into the 21st century.

Figure 2. Industry End-user Prices for Natural Gas and Electricity in Selected Regions



Globally and domestically, we are experiencing heightened political volatility. Hostile foreign nations and domestic extremists understand how much the U.S. relies on our electric system. Destabilizing our grid will have the direct effect of destabilizing our economy and civic life. It is imperative that we invest in the physical and cybersecurity of our critical infrastructure. Defending our electric grid will require robust, redundant, and flexible transmission and distribution services.

At a time of inflation with the costs for goods and services skyrocketing, we risk further unsustainable energy prices for the average American. Without access to abundant, reliable, low-cost energy supply and infrastructure, low-income consumers will be saddled with prohibitively expensive and less reliable electricity, hampering their ability to thrive.

Regulatory Challenges to the Energy Future

It is inevitable that something so crucial to our economy and way of life would be subject to challenges and differing opinions. But we cannot afford to let the perfect be the enemy of the good. We must work together on solutions without drawing lines in the sand and perpetuating inefficient and detrimental regulatory

policies. We strongly encourage Congress to pass electric transmission and energy infrastructure planning and siting and permitting reform to reduce the long and often unsurmountable study requirements and misguided opposition from regulatory authorities. According to a recent survey conducted by the National Association of Manufacturers, 72.4% of respondents in the manufacturing industry cited the length and complexity of the current permitting reform process as affecting their investment decisions in various degrees, with 38.9% of respondents suggesting that they were extremely or moderately impacted.⁸

We applaud the Federal Energy Regulatory Commission (“FERC”) for its recent rules intended to foster comprehensive transmission planning, codify its transmission backstop permitting authority, and alleviate the backlogs in connecting much needed generation to the transmission grid. On this front, ELCON has worked with other consumer groups to propose further reforms to the generator interconnection process to quickly connect energy resources to the grid and lower consumer costs.⁹ ELCON is also a key supporter of the bicameral bill *Expediting Generator Interconnection Procedures Act* (H.R. 8085) sponsored by Representative Castor and Senator Cortez Masto¹⁰ and we strongly encourage Congress to consider this piece of legislation that instructs FERC to take more aggressive reforms to ease interconnection backlogs, increase reliability, and lower energy costs.

Work will need to continue to further encourage grid deployment, anticipate growing demands, and mitigate emerging challenges. The industrial industry endeavors to continue collaboration with FERC and its state regulators in pursuit of continued reforms and greatly encourages Congress, FERC, and the states to strengthen interregional transmission planning to identify multi-value projects and capabilities that open access to sufficient energy resources and deliverability optionality to meet the needs of growing demand and mitigate other grid stresses.

And finally, while we all aim to be good stewards of our environment and precious natural resources, overly aggressive rules from the Environmental Protection Agency exacerbate an already precarious and taxed energy system. Unfortunately, our desire for cleaner energy and industrial processes is not enough to

⁸ National Association of Manufacturers, “2024 First Quarter Manufacturers’ Outlook Survey,” (March 5, 2024); <https://nam.org/2024-first-quarter-manufacturers-outlook-survey/>.

⁹ Ethan Howland, “Consumer groups, R Street urge FERC to expand interconnection reform proposal to increase savings,” *Utility Dive* (June 9, 2023); <https://www.utilitydive.com/news/ferc-interconnection-reform-proposal-r-street-elcon-nasuca/652570/>.

¹⁰ Press Release, U.S. Senator Catherine Cortez Masto, “Cortez Masto Introduces Legislation to Improve Reliability of America’s Electricity Grid, Lower Energy Costs,” (April 18, 2024); <https://www.cortezmasto.senate.gov/news/press-releases/cortez-masto-introduces-legislation-to-improve-reliability-of-americas-electricity-grid-lower-energy-costs/>.

overcome the realities of physics. Any transition to a cleaner economy must be done at a pace and scale that ensures we keep the lights on at affordable rates.

In conclusion, at a time of significant growth in industry and electric demand, we must not take anything off the table. We must commit to a coordinated, cooperative, and bold energy plan for both our electricity supply and the necessary infrastructure to ensure reliable and affordable service that underpins our national economy, national security, and future prosperity.

Senators, I thank you again for this opportunity to appear before you and the members of this Committee today. I will now conclude my remarks, and I look forward to taking your questions.

The CHAIRMAN. Thank you.
Now we have Mr. Gatzemeier.

**STATEMENT OF SCOTT GATZEMEIER, CORPORATE VICE
PRESIDENT, FRONT-END U.S. EXPANSION, MICRON TECH-
NOLOGY**

Mr. GATZEMEIER. Chairman Manchin, Ranking Member Barrasso, Senator Risch, and members of the Committee, thank you for the opportunity to testify today and represent Micron regarding the importance of affordable, reliable, and sustainable energy.

I serve as the corporate Vice President for Micron's expansion in the United States. Micron was founded more than 45 years ago in Boise, Idaho, in the basement of a dentist's office. Today, Micron is a world leader in design, development, and manufacturing of memory and storage technology. We have an expansive IP portfolio of more than 55,000 patents. We operate in 17 countries, and we have over 40,000 team members worldwide.

Micron plans to invest \$125 billion with the support of the bipartisan CHIPS and Science Act to build fabs in Onondaga County, New York and Boise, Idaho that will transform these regions and create over 75,000 jobs. We are also seeking CHIPS funding for our existing fab in Manassas, Virginia, and would be excited to host you or your staff on a tour.

Washington has been focused on the vital role that semiconductors play in American economic and national security. Micron is the only manufacturer of memory. Our memory and storage products are essential to all computing and storage capabilities in phones, data centers, computers, and numerous other devices. Without memory, none of those devices would be able to operate and provide the remarkable capabilities that shape our modern world. Micron has an expansive memory product portfolio, from the DRAM chips that will be made in Idaho and New York to the NAND and NOR in Virginia, to Micron's latest product, high bandwidth memory, HBM3E.

Our high bandwidth memory powers today's generative AI models by enabling them to break through data bottlenecks. Micron's HBM is the fastest, highest capacity, and 30 percent more energy efficient than other products available across the industry. As Micron manufactures, we have made significant efforts to reduce our consumption of energy, which is detailed in my written report.

However, as the expansions of U.S. semiconductor manufacturing, new data centers, and other manufacturing in the U.S. have been highlighted, electric demand will grow faster over the coming years than it has in decades. For all those planned investments in U.S. manufacturing and data centers to actually work, the U.S. needs to modernize its grid and expand electricity generation capacity. When it comes to energy permitting, I am an Idahoan, and I will speak to the challenges that we face.

The western U.S. produces an abundance of sustainable energy, including hydropower in the northwest, wind in Wyoming, and solar in the desert southwest, but capacity is constrained on the transmission lines that move energy from the places where it's generated to the homes, farms, and businesses that need it. There is no transition to sustainable energy without transmission. To power

our fab in Boise, we plan to import 400 megawatts of affordable, reliable power from the Pacific Northwest in the summer, when a surplus of energy is available there. In the winter, when the Pacific Northwest energy demand peaks, utilities there will import energy across the planned Boardman to Hemingway (B2H) transmission line from Oregon to Boise.

B2H began in late 2006. Idaho Power has a Record of Decision but does not have a Notice to Proceed from the Federal Government. The cost to build B2H is between \$1.5 and \$1.7 billion. On top of that, permitting costs have already exceeded \$220 million. Construction is finally slated to begin later this year, with completion in 2027, over 20 years after this project began. A federal permitting process that adds two decades to the project timeline and adds hundreds of millions of dollars in the cost is not a permitting process that will enable a U.S. manufacturing renaissance or AI leadership.

Above all, Micron supports efforts which will ensure affordable and reliable electricity, which could include a balanced approach to permitting reform that utilizes all avenues to support the growth of domestic manufacturing, improves reliability of the grid, maintains low energy costs, and addresses the need for sustainable energy sources.

I will leave you with this: Micron's main product is memory chips. It is an intensely competitive and dynamic business. Micron succeeds because we provide an edge, often in power requirements or better performance metrics, but we have been growing and planning to grow and invest to meet our customers in the digital economy. It is imperative that Congress also plan for the energy demands of the data-driven economy of today and tomorrow so the United States can remain competitive and a destination for manufacturers like Micron.

Thank you, and I look forward to your questions.

[The prepared statement of Mr. Gatzemeier follows:]



**WRITTEN STATEMENT OF SCOTT GATZEMEIER
MICRON CORPORATE VICE PRESIDENT OF U.S. FRONT END EXPANSION**

**BEFORE THE U.S. SENATE COMMITTEE ON ENERGY AND NATURAL
RESOURCES
“HEARING TO EXAMINE THE OPPORTUNITIES, RISKS, AND CHALLENGES
ASSOCIATED WITH GROWTH IN DEMAND FOR ELECTRIC POWER IN THE
UNITED STATES”**

MAY 21, 2024

Opening

Chairman Manchin, Ranking Member Barrasso, Senator Risch, and members of the Committee: thank you for the opportunity to testify today regarding the growth in electricity demand within the United States and the importance of affordable, reliable, sustainable energy. This topic is critical to the future of the American economy. I am honored to be here today to share Micron's insights into both the opportunities and risks that we face as demand for electricity grows.

I sit in front of the Committee today as the Corporate Vice President responsible for Micron's expansion in the United States, representing over \$100B+ in capital expenditures. Micron has planned expansions of leading-edge DRAM capacity in two states, Idaho and New York, as well as an application to modernize and add new capabilities to our existing facility in Virginia. As I will discuss in more detail momentarily, Micron, with support of over \$6 billion from the bipartisan CHIPS & Science Act that Congress passed in 2022, is making transformative investments to build fabs in Onondaga County, New York, and in Boise, Idaho. We also have proposed to expand and modernize our existing fab in Manassas, Virginia—a fab that we would be happy for you or any of your staff to come see. This application is pending review with the CHIPS Program Office.

Americans invented the modern semiconductor in the 1950s. Today, while the U.S. continues to lead in semiconductor R&D and design, the U.S. only manufactures about 12% of global chips. In memory, that is even a lower percentage today. Less than 2% of the world's memory chips are manufactured in the U.S. — all of them at our Manassas, Virginia facility. Micron's planned fabs will help rebuild semiconductor manufacturing in the United States while employing thousands of Americans. Thanks to the bipartisan CHIPS & Science Act, semiconductor companies are investing in America like never before.

Semiconductor manufacturing requires many inputs: A skilled workforce. Access to transportation and large utility infrastructure. Access to water. It also requires access to abundant, affordable electricity. Micron's knowledge that it could secure ample supplies of low-cost energy was an important part of Micron's decision to invest tens of billions of dollars in U.S. manufacturing over the next two decades.

Against that backdrop, I applaud the Committee for holding this hearing on the electrical grid. Growing U.S. semiconductor manufacturing, new data centers for AI and other uses, and the expansion of other manufacturing, means that U.S. electricity demand will grow faster in the years ahead than it has in decades. The U.S. needs to expand its electrical generation capacity and modernize the nation's electrical grid for all these planned projects, including Micron's fabs, to work.

About Micron

I will begin my testimony by talking about Micron, which plays a vital role in the semiconductor ecosystem. Micron was founded more than 45 years ago in Boise, Idaho, as a four-person technology startup working out of the basement of a dental office. Today, Micron is a world-leading designer, developer, and manufacturer of memory and storage products that employs more than 40,000 people worldwide and has operations in more than 17 countries. We are currently 136 on the Fortune 500 list and have over 55,000 patents. Micron serves customers across many industries, including communications, defense, vehicles, aerospace, data centers, and others. I am confident that if you opened up the phones, computers, TVs, and other devices that Members of the Committee use every day, you'd find Micron chips. Indeed, we estimate that half of all cars in America have a Micron chip made close-by here in Manassas, Virginia.

For more than five years now, Washington has been focused on the vital role that semiconductors play in American national and economic security. I know that much of that focus has been on high-end logic chips. Micron is the only U.S. manufacturer of memory—memory that is essential to all computing and storage capabilities in phones, data centers, computers, and numerous other devices. Without memory, none of those devices would be able to operate and provide the remarkable capabilities that shape the modern world. The scale of memory provides a unique opportunity to address both U.S. economic and national security priorities.

Just like human memory is essential to all people in this room to think and remember, memory semiconductors are essential to the digital ecosystem. America cannot have AI without memory storing the data to train it. Americans cannot store pictures on our phone without memory. We cannot have vehicles or healthcare devices without the memory to store the data these devices produce and use to operate. The United States Government—from the Department of Defense to the Intelligence Community to the

National Aeronautics and Space Administration—cannot operate advanced satellite communications without massive memory banks needed to accumulate data and relay it back to earth.

Micron manufactures all the kinds of memory that go into the digital ecosystem: DRAM, which Micron will manufacture in the United States in our planned fabs; NAND; and NOR, which we make in Manassas, Virginia, at a facility we propose to modernize. We also make High Bandwidth Memory or HBM, which is an innovative new product that is valuable for AI and other high-end computing applications. Micron's newest product, HBM3E, is the fastest, highest capacity high bandwidth memory available across the industry. It is what powers today's generative AI models and allows them to break through the data bottlenecks they face.

But customers do not just push us on performance—they also push us to design chips that use less electricity. Customers report that our HBM3E solution has a 30% lower power consumption compared to competitors.

Micron's planned investments

As Micron announced publicly, we are planning to invest more than \$100 billion in four fabs in New York and one fab in Idaho over the next 20-plus years. We expect that these fabs will let us produce as much as 40% of Micron's DRAM chips here in the United States, create 75,000 jobs across the country, strengthen U.S. and national security, and cement Micron as a leader in American innovation.

I have been working on Micron's U.S. expansion for over three years—beginning with site selection. When I set out on our site selection process, I knew that we needed to expand our research and development (R&D) footprint in Boise to continue to maintain our leading position in terms of technology. We also needed a place for high volume manufacturing. These sites will work synergistically to create a U.S. ecosystem for memory.

There are many reasons we chose Central New York for our high-volume production, where we could build as many as four fabs. There are universities and community colleges to partner with to train our workforce. There was a 1,400-acre site that fit our needs for a mega-fab site based on the market demand for memory. There is easy access to water from the Great Lakes. But access to reliable, affordable energy was a key part of Micron's site evaluation process. Consistent power is crucial for fabs that will run around the clock, 24 hours a day, 7 days a week and we cannot afford to suffer even a fraction of a second of power drop which impact hundreds of millions of dollars of production at any given time. We estimate that each of our fabs will use approximately 400 megawatts: the amount of power that would be used by perhaps 200,000 homes. We need that level of power even after we implement a variety of

energy-saving controls across our manufacturing operations. And for Micron we need that power to be sustainable. Micron has publicly committed to achieving 100% renewable energy for our U.S. electricity consumption by the end of 2025 and we currently have the majority of our consumption under contract to meet that commitment. Micron also set a goal of being Net Zero by 2050. Given our proximity to the *Nine Mile Point Nuclear Station*, we expect that nuclear power and large-scale hydropower will be critical to enabling us to meet that sustainability goal, and New York has both. We were pleased to be able to reach an agreement with the local power operator in New York to guarantee us the energy we need at an affordable rate. Further, we plan for our New York fabs to achieve a minimum of Gold LEED status and our office buildings Platinum LEED status.

In addition to our efforts to ensure that our future fabs in New York will conserve energy, we have also honed our operations and manufacturing processes to increase energy efficiency in our Boise, Idaho fab by improving wafer throughput per kilowatt hour, implementing smart controls and “eco-mode” on our process steps and reducing use of auxiliary equipment like pumps and chillers. We also seek to recapture energy within tools, replace energy sources and give our process engineers visibility on energy consumption data using smart controls and real-time data. These efforts allowed us to reduce our Boise facility's energy consumption by 19.5 million kilowatt hours last year—equivalent to the average annual consumption of over 1,700 households. Micron also recently announced a partnership with Schneider Electric, a global leader in digital transformation of energy management and automation, to enable strategic collaboration across sustainable development, smart manufacturing, green factory and carbon management.

To scale these efforts, Micron is engaging in R&D on advanced memory technology with a number of government partners. The company has a long history of collaboration with Pacific Northwest National Laboratory and Sandia National Laboratories, and we are looking forward to expanding partnerships with other government labs, particularly the Air Force Research Laboratory, Idaho National Laboratory, and Argonne National Laboratory.

Micron has also taken steps over the years to improve power efficiency in our chips. Much like with our promising HBM3E power savings, since 2011, Micron has enabled a 6x improvement in system bandwidth while delivering a 10x improvement in performance and a 10x improvement in power efficiency. Our current industry-leading 1beta technology provides a 15% power savings over our previous technology, 1alpha. Whether through our policies or products, in our past, our present, or our future—Micron is a leader in taking steps to increase energy efficiency.

Despite Industry Efforts, the Government Must Act as Energy Demands Rise

Of course, Micron is not the only company building new factories in the United States. The country is seeing a boom in semiconductor manufacturing, data centers, and manufacturing for other industries, such as vehicles and batteries. This is great for the United States. But this manufacturing boom is also going to require a record level of electrical power and U.S. government officials now project a robust increase in U.S. electrical demand over the next decade. While projections vary, demand growth could increase by several percent per year over the next few years. That may not sound like much at first, but it is the equivalent of millions of homes per year being added to the grid. And that will happen in each of the next few years.

The U.S. government needs to make sure that it can permit both the power generation and the power transmission facilities that will be required to meet this demand. And to be frank, I am worried that the U.S. is not on track to permit those facilities, based on the experience I have seen as an Idahoan responsible for securing power for my company.

The western U.S. produces an abundance of clean energy, including hydropower in the Northwest, wind in Wyoming, solar in the desert Southwest. But capacity is constrained on the transmission lines that move that energy from the places it's generated to the homes, farms, and businesses that need it. The Boardman to Hemingway (B2H) transmission line is a 500 kilovolt transmission line that will run from the future Longhorn substation east of Boardman, Oregon, to the existing Hemingway substation in Boise, Idaho. B2H will be a clean-energy superhighway between the Pacific Northwest and Intermountain West — Idaho Power's region. Idaho will import up to 500 MW of affordable, reliable power from the Pacific Northwest in the summer, when a surplus of energy is available there. In the winter, when the Pacific Northwest's energy demand peaks, utilities there will import energy across B2H to meet their customers' needs.

B2H began in late 2006. At the time, you might have thought that it would take a few years to complete. And, candidly, in many foreign countries, that kind of power project would be completed within a couple of years. Yet today, nearly 20 years later, while Idaho Power has a Record of Decision, it still does not have a Notice to Proceed from the Federal Government.

Moreover, as a result of this permitting delay, costs have soared. The cost to build B2H is estimated to be between \$1.5-\$1.7B and, on top of that, permitting costs alone have ballooned to \$220M. Construction is finally slated to begin later this year, with completion in 2027—more than twenty years after this project began. This drives up the cost of electricity, making the United States a less competitive destination for companies like Micron.

Members of the Committee, a federal permitting process that adds two decades to a much-needed transmission project and adds hundreds of millions of dollars to the cost

is not a federal permitting process that is aligned with the U.S. government's goals—no matter which side of the aisle you are on.

I hope this gives you a sense of the challenges that we're facing in Idaho and serves as an illustration of what is going on across the country as we seek to rebuild U.S. manufacturing that supports resilient businesses and healthy, growing communities.

Above all, Micron supports efforts which ensure affordable and reliable electricity, which could include a balanced approach to permitting reform that utilizes all avenues to support the growth of domestic manufacturing, improving reliability of the grid, maintaining low energy costs, standardization of what's renewable and addressing the need for sustainable energy sources. Micron also recommends action to reduce permitting burdens related to the National Environmental Policy Act (NEPA) and duplicative state and federal environmental review processes; doing so would help speed up CHIPS investments, like Micron's.

Conclusion

In closing, I will leave you with this: Micron's main product is memory chips. Memory is an intensely competitive business because many memory chips are standardized products that, to a degree, are commoditized. Micron succeeds because we can provide an edge—often in terms of better power consumption or performance metrics—but much of our success is also about meeting the moment when demand will peak.

After weathering one of the more vicious cyclical downturns in our industry recently, Micron is ramping up to meet peak demand in the coming years. We've been planning for years to meet the demand we know will be coming later this year and into the latter part of the decade. But Congress and the U.S. government need to be planning for demand, too. It is imperative that the whole of the U.S. government plan for the energy demands of the data-driven economy of today and tomorrow, so that the United States can preserve its competitive advantage. This is a good problem to have, but we must meet the moment to help the United States unleash its potential over the coming decade. Thank you.

The CHAIRMAN. Thank you. And now we will hear from Mr. Mills.

**STATEMENT OF MARK P. MILLS, EXECUTIVE DIRECTOR,
NATIONAL CENTER FOR ENERGY ANALYTICS**

Mr. MILLS. Good morning. Thank you, Chairman Manchin and Ranking Member Barrasso for the opportunity to testify. And Senators, if I may, as a personal observation, as a longtime observer of this great Committee and occasional witness, just note that it's music to my ears, I will have to say, to hear such significant bipartisan convergence on such a critical issue.

It is of personal interest, because I began my career as a young physicist in semiconductor fabs in New Jersey and Ohio. And we are, as you said, Senator, at a rare pivot in history. We are witnessing the emergence of a significant and ostensibly unanticipated new vector for electricity demand. And as you know, I am referring specifically to the emergence of useful artificial intelligence (AI), especially when it's combined with the next phase of expansion for the cloud computing infrastructure that was pioneered in the United States and has expanded to the world.

While there is debate, of course, and outright guesswork about where the future specific uses for AI will come from—both civilian and military—no one doubts that the AI boom is here. Utility planners and energy pundits have rediscovered a basic truth—the arrival of new ways to boost the economy illustrates a longstanding correlation, a kind of iron law that links growth with rising energy use and especially electricity use. We have a good idea why we are now seeing such surprising leaps in the near-term forecast for electricity demand.

Put in monetary terms, not the physics terms that I grew up with, but in monetary terms, every billion dollars spent on data centers leads to over \$60 million a year in electricity purchases. And last year, before the AI acceleration kicked into high gear, capital spending on U.S. data centers was running at over \$100 billion a year. Now, the addition of AI-enabled hardware is accelerating both the rate at which data centers are being ordered, and the energy use per data center. So a billion dollars spent on a new AI-infused data center will likely drive something like \$200 million a year in energy purchases.

Now, for context, a billion dollars spent on new EVs, for example, or a billion dollars' worth of new chip factories, generates only about \$20 million a year in annual electricity demand. That AI has a voracious energy appetite is not news in the technical community. There have been myriad studies pointing out that the so-called "training" phase that is the equivalent of building, not flying, an aircraft, can use as much electricity as driving a Tesla anywhere from 300,000 to four million miles. And then the use phase—flying the AI, so to speak—can consume ten times more electricity. And there are, for all practical purposes, nearly unlimited numbers of potential applications for both training and using AI.

Of course, AI will become more energy efficient. The latest AI chips are already a hundredfold more energy efficient over the last half-dozen years, and they will get another hundredfold more effi-

cient before the year 2030. But efficiency won't solve the so-called problem of rising electricity demands. It will do the opposite, just as it did in the rise of the first cloud era. Improving energy efficiency lowers costs, which is what makes the proliferation of the benefits of the product or service possible, especially in digital domains.

Operating at the computing efficiency of a 1980 computer, a single smartphone today, just one of them would use as much electricity as a skyscraper. A single data center would use the entire grid. It is because of electricity gains that the world has billions of smart phones and thousands of data centers. Consequently, today's global cloud infrastructure already rivals the energy use by global aviation, and that is before AI. We can count on the pattern repeating with AI.

Electricity demand coming from the expansion of the cloud will continue to overshadow the combined impact of new EVs and new chip factories. But whether the AI expansion is in fact fully realized, and the expansion of chip factories and EVs as well in America, that will be determined, as other witnesses have said, on whether we have adequate electricity, whether it's affordable, and whether it's available when it's needed. And given the scales of electricity demand from the cloud, and AI particularly, when added to the demands from reshoring manufacturing and promoting EVs, the nation's electricity producers now need full access to all options. Electric power planning now needs to focus on additions to—not transitions away from—existing electricity production.

The U.S. is the world's cloud leader today. We pioneered it. We pioneered AI, much as the U.S. was a dominant aluminum producer just 25 years ago. Producing, again in monetary terms, a billion dollars of aluminum requires purchasing some \$400 million of electricity, which today happens mainly on low-cost coal-fired grids in China, which has become the world's dominant supplier of aluminum, while the U.S. now has a single-digit percentage share of global aluminum supply. Aluminum and silicon are different materials and different industries, but the energy implications of the two domains, I suggest, has a relevant lesson for us.

Thank you.

[The prepared statement of Mr. Mills follows:]

Testimony of Mark P. Mills
Executive Director, National Center for Energy Analytics
Distinguished Senior Fellow, Texas Public Policy Foundation
Before the
U.S. Senate Committee on Energy and Natural Resources
Regarding
“Opportunities, Risks, and Challenges Associated with Growth in Demand for Electric Power in the United States.”

May 21, 2024

The leaders of America’s electricity producing industries are in an unenviable situation. Like many other professionals, they are engaged in a business that is anchored in making predictions about the future but, more than most, when they get it wrong it’s very hard to hide from or casually dismiss the consequences. No one doubts the centrality of electricity to modern life, especially now in our increasingly digital age. The impact of getting forecasts wrong, specifically not having enough electricity available when it’s needed, or at prices markets can tolerate, are consequential and widespread.

Forecasts about electricity sit at the center of predicting outcomes at the intersection of three domains: supply, demand and politics. Because electric grids are intended to serve everyone and everything, and do so for decades, traditional utilities and grid operators such as Regional Transmission Organizations, e.g., PJM, ERCOT or the California Independent System Operator (hereafter “utilities”), must evaluate the long-term viability of new or improved technologies for supplying reliable and affordable electricity. At the same time, utilities need to forecast the future demand from greater use of existing technologies and, far more challenging, the emergence of demands from inventions of new electricity-using technologies without being lulled into the complacency of the status-quo. And then of course, arguably more so than for other leaders except those in health-related domains, utilities need to forecast the vicissitudes of future regulations and political forces.

My testimony focuses on the now widely noted, and central issue of this hearing: we appear to be at one of those rare pivots in history witnessing the emergence of significant, and ostensibly unanticipated, new vectors for greater electricity demand. Rising demand not only increases the need for greater capacity to produce electricity but also amplifies the importance of affordability and reliability. The vectors for the new demands are centered around continuing growth in cloud computing now accelerated by the arrival of useful artificial intelligence (AI), the revival and repatriation of electricity-intensive manufacturing (especially for semiconductors), and governmental mandates and subsidies directed at electric vehicles (EVs). Only the first constitutes a technologically net new demand for energy. The other two entail a shifting of demand in terms of sources or locations.

What is clear, as I will summarize below, is that the era slow to flat electric load growth is over and that there is now an urgency to ensuring policies that will ensure adequate, reliable electricity supplies in the coming decade. Talk of an “energy transition” that entails shutting down or replacing conventional power supplies is not only unrealistic but also will have near-term deleterious consequences.

While there is vigorous debate over some of the worrisome uses (and abuses) of AI, from detecting deep fakes to protecting intellectual property, there are also benefits from the new

capabilities that outweigh the challenges. Many such benefits are already clear not least in such things as improving the efficiency of complex supply chains, enhancing security (both civil and military), and accelerating discovery of new therapeutics. It is precisely because of the democratization of AI, a class of software heretofore only available in supercomputers, that one sees such rapid adoption by all manner of businesses. Federal Reserve data shows that private, non-residential investment in [information](#) technology (IT) is now running at over \$1 trillion annually compared to, for example, \$300 billion a year on [transportation](#) equipment. In fact, corporate spending on just the [AI share](#) of IT investment is now approaching that total spending for transportation equipment.

Estimating the future aggregate impact of shifting on-road energy use from gasoline to electricity for vehicles entails well-understood technical underpinnings that will not change significantly within useful forecasting time periods. The key variable is the level of EV penetration for on-road vehicles wherein an upper bound would be the level of new car sales imagined as feasible by the EPA in its most recent rulemaking. Every \$1 billion of new cars in the market leads to, over the cars' operating life, about \$200 million of energy purchases. (That total is roughly the same whether for a conventional car or an EV on an equal availability and equal tax basis.) Americans spend over \$500 billion a year on new cars.

Similarly, forecasting the range of future demand arising from expanding U.S. manufacturing is anchored primarily in knowing the electric intensity—kilowatt-hours (kWh) per unit of economic output—of manufacturing, especially semiconductor “chips.” This is a feature that is well-understood and extremely unlikely to change significantly within the timeframes in which the new facilities may be built. Thus, the key variable is in estimating the number of new chip plants the world will need, and how many of them will be built in the U.S. in the next decade. In both cases, reasonable upper bounds are easy to imagine.

Put in the same economic terms as noted above for cars, every \$1 billion spent on new chip plants leads to (an estimated) \$300 million in energy (primarily electricity) purchases over a decade. Since the latest [forecasts](#) from the semiconductor industry see \$250 billion a year in America's annual average spending on new factories, which will in total rival new cars in terms of adding to U.S. energy consumption.

But for the third vector, AI and the broader digital economy, the “cloud,” the boundary conditions are far more challenging when it comes to predicting future electricity demand. While it should be obvious that all things digital create net new demands for energy, the challenges in forecasting lie primarily in guessing how much demand will emerge from entirely new kinds of products and services, and the velocity of their adoption. The core challenge is that many of the new technologies are nascent, and most have yet to be invented at all, especially those associated with AI.

Again, in monetary terms, every \$1 billion spent on datacenters leads to over \$600 million in electricity purchases over an operating decade. Last year, capital spending on datacenters was running at about [\\$100 billion](#) a year in the U.S. Now, the addition of AI-enabled hardware is accelerating both the buildout of datacenters and the energy use per datacenter with at least a doubling in both factors which means, combined, there's a potential four-fold jump in energy use per new dollar of capital deployed in digital domains. That would translate into well over \$2 billion in energy purchases over a decade for every \$1 billion spent on new AI-infused datacenters.

The AI revolution is on track to add more net new energy demand annually than will manufacturing, or the auto industry, and far more than EVs. And this says nothing about the

spillover effect, the point of using AI in the first place, which is to accelerate economic growth and competitiveness. The arrival of a new way to boost the economy illustrates the long-standing correlation, a veritable iron-law, that links economic growth and rising energy use, especially now electricity.

The boom in both manufacturing of AI-class silicon chips and simultaneously construction of massive AI-infused datacenters should, finally, put to rest the illusion that a digital economy will “decouple” economic growth from rising energy use. But as recently as two years ago, an [OECD](#) analysis claimed that “digitalisation can contribute to decoupling economic activity from natural resource use and their environmental impacts.” A key question now is whether the current state-of-affairs is a kind of bubble, or whether it signals something more fundamental and if so, just how much more power the information infrastructure will consume, especially now that AI has been accepted as critical to global competitions.

That AI has a voracious energy appetite, that “inference” rather than “calculation” is so [energy intensive](#) is not news to the technical community. Consider, for example the results of one recent analysis that showed building, not operating, an AI tool—i.e., the equivalent of energy used to build an aircraft, not fly it—found that a single, modestly small AI application in the “training” [phase](#) consumed more energy than driving a Tesla 300,000 miles. Another [analysis](#) of building a bigger AI tool, more akin to training ChatGPT, found that application used as much electricity as driving a Tesla four million miles. As with automobiles and aircraft, once built, AI also consumes energy to operate (so-called “inference”) which entails as much as a ten-fold [greater](#) energy use than training. Meanwhile, the number and nature of potential applications for training and using AI are essentially unlimited.

At a conference several months before the November 2022 unveiling of ChatGPT that ignited the public interest in AI, the CTO of AMD, a world-leading AI chipmaker, [observed](#) that current trends pointed to AI, by 2040 consuming a major share of all energy used by the U.S. for all purposes. That won’t happen because the AI engines will become much more efficient. While we don’t know, yet, is just how fast AI electricity use will grow, we do know that it will grow despite efficiency gains. The underlying energy-efficiency metric for AI hardware has already improved 100-fold in the past half-dozen years, and engineers [expect](#), based on known trends, another 100-fold gain by 2030. But such amazing progress in efficiency won’t stem the rise in electricity demand, rather it will stimulate it, the so-called “Jevon’s Paradox.” And we have seen that play out before. It’s what gave us today’s global cloud’s electricity consumption.

Improving efficiency is a feature of technology progress, and one that is most especially true in digital domains. It was the British economist William Stanley Jevons who [first](#) codified this phenomenon in 1865 in a seminal paper focused on the question of whether England would run out of coal given the demands from the industrial revolution. The solution offered by experts at that time was to make coal engines more efficient. Jevons pointed out that improvements in engine efficiency would lead to more, not less, overall coal use. Thus, the so-called paradox. Some modern economists call this the “rebound effect.” It’s not a rebound; it’s the primary purpose of efficiency.

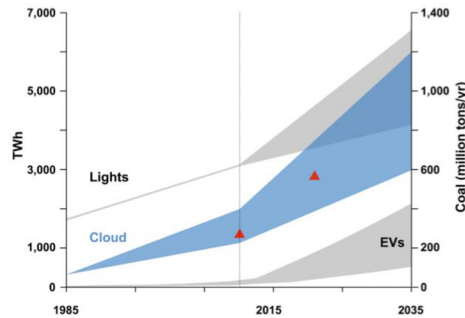
Improved energy efficiency makes it possible for the benefits from a machine or a process to become cheaper and thus available to more people. For nearly all things for all of history, rising demand for the energy-enabled services outstrips the efficiency gains leading to a net gain in consumption. Aircraft today, for example, are three times more energy efficient than the first commercial passenger jets. That efficiency didn’t “save” fuel but instead propelled a [four-fold](#) rise in aviation energy use.

The same dynamic occurred during our first microprocessor era. Over the past 60 years, the energy efficiency of conventional silicon chips has improved by over [one billion](#) fold. This means that if a single smartphone today operated at 1980 energy-efficiency, it would require as much power as a Manhattan office building. Similarly, a single datacenter at *circa* 1980 efficiency would require as much power as the entire U.S. grid. But *because* of efficiency gains, the world today has billions of smartphones and thousands of datacenters. That is precisely the efficiency trajectory we will now see for AI hardware and AI-infused datacenters.

Despite the spate of recent headlines evincing surprise at the end of the era of flat growth in electric demand, none of this should have surprised anyone, including the emergence of electricity-hungry AI. Forecasting electricity demand from the first two vectors, more manufacturing and more EVs, is relatively straightforward and can be reasonably bounded. The emergence of the AI, a genuinely new vector for demand, while more difficult to forecast accurately, the technical literature made clear that we should expect significant impact.

I note, for the record, such trends were documented (from the technical literature) in my recent book, [The Cloud Revolution](#), published just before the intense media coverage around ChatGPT, as well as in my decade earlier [study](#) issued in 2013 (see Figure below), which analyzed the literature to forecast global trends in electricity demand. (Indeed, 25 years ago, my long-time colleague the late [Peter Huber](#) and I published articles in both *Forbes* and the *Wall Street Journal* pointing to these realities at the intersection of energy and information.)

Figure
Global Electricity Demand from Three Sources: Forecast Published 2013



Source: [The Cloud Begins with Coal](#), August 2013, Mark P. Mills

This forecast, published in 2013, showed the then conventional wisdom (left red triangle) for global cloud electricity use and (at that time) the author's forecast for 2023 demand (upper red triangle). The latter value is now consistent with current industry estimates for actual demand in 2023. The upper bound for EV data is based on the optimistic forecasts for EVs at that time. The actual EV consumption in 2023 was at the lower end of the range illustrated. The study's title derived from the fact that coal had accounted for 50% of net new electricity supplied between 2000 and 2012, contemporaneous with the emergence of net new demand from the cloud.

While the build-out of the modern cloud infrastructure began about three decades ago, we are now at the end of the beginning, not the beginning of the end of that build-out.

The cloud, measured in various terms—the size of the network, the capital deployed, or the energy used—is on track to become the biggest infrastructure ever built by humanity. Global capital spending on (energy-using) hardware to build [the cloud](#) and its networks now exceeds global capital spending by all [electric utilities](#) on power plants and the power networks.

Similarly, regarding the scale of the global cloud network that connects to people and devices: measured in the combined length of both physical (cable) and virtual (wireless) connections, that network totals well over a [billion](#) miles, vastly exceeding all the world’s road-miles.

As for the energy already used by the global cloud infrastructure—operating the networks and datacenters, and building the devices that make it possible—that already rivals the [energy](#) used by global aviation, and that’s an estimate based on data that are a half-dozen years old. Recent years have seen a dramatic acceleration in datacenter [spending](#) on [hardware](#) and [buildings](#) along with a huge [jump](#) in the power density of that hardware, the latter now because of AI being added to that infrastructure.

The question of guessing the extent of electricity demand from AI and the cloud, an emerging technology-industry, is analogous to guessing in the 1950s the future energy demands from aviation. By the early 1950s, the aviation industry was already [three decades](#) old and was carrying more passengers than all intercity railways. But the emergence of a new kind of engine, a practical jet engine—equivalent in our time to the arrival of a new class of logic engine, the AI chip now three decades since the cloud began—created the age of modern jet passenger aircraft and global travel. In the two decades that followed the introduction of the Boeing 707, global air passenger-miles increased [15-fold](#). Today, every \$1 billion spent on new aircraft leads to about \$2 billion in fuel purchases over the decade of use.

We are in the equivalent of the 1950s when it comes to the expansion of AI and the associated cloud infrastructures.

But whether the benefits from both building and using AI are in fact fully realized in the U.S. will depend on the extent to which the electricity is available, when it’s need—in the case of datacenters, that’s 7/24—and at prices that are acceptable. It is not too much to imagine that the U.S. could put in place policies that would lead to an AI future that is increasingly offshored much as happened to the aluminum industry. The latter, it bears noting, is also electricity intensive. Producing a \$1 billion of aluminum requires using some \$400 million in electricity (on low-cost coal-fired Chinese grids). Two decades ago the U.S. was the primary global producer of aluminum, it now has only a few percent share and China, using its low-cost grid produces [60%](#) of the world’s aluminum.

Given the emerging scales of electricity demand from the cloud and AI, especially when added to the emerging demands from reshoring manufacturing and promoting EVs, it should be clear that policymakers can no longer entertain the idea of an “energy transition.” The nation’s electric sector will need full access to all options to ensure enough electricity is produced reliably, and at prices American businesses, and ultimately the public, can afford. <>

The CHAIRMAN. Thank you. And now we are going to start with our questions, and I will begin. I have so many questions, I don't know where to start to be honest with you.

But first of all, I would ask you all, you heard about the rules that FERC came out with, and some people are thinking it took care of everything. Do any of you believe that what FERC did cleared or took care of our permitting problems that we have getting things built, especially transmission or getting pipelines built or any of the things we need? Anybody believe that it cured it? Nobody? Okay. And you know, we all understand it stays within the region, so all it did is allowed, if you have a regional transmission line, it applies there, but it does not take care of interregional, right? Okay, so we are on the same page there.

We all agree with the charts that we had here? Let me just show you on this chart here.

[The chart referred to appears on page 5 of this hearing document.]

This chart shows that if you live in these areas or you represent any of these areas, coming this summer is where they are predicting you are going to have rolling brownouts or blackouts because demand will be so great. It doesn't account for the winter now. It will change around in winter when the load is different in the winter. We understand that. I would ask you, Mr. Gatzemeier—coming from the technology end of it where you are all looking to put your new databases and things of that sort—do you look at this, and finding out where you might have more reliable power, where you might go and recommend putting a plant or a center in an area where they are going to be reliable and not basically intermittent?

Mr. GATZEMEIER. Yes. Power reliability is incredibly important to our industry. A minor—

The CHAIRMAN. Did that factor into basically making decisions on where you are located?

Mr. GATZEMEIER. Yes, yes it did. In fact, when you look at New York, one of the reasons why I made the decision to go there is there is a nuclear power plant 40 miles directly north of our facility with a direct-line connection to a 345-kV substation across the street from that site. And in looking at it, it was one of the most reliable substations on the grid when we were looking at where to select our site.

So reliability of the system is incredibly important to semiconductor fabs, because a small millisecond blip in our power would take down our factory for up to a week by interrupting processing. So reliability is incredibly important to semiconductor fab manufacturing.

The CHAIRMAN. I am going to put a chart that I used before on wind, and truly all of our environmental friends and everything are big on the wind thinking it's going to come.

[The chart referred to appears on page 7 of this hearing document.]

I know our Majority Leader is big on wind. Wind has hit a slump and it's going down because it takes so long to build transmission lines. Solar—it's easy to bring solar on. Solar is record high. Wind has dipped clear down to here. Do you all agree or disagree with

this analogy of what happened to wind, because we can't get transmission built?

What I am trying to make a point on is that we all have to have permitting reform, and we have worked on this Committee in a bipartisan effort. Mr. Mills, you pointed out, we all understand, we just can't get the Administration to understand how desperate that we are in need of this. Have you all had any contact with the White House, John Podesta's office, the climate department there about the need to get permitting done, to get the lines to be able to deliver the—have you had any input at all? Have they reached out to you at all?

No? None? None of you? Have you tried to reach out to them and tell them how desperate we are of trying to get transmission and get things built? I would encourage you to do so if you haven't. Please do so and reach out to them.

The other thing is on China. Do you believe that China has a competitive edge with the amount of power they have dispatchable to them? Mr. Mills, do you want to comment on that?

Mr. MILLS. Well, Senator, they have a profound competitive edge in low-cost, high-reliability, electric power, as you well know, and a profound competitive edge on exporting the critical minerals materials that we use to build our unreliable power.

The CHAIRMAN. If we don't have the capacity, Mr. Gatzemeier back to the production end of it, with AI coming on so strong, if we are not able to keep pace and be the leader of the world, are we in jeopardy because of the lack of power that we have in our manufacturing?

Mr. GATZEMEIER. Yes, I think you said it, you can't run a business if you can't keep the lights on. We need additional generation, and so we encourage investigation in all sources of new generation, like new hydro, new nuclear, small modular reactors, geothermal, battery technology for wind and solar to make them more reliable, because our fabs run 24/7. So we encourage looking at all sources of generation and requiring new generation to be created before you retire existing generation.

The CHAIRMAN. Mr. Fowke, if I could ask you, since I am a customer of yours.

[Laughter.]

Mr. FOWKE. Thank you.

The CHAIRMAN. Anyway, are you concerned about the amount of EPA regulations coming out in power plants that you are going to have to be closing more reliable power than what you intend to do?

Mr. FOWKE. Yes, very much so. The EPA is a big fan of CCS, and they think that is the best available technology. As you know, we had a pilot program to explore the carbon capture, and we have some experience with it and it has its challenges in front of us. And it's not a proven technology today, and nor is the infrastructure to move the carbon to sequester it available. So while it might be a viable technology, a proven technology in the future, it's not today, and it's unrealistic to expect that it will be available by 2032.

The CHAIRMAN. Do you have any coal-fired plants that are being retired earlier than their time?

Mr. FOWKE. We will have to have that conversation with our commissions. They were not scheduled to be retired in 2032. And

these rules—if you don’t comply with these rules, you need to shut the plants down and that would be a premature shutdown.

The CHAIRMAN. And also, for the record, on the premature shutdown, who continues to pay? Because your rate was based on the life of the plant, correct?

Mr. FOWKE. Correct.

The CHAIRMAN. So it’s based into the rate that West Virginians and anybody in your system are going to be paying for shutting down earlier and bringing on other power too. So it’s a double-whammy for the most hard-pressed and challenged people, basically. It doesn’t make any sense at all. No sense whatsoever, sir. I hope you speak up loud and clear and you put statements out—what is going to happen, and who’s going to pay the freight.

Mr. FOWKE. We plan to do just that, Senator.

The CHAIRMAN. Thank you, sir.

Senator BARRASSO.

Senator BARRASSO. Well, thank you. Just to follow up, Mr. Fowke—so, in 2021, you testified before a different committee in the Senate that “renewable energy can only take us so far.” You went on to say, “at higher levels of intermittent renewables, the cost of the energy system begins to skyrocket, and the reliability degrades.” Still true today?

Mr. FOWKE. Yes, I made that testimony when I was CEO of Xcel Energy, but that statement still holds true because it reflects the physics of the grid. I am a big proponent of renewable energy. I think it’s part of the solution and it’s part of how we address climate change and the risk of it. But the reality is, the more renewable generation you put on the grid, at some point that grid reaches saturation point, and then the value of that renewable energy diminishes and the integration cost increases. And it’s the reality that the big grid that we are all part of needs 24/7 spinning mass dispatchable generation. And that’s just a fact, and we have to accept that.

Senator BARRASSO. So it’s dangerous to force all these natural gas and coal-fired plants offline at this point.

Mr. Mills, let me go to you. What would be the consequences if federal and state regulators effectively prohibited the use of natural gas and coal to meet the growing demand for electricity?

Mr. MILLS. Well, in simplest terms, the stifling of economic growth and opportunity and the profound disadvantage geopolitically. You can only consume the energy you produce. And since all of the witnesses and all of the members of the Committee understand now that we have soaring demand and economically driven need for electricity, we would not get that growth without the power.

Senator BARRASSO. So, some argue that electric batteries will also play a big role in meeting the growing demand for electricity. They argue that rapid deployment developments in battery technology are going to enable us to store energy for longer periods of time at lower costs. What is your assessment of the state of battery technology, and what are the implications for the affordability of electric service if we rely significantly on these batteries?

Mr. MILLS. Well, I’ll make a point—a technical point, a physics point: batteries don’t produce energy, they store it. They are ex-

traordinarily expensive ways to store energy. On an engineering/physics basis, roughly 100 times more expensive than the traditional ways to store energy—tanks, caverns, piles of coal. They will play, and are playing a very significant role in short-term stabilization. For long-term energy storage, the United States would have to deploy tens of trillions of dollars of batteries at scales that the world cannot now manufacture, nor produce the minerals for.

Senator BARRASSO. So let me follow up. So Jigar Shah, who is the head of the Department of Energy's Loan Programs Office, recently argued that the projected growth and demand for electricity that we have all talked about and has been reported broadly in the press, he said that is significantly overstated. He claims many large energy users can control when they need electricity. He said they might agree to stop using power during times of peak demand. He also said that individuals will stop using electricity during times of high demand in response to high prices.

Mr. MILLS. Right.

Senator BARRASSO. In your view, will this be enough to address the growing demand for electricity? And if not, why not?

Mr. MILLS. Well, first another physics point. Demand-side management does not produce energy. It is avoiding the use of energy. Economic growth requires more energy. Also, utilities have been very, very good at managing demand for about a century. It's not a new discovery in the utility industry. I would say the principal discovery is that our society is more electrified and that there are fewer and fewer sources of "low-hanging fruit" where we would turn to.

And I will pick on Micron because they are a spectacular company, where you would turn to them when they are running their factory, who will tell us, as the fabs I worked in, if you take power away for milliseconds, you cause astonishing economic destruction. I have had that happen to me when I ran a fab as a young man. So you don't get to ask them to please turn it off right now, the wind isn't blowing and our batteries have run out, because when you have a four-hour battery, at four hours and one second, you are black. You don't have a pile of coal nearby. You don't have more electricity if there is wind lull and it's cloud covered.

It is not a solution, but it is a tool in managing cycles. Society is cyclical. Humans are cyclical. So peak demands can be shaved, but they don't produce energy.

Senator BARRASSO. Well, since you turned to Micron, let me turn to Micron. I understand that both the availability of electric service and the quality of the electric service that you get are incredibly important to Micron. What is the impact of the temporary voltage dips that we just talked about on facilities like yours?

Mr. GATZEMEIER. Yes, I also unfortunately have had the opportunity to recover a fab from a minor power blip—milliseconds, you know, tens of millions of dollars of product loss in that fab recovery. This would be on the order of hundreds of millions of dollars product loss on these other, you know, larger facilities that we will be building. So absolutely a large economic impact.

And while we are putting in all sorts of energy savings types, opportunities—variable speed drives, heat capture recovery—we are putting all that in to try to lower our demand, the ability to fluc-

tuate, we are what we call a baseload. You know, we run 24/7, 365 on all the time at peak out, and you can't just shut it off.

Senator BARRASSO. Thank you, Mr. Chairman.

The CHAIRMAN. Senator Cortez Masto.

Senator CORTEZ MASTO. Thank you. Thank you, Mr. Chairman and the Ranking Member. I am one of those that believes we still need permitting reform. And Ms. Onaran, let me start with you, and I want to express my appreciation for ELCON's endorsement and support of one of my bills. It is the Expediting Generator Interconnection Procedures Act—EGIPA—for short.

I was pleased to see your testimony call on Congress to consider this legislation as soon as possible, really in order to ease what we are talking about—interconnection, backlogs, enhance grid reliability, and lower energy costs. As we have all been talking about and are aware, Lawrence Berkeley National Lab recently determined there were over 2,600 gigawatts of generation in storage pending in U.S. interconnected queues at the end of 2023.

Ms. Onaran, can you talk a little bit about why—expanding on some of the ways—that this legislation works to alleviate the bottlenecks, and it will have a positive impact on energy development and grid resiliency?

Ms. ONARAN. Yes. Thank you for the question, Senator.

And yes, ELCON was a supporter of that proposed bill. We are at a point where we need, again, as my testimony stated, all of the above resources. We have a lot of resources that are hung up in the interconnection queue that are ready to put steel in the ground and start producing power. And unfortunately, due to regulatory constructs in the markets, these are being held up through red tape and, you know, restudies, and so we really need to find a way to standardize and perhaps automate some of these study processes so that we can do it more quickly, and get these resources on the grid.

FERC has done some work with their Order No. 2023, but we still need to go further, and it's just the first step. Thank you.

Senator CORTEZ MASTO. Thank you. And while I have you, because you mentioned this, and this is always a concern of mine because I think as we build out our portfolio around energy, including clean energy, we need to ensure we have a workforce.

Ms. ONARAN. Yes.

Senator CORTEZ MASTO. And you talked a little bit about it. So when considering the severity of literally growing and moving forward in clean energy and all of these projects, what do we need to be thinking about for that workforce?

Is it there, or should we be putting more investments, and what type of investments in the workforce?

Ms. ONARAN. Yes, absolutely. You know, coming from the utility side, before I joined the consumer side, that was something we heard from the utilities quite a bit, that the workers, to come, even managing our electric system, the same for manufacturing, you know, trade schools, things like that have, you know, declined. There was a more prominent focus on say, you know, liberal arts education. We moved away from sort of the trade education that we need. We need to encourage more workers to look at some of these new and emerging jobs. We need to make sure that they are

well paid, we need to make sure that they can exist in this society and can prosper. And so we really need to be investing in our future workforce, and we need to start doing that now.

Senator CORTEZ MASTO. Thank you. Mr. Fowke, are you familiar with advanced reconductoring?

Mr. FOWKE. Yes, very much so.

Senator CORTEZ MASTO. Can you talk a little bit about that? Because there is an opportunity, as we are talking about building out the grid and transmission, the technology is also going to help us with capacity. Isn't that correct? So can you talk a little bit about that?

Mr. FOWKE. Yes. It's a grid-enhancing technology. We actually have just used it a couple years ago down in South Texas where we used the advanced conductor technology to—I think a 330-mile transmission line of 345-kV. And to your point, it increased capacity by about 40 percent. I would caution though that you do have to find specific applications in specific regions and a lot of other technical things before it can produce those sorts of results that I mentioned. But we have been a very big proponent of grid-enhancing technologies, making sure that they also have a cost benefit, you know, favorably score out on that. And when they do, we are all in.

Senator CORTEZ MASTO. Are other countries already using this type of technology, advanced reconductoring?

Mr. FOWKE. Are other utilities?

Senator CORTEZ MASTO. Countries.

Mr. FOWKE. Countries? I believe so, but I would have to check with my team to see how extensively they are.

Senator CORTEZ MASTO. I appreciate that. Thank you. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

And now we have Senator Cassidy.

Senator CASSIDY. Mr. Fowke, the Chairman just reminded me—do you also have that coal-fired plant in Shreveport, Louisiana, or did you all shut that down?

Mr. FOWKE. I believe that has been shut down.

Senator CASSIDY. So the Chair just reminded me that my ratepayers in Louisiana are still paying for that—

The CHAIRMAN. Absolutely.

Senator CASSIDY [continuing]. Because it did not go to its life, so when we speak about higher energy costs, and they have risen significantly during this Administration, part of that is the kind of unrealized productivity of sunken assets. And let's be clear: that's regressive. That is regressive. Poor people pay a greater percentage of their income for this unrealized potential.

But I will note, by the way, in Northwest Louisiana, and Louisiana, you guys and Cleco, I think, supply that area, and you all have great reliability. So I just also want to give you a congratulations and a shout-out. Our state consumes a lot of energy, and you guys are providing reliable energy. So I appreciate that.

Let me ask you this: I recently toured Sempra—building a little bit off of Senator Cortez Masto—Sempra in Southern California, and 100 percent of their electricity right now is being supplied by renewables. You just got to hand it to them. It's remarkable. Now,

I don't think of Southern California as being huge in manufacturing, but there is more than I thought there was. Now, they admitted in another time of the year it would have a mix. But just to say, this kind of load balancing, it is possible, correct? I mean, as much as I believe in fossil fuel and the necessity for baseload, in a place like Southern California with lots of renewables, et cetera, it is certainly possible, correct?

Mr. FOWKE. I will tell you, in all sincerity, they are connected to a big grid that somewhere has that dispatchable 24/7, likely fossil fuel, that is supplying them. And you can stream renewables from different places, but at the end of the day, they are still connected to grids that have fossil capability on that.

Senator CASSIDY. So I was struck that Micron located downstream from a nuclear power plant. And that was one of the reasons you did that. Somehow, I think state subsidies had a role to do with it, but that's okay. You know, we will leave it at that. So for that "always got to be on," even if you are like this great utility in Southern California, in which at that time they were using 100 percent renewables, you've still got to have that baseload.

Mr. FOWKE. Absolutely. And you know, that nuclear power plant, I assume, is not behind the meter of Micron. It's on the grid, so it's supplying its resources to the entire grid for the benefit of many customers, not just Micron.

Senator CASSIDY. Okay. Thank you.

Mr. Mills, going to permitting reform. I have been interested in the judicial review aspect of permitting reform. Any comments on that?

Mr. MILLS. Well, I think, as you well know, Senator, one of the big challenges for large manufacturers of any kind is that the permits are effectively in an infinite period of potential review, judicial and other forms of review, which is why we see exactly the kind of challenges, especially to the transmission line—in Idaho—the same was true in Maine, where I spent my summers, a transmission line that just never got built.

Senator CASSIDY. So again, the Chairman knows how lawsuit after lawsuit can effectively tie up something and effectively kill the project. So I like to say that the folks on the other side of the dais want powerlines, and the folks on this side want pipelines. But we really want both because we know that both are essential. So is it fair to say that the permitting reform that would benefit both power and pipe are the same ones that would benefit pipe and power?

Mr. MILLS. Well, yes sir. That would be a terrific outcome, to accelerate the permitting of both, because the world cannot operate without both.

Senator CASSIDY. Got you. Sir, I know that Micron has had development in China. I just know that because the Chinese have been somewhat non-cooperative with your economic development there. Is the power source there coal? Or what is the typical source that you get there?

Mr. GATZEMEIER. I don't know what the power source is for our back-end facility, but at Micron, we are one of very few semiconductor manufacturing companies that do not have front-end manufacturing in China.

Senator CASSIDY. That do not have what?

Mr. GATZEMEIER. Front-end. We don't have a fab in China.

Senator CASSIDY. Got it. I want to point out that I just learned this, that I think 60 percent of Chinese power is generated by coal. They typically don't turn on their scrubbers because that decreases the efficiency. Oftentimes, they are built on the Pacific Coast, which means the trade winds blow them over to the United States. So, to the degree that our energy policy increases the cost of energy and therefore encourages someone to move to China, we are actually worsening global greenhouse gas emissions because we are increasing consumption of Chinese coal-fired electricity as opposed to clean-burning U.S. electricity, be it renewables, nuclear, or natural gas.

And natural gas has accounted for a decrease in absolute emissions in the United States, less than I think now, well, certainly 2005—you guys will tell me it's probably even earlier—despite a bigger population, a bigger economy, and more electricity usage. I say all that, and I yield back, Mr. Chair.

The CHAIRMAN. Right on, brother.

[Laughter.]

The CHAIRMAN. We have Senator Cantwell now.

Senator CANTWELL. Thank you. Thank you, Mr. Chairman. Thank you for highlighting the success of the CHIPS and Science Act. This breakthrough legislation is on track to triple domestic chip manufacturing capacity by 2032. So we should be excited about that. And thanks to the Act, that is the largest percentage of semiconductor growth rate in the world, so I can't emphasize how important that is, and many people here played a big role in supporting that.

But we have the same issues as the Chairman mentioned in the Northwest. The Northwest Power and Conservation Council calculates that the region will need 3,500 megawatts of renewable generation by 2027 and 14,000 additional megawatts by 2040. I think it's a DOE estimate that puts the Pacific Northwest in a need of 56 percent more transmission capacity by 2040.

So we are very proud of our AI, cloud computing, all of that, but we have to figure out what we are going to do about the power need. You mentioned hydro, so I wanted to ask you about what you think the priorities there for hydro relicensing should be. Do you think we need a tax credit to help spur baseload, keep baseload power in place? And what other things do you think we need to do in the transmission capacity that would be interesting for your next phases of production?

Mr. GATZEMEIER. So first, I mean, we are fortunate to operate in Idaho, where we have a lot of access to hydro in the Pacific Northwest generation. And then we will be operating in New York, where again, there is additional hydro, you know, access. So it's absolutely a good source of, you know, sustainable energy that we should be continuing to invest in. But I would also say we need to be looking at all sources of sustainable energy—looking at nuclear, small modular reactors, investing in that, investing in improved battery storage technology for wind and solar, which we have discussed here as well. And then geothermal and other sources. Any additional generation that we can get is critical.

And then for the grid in the Pacific Northwest, I mentioned the B2H transmission line, getting that put in place and interconnecting, you know, Washington, Oregon, and Idaho more, to where there could be seasonal demand fluctuation and differences in generation being able to share. That's how that transmission line is going to be critical for the Pacific Northwest in enabling interconnectivity.

Senator CANTWELL. Well, just to make clear, there are some savings, right? I mean saving, I think it's like one-third or one-fourth the cost to basically save an electron than it is to produce one.

Mr. GATZEMEIER. Yes.

Senator CANTWELL. There is some capacity to build into the grid on smarter technologies that would help us in moving power around where we need it.

Mr. GATZEMEIER. Yes. And when you look at the availability of power from lower-cost sources during different seasonality, and then also you look at the cost of an asset, if you will, of a generation source that sits idle because wind or solar are running at that time, if you could send that power somewhere else to where it could be utilized as a lower cost, that could help savings as well.

Senator CANTWELL. What about the tax credit idea? We already have it for wind and solar. Why not for hydro?

Mr. GATZEMEIER. You know, one thing I will say, in New York, they introduced zero-emission credit (ZEC) for their nuclear power plants that they had, to work on, effectively, maintenance activity that they had with their nuclear plants to keep them online and running. So to continue hydro plants funding, that could be a program that you could look at and follow potentially.

Senator CANTWELL. Okay. And what about other sources of energy for the future? You mentioned battery technology. You didn't mention fusion, but we have three fusion companies going to work in Everett, Washington. Do you think that there are some other things that Micron is looking at as we think about these data centers and AI integration into the grid?

Mr. GATZEMEIER. Yes, I mean, we produce semiconductors, not energy. We are a consumer of energy, but I will say that we are working to innovate in our factories to lower our consumption, and then also our products. You know, it takes power to make our chips, but then it's also about the power our chips use after they get out in the data centers. So every generation of our technology, we are working to reduce the power that they consume. Since 2011, we have done a 10X reduction in our power consumption of our chips. And as I mentioned, our high-bandwidth memory is 30 percent more energy efficient than other competitors' products on the market. So we are working to effectively reduce our energy consumption in those ways.

Senator CANTWELL. And, I don't have enough time, but that is monumental success, right? And when you think about driverless cars or other applications, it's an immense amount of energy and memory that is required. So thank you.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator.

And now we have Senator Murkowski.

Senator MURKOWSKI. Thank you, Mr. Chairman. I want to follow on the comments from Senator Cantwell about hydro. Now, just thinking about what we have in place with the hydro production in this country and how it has provided us that great baseload—wonderful. We can do more. We know we need to be doing more, but when we are looking at the number of hydro facilities that are now up for relicensing, and recognizing how much it costs to relicense and how long it takes to do it, you know, what's to say that we are not going to have some of these facilities that are just like, not worth the time nor the energy, and it goes back to the permitting, but it is something that I think, as we think about our energy demands, we have got to have some better projection here.

I was in a Defense Approps hearing not too long ago, and we were talking about PACAF's number one priority at JBER in the Anchorage area there. It is a training facility, and they just very casually say that it's going to increase JBER's power requirements by roughly 50 percent. And you're thinking about what that means. This is in an area of the state where we are talking right now about importing LNG from Canada because our LNG reserves in Cook Inlet are going down.

So we are thinking about what it's going to mean. Are we going to be seeing brownouts? What's happening? Where are we going to get this resource? We have got a Governor that is now saying we are going to go back to coal. I mean, there is more than a little bit of panic and anxiety. We had our legislature just shut down just last week. But so much of the focus has been on our energy and the increased consumption, the increased demand here.

So a question for probably Mr. Fowke and Mr. Mills, this anticipated energy demand, we see the forecasts in filings by the RTOs over the last couple years. But EIA's latest 2023 Annual Energy Outlook only forecasts demand would grow by about one percent on average from 2022 to 2050. I cannot even begin to think that that is reasonably or remotely sane. It's not the world that we are living in, and we are seeing this every single day.

What is the discrepancy here in terms of the forecast, whether it's from EIA or the RTOs? Is the problem in how they are collecting the information? The forecasting issues—we have got to get a better handle on what's coming down the pike here.

What do we need to do?

Mr. FOWKE. Well, I don't know where EIA is getting their information. That sounds like a forecast that maybe would have been accurate four years ago—

Senator MURKOWSKI. Maybe.

Mr. FOWKE [continuing]. But not with what we are seeing. Not with what we are seeing in today's world. I mean, in central Ohio, we are going to double our capacity in five years. And we have talked extensively about the amount of demand we are seeing. I think one thing that has to happen within the RTO structures is, it is incumbent upon us as a utility to get the updated forecast in a timely manner so they can have full information.

Senator MURKOWSKI. Do you think that they are collecting the right data in order to give you a forecast that is accurate?

Mr. FOWKE. Well, the RTOs typically collect their data from their members. So we need to tell them how much load we are seeing.

And then of course, there is a risk adjustment process and how much of that is actually, you know, serious, how much—maybe it's duplicate, et cetera. But we are working very closely with them to get those forecasts right. And they are recognizing it.

And you are starting to see it, Senator, in what is happening with the pricing of capacity, for example, in the PJM market. A three-year capacity window does not encourage the capacity that needs to be built for a 30-year time frame. But we are starting to see change.

Senator MURKOWSKI. Mr. Mills, do you want to comment on this?

Mr. MILLS. I think the fundamental problem is the obvious one—it's hard to predict the future, but one thing we do know we can predict is that innovation occurs in episodes. There are interregnums.

Senator MURKOWSKI. Well, okay, but talk to me, because we just passed the CHIPS Act a couple of years ago. We know that is coming, right?

Mr. MILLS. Correct.

Senator MURKOWSKI. So how are we incorporating what we know legislatively, what we know from an appropriations perspective we should see coming our way?

Mr. MILLS. Well, Senator, I would say this is blowing my own horn, as they say, but when the CHIPS Act was passed, I did write and did testify for the Committee that the effect of that would be to radically increase electricity demand, because chip fabs—in fact, in Taiwan, 20 percent of the entire country's electricity is used to build semiconductor chips. And in Ireland, because it's a data center hub, 20 percent of the entire country's electricity is to run data centers. This was predictable. It was predicted in the technical literature.

I am one of the players that tries to push it into the public policy domains. But we are told that we will see efficiency solve “that problem.” And what I have pointed out in my testimony and said for years is, efficiency does not solve the “problem” when you have net new demands from new innovation.

Senator MURKOWSKI. Right.

Mr. MILLS. The invention of the car led to the demand for gasoline, the invention of electric car, demand for batteries, the invention of chips, demand for electricity, and so on. So the hard part is that—and I have sympathy for the leaders of electric utilities and RTOs—they are stuck with trying to guess what innovators are doing in this market. They are stuck with guessing that a new Micron might show up one day.

There aren't—I can promise you, as a student of this industry—there are hundreds of new Microns brewing in the country. Five or ten of them will succeed. In a very few years, they will demand astonishing amounts of energy and we will all act surprised. It's predictable that it will happen. What is hard to predict is exactly when, but it's not a century, it's a few years.

And I will sort of close by saying that the demands, as we have discovered, occur faster than we can get permits to build power plants or relicense hydro dams. And this is the part that has to be resolved, the incommensurate velocity of what we want for growth—we won't get it—and what we don't want to permit. And

it doesn't matter whether it's transmission lines for wind or the gas turbines and the pipelines for the gas turbines.

Senator MURKOWSKI. Thank you.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator.

And now we have Senator Hickenlooper.

Senator HICKENLOOPER. Thank you, Mr. Chair and Ranking Member Barrasso. I have and continue to support your bipartisan efforts to—

The CHAIRMAN. Now we have got contents for you. We are going to have everything at your desk.

Senator HICKENLOOPER. Okay, well, I'm ready. I am looking forward to it. I support that permitting reform and will assist any way I can. Obviously, we need to accelerate all the points that you all are making. And it's far beyond whether someone is on one side or the other of the climate change debate. The world is changing so rapidly, and a big part of the ability to respond to the greater need is going to be our ability to move electricity from one place to another.

I will start with Ms. Onaran. How would you say, specifically, and just provide a couple of examples of how permitting delays impact your members and their ability to grow.

Ms. ONARAN. Right, thank you. Yes, so, you know, we are looking into communities, as is Micron. We are looking for the reliable, we are looking for states and regions that are open to infrastructure expansion, that are not shutting those conversations down. The permitting, of course—when we delay getting that infrastructure in the ground, we cannot expand our operations there because we will not be able to reliably support our operations. We need to have that infrastructure in place. The longer it takes to permit, we either move to a different state or we do not expand. And so we are curtailing our economic prosperity by delaying this permit and getting that infrastructure that we need.

Senator HICKENLOOPER. Right. And I think the same was said in terms of reliability.

Ms. ONARAN. Absolutely.

Senator HICKENLOOPER. The same constraints exist and restrictions. And we have been discussing all about the predictions that NERC has provided that the enhanced interregional transmission would significantly lower costs and enhance reliability. We have got a BIG WIRES Act to hopefully help coordinate interregional build-out, as I have discussed with several of you over a period of time. And the SPEED and Reliability Act would streamline permitting reform on nationally significant lines.

Mr. Gatzemeier, Micron is obviously making huge investments in New York and in Boise. How does that reliability and access to low cost influence those decisions?

Mr. GATZEMEIER. On the reliability side, you know, we have talked about the impacts that a millisecond dip in power can have, right, in significant product loss for us. So reliability is absolutely paramount. Availability as well. And that's where, you know, the cost of inaction is extraordinarily high here. We have a once-in-a-lifetime opportunity. You know, I will just talk about DRAM for a second. Ninety percent of the world's DRAM used to be made here

in the U.S. in 1975. Today, less than two percent of the world's DRAM is made here. And that is at Micron's facility in Manassas, Virginia.

With our planned investment, right, in Idaho and New York, we will get that up and we will get to where over 60 percent of our capacity, you know, 12 percent of the world's capacity is built here in the U.S. again, but if we are unable to get the power, you know, either the generation or the transmission to the locations where we want to build, it will be an opportunity missed for the United States.

Senator HICKENLOOPER. Right. No, I appreciate that. And I celebrate Micron, your innovation and your success. Even though you are Idahoan, we still in the West take—of innovation. I realize innovation occurs everywhere. I don't want to create enemies. But we do appreciate all that you guys have done and are going to take this CHIPS and Science investment and make the most of it.

Mr. Fowke and I have known each other for many years, well back into my gubernatorial days. AEP testified last year before FERC that you are being asked to connect loads across the transmission system footprint equal to roughly ten percent of the total U.S. electricity demand today. And earlier this month, DOE released that preliminary list of National Interest Electric Transmission Corridors (NIETCs). And many of these primarily designated areas fall within AEP's service area.

So how would that final designation of these high-priority areas make it easier for you to access new transmission infrastructure and connect new generation? How much of the work has been done?

Mr. FOWKE. Yes. First, good to see you again, and we are very supportive of the BIG WIRES Act, by the way, and want to continue to work with your staff on that. As far as the national corridors, you know, at AEP, we have had a tremendous amount of success working with our states to get transmission sited, and I think we have had to use eminent domain in less than three percent of the circumstances. So I think what's important, what the national corridors bring—FERC doesn't have the ability across the full grid—is in those rare cases where we need a federal backstop to step in when it's a critically important transmission line for reliability, that's where I think FERC today only has that authority in these national corridors.

So that to me is the bigger thing than having a national corridor in my humble opinion, because states should be leading the siting process. I think they are critical in that process.

Senator HICKENLOOPER. Totally agree.

Great. Thank you all. I appreciate your—I am out of time, but I might come back for a second round of questions. Mr. Chair.

The CHAIRMAN. Senator Hoeven.

Senator HOEVEN. Mr. Chair, I am just glad I could be here to help balance things out for you.

The CHAIRMAN. Oh, I'm so happy you're here.

[Laughter.]

The CHAIRMAN. I am looking forward to this.

Senator HOEVEN. Well, I knew you would be. Thanks to all of you for being here. I have got to start with Mr. Gatzemeier. I don't

know if anybody has mentioned it yet that you were a four-year member of the University of North Dakota's outstanding swim team and that you received a B.S. in electrical engineering—double E. So obviously a jock on campus and obviously managed to get an electrical engineering degree. Pretty impressive. Then went on to, you know, reasonably good schools, although not as good, to get an M.B.A. in Fort Collins and an M.S. at Berkeley. So I just wanted to make sure people were aware of your impeccable and outstanding credentials. If you would have had something in West Virginia in there as well, it would have been a trifecta.

[Laughter.]

Senator HOEVEN. But seriously—

The CHAIRMAN. Now you see why we are happy he is here.

Senator HOEVEN. Yes. He and I were Governors together for about ten years. So we go way back.

The CHAIRMAN. Way back.

Senator HOEVEN. Way back. But seriously, let me start with Mr. Fowke. And that was serious, but I did want to welcome you. Mr. Fowke, in your testimony, you say that EPA has finalized new power plant sector regulations, and I quote, "which could hasten the pace of plant retirements and diminish reliability" at the same time that FERC is saying we need to increase electricity over the next five years. Increase it. So, don't we need to be focusing on dispatchable resources 24/7 to provide this additional electricity? I mean, it's not going to magically appear out of thin air, right? So aren't we on the wrong track, and don't we need to have EPA work with our baseload industry to make sure we can meet our electricity needs? And we're not like some third-world country with blackouts and brownouts, which have already started to happen.

Mr. FOWKE. Yes. I agree with you there. I love seeing renewables on the grid, but you cannot substitute 24/7 dispatchable generation. In fact, if you look at the queue right now, the generation queue, I think it's 2.6 terawatts, which is more than double the existing capacity we have on our system. But if you look at what is in those queues, Senator, over 95 percent of it is non-dispatchable generation.

Senator HOEVEN. What was the percent?

Mr. FOWKE. Over 95 percent of it is—less than five percent of it is dispatchable 24/7 generation. So we absolutely need to hang on to what we have.

Senator HOEVEN. I heard you the first time. I just wanted to make sure everybody else did.

[Laughter.]

Mr. FOWKE. We absolutely need to hang on to what we have. And the EPA rules, I believe, will hasten the retirement of the dispatchable generation we have on our grid today.

Senator HOEVEN. Okay. Who wants to disagree with him and why?

Let the record show that nobody disagrees. I think that is pretty important. Now, from the user side, Mr. Gatzemeier, I don't know, is dependable electricity important at all in your business, or do you think it's important to anyone else?

Mr. GATZEMEIER. It's incredibly important, and I know it's important to all semiconductor manufacturers. Minor interruption, milli-

seconds, can cause our factories to go down for a week and cause, you know—millions—tens of millions in product loss, so incredibly important, and our factories run 24/7, 365 at peak output operations, so we require, you know, the baseload to meet our demand.

Senator HOEVEN. So, would you argue it's vitally important in terms of our economy, being competitive in a global economy? And would you argue it's important for national security as well to be able to generate energy for ourselves and our allies?

Mr. GATZEMEIER. Absolutely, yes.

Senator HOEVEN. Okay. Any other thoughts on how we not only maintain, but increase our baseload—from any of you that would like to respond to that? Mr. Mills, sir.

Mr. MILLS. Senator, the fastest way to increase power supplies, as we are talking about demands that are occurring in the next few years, not decades, is not things we don't know how to build, but things we know how to build. So the fast construction of dispatchable power will come from gas pipes and gas turbines. That will be the primary source of new supply. This will be true with the United States—almost every state—and it's also true in Europe. It's what is happening in and around the world, but especially here.

Senator HOEVEN. And would you agree that American technology and ingenuity is driving improvements to environmental standards at the same time that we are producing energy on a low-cost basis, and on a dependable basis in this country, and that is a better approach than regulations that shut us down and force us to get energy from other countries?

Mr. MILLS. Well, you know the expression that the question answers itself, sir.

Senator HOEVEN. Good. Well, I really like that answer. So again, I want to thank all of you.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator.

And now we have, let's see—Senator King.

Senator KING. Thank you, Mr. Chairman. What's bothering me about this entire discussion is that we are only talking about half of the equation. We're like in a car on a railroad track with a train coming toward us, and we're talking about the cost of a tow truck. The cost of not addressing climate change dwarfs the cost of addressing climate change. There are reliable studies that indicate it is as much as five times. In Houston today, the power is off.

Now, we can talk about this, and you can dismiss these studies and talk about environmentalists and everything else. I will tell you who is paying attention to this—the insurance companies. They are cold-eyed businesspeople. And there was just a report this morning that Texas has had to create a kind of risk pool because people can't get homeowners insurance because of the volume of these violent storms.

So I just want to put the context here. Nobody is saying we should go back to hydro because they love the looks of dams. They are saying we should be talking about renewable power because the alternative to moving in that direction is catastrophic in terms of dollars and cents. So I just wanted to lay that little bit of context. I agree with you all, Mr. Mills and others, about permitting

reform. I have been working with the chairman for years on this. It has got to include judicial reform. So the whole point is that the process just can't take forever. Last week we had the Secretary of the Interior. I talked to her about it, and I informed her, because of the delays that they have in doing their studies, that Eisenhower retook Europe in 11 months. So I suggested she send an email to her permitting staff with one word—Eisenhower.

And so we have got to address that. I understand that. But to act like the transition is just something we are doing because it's a nice thing to do, or because some elite group says we should do it, is just not accurate. Transmission is obviously a big part of the problem. Mr. Fowke, I like your testimony about GETs, that's not the whole answer, but it's part of the answer. And an indication, you increase the throughput by 40 percent without building new poles. And I think that is the kind of thing—and also dynamic line management has got to be part of that as well.

The other piece is the queue. Nobody has talked about the queue. I think one of you, I think you testified there is as much power waiting in the queue of the various RTOs around the country that's double the total amount of power being produced in the country right now. And by the way, it's not all non-dispatchable. Five hundred gigawatts is batteries. Batteries are dispatchable. And that's a technology that is obviously in development. There are other kinds of storage technologies. Good old pumped storage has been around for 150 years. All those kinds of alternatives.

But Mr. Fowke, how do we get there? I guess I will go back to my original question. Do you believe we have to address the threat of climate change?

Mr. FOWKE. Yes, absolutely. And I think there is a lot we can do, but we also have to balance that against the need for reliable and affordable power. And we need to—

Senator KING. Absolutely.

Mr. FOWKE. I have spoken many times about this in my former role, and I will say it as just somebody that is in the industry. This industry can make tremendous strides to reducing carbon emissions, and already has, more than we probably ever thought possible. But that last—you picked a percentage—that last 20 percent is going to require different technologies than we have today. I am a big believer—

Senator KING. For example, small modular reactors.

Mr. FOWKE. You just took the words out of my mouth, Senator. I am a big proponent of that. Maybe carbon capture becomes viable. It's not now. Maybe there's something else, but we have to have technology move at the speed of value. And I worry that when we prematurely shut down power plants that are running, that is going to have a very negative impact on reliability and potentially the ability to fund this terrific growth that we are seeing across the country.

Senator KING. Do you agree though that the queue is a barrier in itself, in terms of the what's waiting in line?

Mr. FOWKE. Yes, I do. And that's why we think that FERC should be encouraged to fast-track those resources that load-serving entities that have the obligation to serve feel are essential to preserve reliability. We don't have that today, Senator.

Senator KING. I think part of the answer here, and we always talk about all of the above. There are so many options. Everything from GETs to storage to more efficient conservation. I used to be in the conservation business, where we could cut energy usage significantly in a factory or a hospital. And those are kilowatt-hours that you can use somewhere else. They are not generation, but they free up generation to be used somewhere else. So, plenty of options.

Thank you all very much for your testimony. Thank you, Mr. Chairman.

I don't know what to say. You're——

Senator HICKENLOOPER [presiding]. I have gotten wiser.

Senator KING. Say something in West Virginian.

[Laughter.]

Senator HICKENLOOPER. I can't quite speak that language yet, but I am getting close.

Senator Hirono.

Senator HIRONO. Thank you very much. I am glad that Senator King noted how important it is for us to deal in this space with climate change because I agree that the insurance industry certainly has gotten it when you can't afford homeowners insurance because of the need to cover the results of extreme climate disasters, including, I have to say, wildfires, which is what Maui experienced. Then, you know, at least we have one major industry that has said we need to deal with climate change. And thank you for agreeing that that's something we have to do.

So I am interested in the importance of clean energy goals. Mr. Gatzemeier, the analysis from S&P Global recently released a study on data center power demand that concluded, "Many of the large technology companies and private equity groups that own and manage data centers have pledged to use green-powered electricity for their needs. And we expect renewables to ultimately supply a majority of the incremental supply to the facilities." Can you elaborate on Micron's renewable energy commitments and the role they played in locating new plants Micron is building with the help of the CHIPS and Science Act?

Mr. GATZEMEIER. Yes, so at Micron, we have committed by the end of 2025 to be 100 percent renewable in our factories in the United States, and elsewhere in the world where available. Fortunately, you know, you look at Idaho and New York, the availability of renewables there was a play. The other thing that we were looking at is entering into co-op solar projects like we did with Idaho Power, with the Black Mesa project, which was a 40-megawatt project. In addition to that, we'd be looking at additional PPAs or renewable energy credits purchased as well, to hit those goals.

Senator HIRONO. So how much did the falling cost of renewable power contribute to Micron setting its energy goals?

Mr. GATZEMEIER. I'm sorry, what was the question?

Senator HIRONO. How much did the falling cost of renewable power play into Micron setting its energy goals moving toward green energy?

Mr. GATZEMEIER. Yes. Obviously, we look at the cost of energy and we are in a cost-sensitive business, so we want to continue to drive that and be effective. And fortunately, in the U.S., you can get renewable energy credits, you can look at renewables that are

effective today. However, if there is not more generation added onto the grid with the amount of demand that we are talking about, the cost of energy would rise and create problems.

So then you would run into availability issues, reliability issues, and those are the things that we would like to avoid through change here with transmission and additional generation of multiple sources coming online. So solar, wind, battery technology—to enable those to be more effective—geothermal, and we have talked about nuclear with the small modular reactors and other investments that could be done to continue down that path to meet all of the goals that we are looking for.

Senator HIRONO. So I think you are an example of a private company that pays attention to these issues.

For Mr. Fowke, you described how new data centers could require 3 to 15 times as much power as a more typical industrial plant. Do you think states and utilities should require data centers with such a new demand for power to install energy storage onsite in order to shave back their demand for power from the grid at periods of peak demand?

Mr. FOWKE. I think that's an interesting commentary and it's something we need to look into. I mean, traditionally—and I refer to my colleague—data centers are backed up because of the importance to making sure you have backup power. But I think increasingly as we look around, I think data centers are more open to doing exactly what you described.

I also would want to call to your attention the data center tariff that we filed in Ohio, recognizing that this extraordinary growth needs to be funded fairly by the data centers and not cost-shifting to other consumers. We think it is a critically important first step as we move forward with the data centers—the demand we see from the data centers.

Senator HIRONO. I agree. Mr. Gatzemeier, do you have a comment on this question?

Mr. GATZEMEIER. Unfortunately, right now, we have power conditioning coming into our site, but we don't have any co-generation or large power backup that could sustain us through a reliability event. So in the case of a reliability issue, we would see a power implication that would impact our production in a negative way.

Senator HIRONO. I have run out of time. Thank you, Mr. Chairman.

Senator HICKENLOOPER. Thank you, Senator.

So now I get to have a second round by myself, or at least until the Chair gets back. He will be looming over my shoulder soon enough. Oh my God, there he is.

[Laughter.]

Senator HICKENLOOPER. Looming over my shoulder, as predicted.

The CHAIRMAN. You're on brother, take it.

Senator HICKENLOOPER. Let me ask a final question. Mr. Mills, I will talk with you because you have been working on this for such a long period of time, and I think you have a perspective and, you know, part of what America values in this strange creation of a democracy, that most of the time functions pretty well—people have an opportunity to voice their concerns. We spend a lot of time de-

signing the process by which neighborhoods and counties and states are heard.

Two of the biggest reasons put forward in terms of the slowness of progress, especially in expanding transmission, but also making sure that it's efficient where it needs to be, have been the process, but then also the litigation. How would you rank those, relatively speaking, in terms of where we should put more attention to trying to move more rapidly? And again, I am a big believer that climate change is real and is happening at scale. And the costs of avoiding it, as Senator King said, are enormous. By delaying our response, it's going to cost 5 or 10 times what it would cost now. So within that, where should we be focusing our attention?

Mr. MILLS. Well, you know, as a former practitioner, building things as a physicist and engineer, you are asking me to choose between process and litigation as the lesser of evils. It's a tough challenge.

But seriously, I think what you would find from most industries, the threat of litigation is real. And in the hypertrophied examples, it becomes the critical—the dispositive factor that kills things. But on average, I think what you would find in business is that it's the regulatory process, it's the sand in the gears that, as economists would talk about, that faces businesses small to large in the United States.

So the International Manufacturers Association puts out a semi-annual study of the actual costs of process in the form of regulations, but they monetize it. And of course, in the United States, the last study came out this spring. For a large firm, it's \$18,000 a year per employee, and for small firms, \$36,000 per year, if I recall correctly, per employee for the regulatory compliance process. So that is a huge headwind for businesses to start and expand in the United States.

So I would say, if I had to choose from the two, I would say the process system, the regulatory systems—federal in particular—but state as well, are big impediments.

Senator HICKENLOOPER. Right. And I appreciate that. And I would argue that the process is, again, uniquely American and critically important—

Mr. MILLS. It is.

Senator HICKENLOOPER [continuing]. And we don't want to eliminate it. But certainly, I think there are probably ways when we look at something like this, where really both sides, the Republicans and Democrats, rural and urban, everybody's got an alignment of self-interest, and getting things built more rapidly to address this energy challenge that we face, I think it's maybe a time to go and re-look at some of the processes, make sure people's voices are heard, that there is an inherent sense of fairness in how decisions are made. But we can do it more quickly.

With that, I yield back to the Chair. The man who must be respected, who always is seeing both sides of the fence.

The CHAIRMAN. Well, let me just say to all of you, thank you for your expertise that you bring to the Committee. I think it's something that we need to continue to raise the alarm on. Because I can see a real catastrophic situation happening in our country and not being able to meet the demand, no matter what side of the political

fence you are on. And it's a shame that politics has divided us up to what team you are on. There is only one team, the American team. And every American expects to have dependable, reliable, and affordable energy because you know what, they always have.

We have built a system around what the needs of the country are and the defense of our country. And we are getting to a situation now because of the political will, if you will, and whoever's in charge wants to push one agenda over the other. And I have always said this, if it's not feasible, it's not reasonable. It really isn't. If you can't do it, we are not there. We haven't matured. Carbon capture sequestration, Mr. Fowke, I remember, I was Governor at the time, and the Senator will tell you this, Senator Hickenlooper here, you all went into that venture.

It was a 900-megawatt plant—the Mountaineer Plant, correct? I'm understanding in order to prove that we could commercialize carbon capture sequestration, and you all did that, and we showed that we could take Clearstream carbon off, liquefy it, pressurize it, and put it back in the ground. But it took about three—on scale, it would have taken a third of your power. So when President Obama—I told him this—I said, “President Obama, you have said go ahead and build a coal-fired plant and I will break you.”

And you would, if you made us use carbon capture at that time, we didn't have the maturity in technology. You can't build a plant that costs 900 megawatts of investment and only gets 600 megawatts of return. That's the problem. That's how it would break you. So when they said it was a war on coal, there was no alternative. It's either shut it down or get out of the—you know. So that was the problem. I will tell you this—politically, it changed my State of West Virginia from being over 75 percent Democrat registration—old line conservative Democrats—but they were still Democrats. That switched now to 80 percent Republican in one decade because of that. And the only thing I have said about transitions, don't ever take someone's job away from them unless you have something equally as good, if not better, because you will pay the ultimate price on that one.

So this transition is going on. We gave you the maps and this and everything else. My state will be hit eventually because if it wasn't for West Virginia two years ago with that polar bomb or whatever they called it, remember, shut everything down, every coal plant we had—and Ben, you can confirm this—you were running about 110 percent, putting out everything you had to keep PJM from falling apart. It would have gone down. So that's all we're asking this administration to realize, that I am not defending fossil over renewables or either one. I am just basically looking at the load that we have and the need.

And we have replaced—growing up, the only two dispatchable 24/7 that we had was at that time nukes and coal. Gas has replaced the coal. And we saw gas freeze up in Texas and people died. So we have some work to do there. SMRs are coming on, and we are all in. Battery storage, we are all in. Wind has the greatest challenge of all, I believe, of all the renewables they want to use because of permitting. So we need permitting for pipelines to move carbon capture and really get it matured. They need it, we all need it. And that's all we are saying.

So when Senator Schumer said, you know, he thought it was not going to go anywhere, I think it must go somewhere and we have it ready to go, and we will, and we are working with our Republican colleagues here, our Democratic colleagues, and we will go and see if we can move this from this Committee forward on the floor.

But again, your expertise means an awful lot to us. And I want to thank you for that. And what we will do is, we are going to go ahead and adjourn the meeting, but we are going to give members until the close of business tomorrow to submit additional questions for the record.

So with that, thank you. The meeting is adjourned.

[Whereupon, at 11:48 a.m., the hearing was adjourned.]

APPENDIX MATERIAL SUBMITTED



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**U.S. Senate Committee on Energy and Natural Resources
May 21, 2024 Hearing: *Opportunities, Risks, and Challenges Associated With
Growth in Demand for Electric Power in the United States*
Questions for the Record Submitted to Mr. Benjamin G.S. Fowke III**

Questions from Chairman Joe Manchin III

Question: Our country has a once-in-a generation opportunity to on-shore manufacturing, lead in new high-tech industries, and increase our economic competitiveness and in turn national security. But electric power needs to be available, reliable, and affordable to capitalize on these opportunities.

- a. What is at stake nationally—for our economic competitiveness and national security interests—if we can't build out high-tech chip manufacturing and advanced computing facilities here in the U.S.?

Answer: The electric power industry will play a crucial role in helping the U.S. remain a global leader in advanced manufacturing and technology innovation. The demand growth we are seeing throughout our service territory represents a historic moment for our country and is important to our national security and economic competitiveness. A significant portion of this demand growth is due to the onshoring of critical manufacturing like high-tech chip fabrication facilities, as well as industrial manufacturing and data processors. These companies are choosing to build here because, in part, we have abundant energy resources and reliable, affordable power.

In order to facilitate this growth in critical manufacturing, we will need to expand our nation's electric generation capacity as well as our electric transmission system. Access to reliable, affordable power enables the onshoring of critical manufacturing, leading to economic growth, job creation, and improved national competitiveness and security.

If we are unable to meet this challenge, much of this growth may be realized in other parts of the world. Offshoring critical components of our supply chain could have negative effects on the economy. It could lead to job losses in the communities we serve and harm our national interests by allowing critical components of our modern economy to potentially be manufactured by countries that do not share our values. Accelerated development of the bulk power system must be a national priority if we are to meet this challenge.

Questions from Senator Martin Heinrich

Question: Whether we're talking about energy or infrastructure, we can't solve today's challenges with yesterday's solutions. What are some of today's grid enhancing solutions to get more out of our grid? And what are the tangible benefits of those solutions?

Answer: We are experiencing unprecedented demand for electricity while we are simultaneously transitioning to a new generation resource mix and investing in modernization of an aging transmission grid. Grid planners



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across the country are assessing and deploying grid enhancing technologies (GETs) in an effort to maximize existing infrastructure and reduce costs for customers.

AEP has a history of developing, testing and integrating new GETs and we remain committed to deployment of GETs on our system where these technologies are reliable and cost effective.

These include Dynamic Line Ratings, Advanced Conductors, Power Flow Controllers, and Grid Topology Management. In addition, we have deployed other advancements in technology such as AEP-created BOLD Transmission Technology. BOLD is a solution for increased transmission line capacity that utilizes reduced structure heights and smaller rights of way. We continue to deploy this technology in multiple regions of the country today.

GETs are useful tools that can create efficiencies on the transmission system and are certainly part of the solution, but are not “the solution.” These technologies can serve to better manage the transition, but will not be able to replace the need for new generation or transmission considering the level of increase in the demand for electricity in different regions of the country.

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Questions from Chairman Joe Manchin III

Question 1: Our country has a once-in-a generation opportunity to on-shore manufacturing, lead in new high-tech industries, and increase our economic competitiveness and in turn national security. But electric power needs to be available, reliable, and affordable to capitalize on these opportunities.

- a. What is at stake nationally—for our economic competitiveness and national security interests—if we can't build out high-tech chip manufacturing and advanced computing facilities here in the U.S.?

Answer: Our nation stands to lose economic prosperity and national security if we fail to embrace our innovative capabilities and the necessary energy grid infrastructure to support domestic manufacturing and computing. In ceding onshoring opportunities, our nation risks dependence on foreign supply chains for essential computing components, manufacturing equipment, and critical minerals. By relying on foreign nations, we are vulnerable to supply chain interruptions which we have no control. We, as a nation, will lose our technical leadership, trade superiority, and expertise in consumer electronics and advanced computing while also foregoing essential job creation and economic development in communities that have long been overlooked.

Even more threatening than economic disadvantage is the threat to our national security should we fail to invest in our domestic manufacturing and computing infrastructure. In a time of elevated political turmoil overseas, the U.S. cannot rely on hostile foreign nations for such essential services. These hostile nations have the potential not only to intentionally disrupt our critical supply chains but also have access to our intellectual property and sensitive information increasing the likelihood of espionage, sabotage, and theft. As our military relies on advanced technologies for communication, surveillance, and protection, these foreign intrusions would be devastating.

Questions from Senator Martin Heinrich

Question 1: You shared that grid modernization and grid enhancing technologies will save consumers millions of dollars and expand transmission capacity. Can you share how it will help New Mexico families?

Answer: There is no question that electricity bills are increasing, especially the transmission rate component. While New Mexico's retail rates are typically lower than the national average,¹ many New Mexico families struggle to pay for this essential service as New Mexico's per capita income is also below the national average, ranking 45th in the country.² As the nation transitions to cleaner energy and expands domestic manufacturing and computing capabilities, transmission capacity will need to double or even triple in the next decade with some estimates in the trillions of dollars.

¹ U.S. Energy Information Administration, Table T5.a "Residential average monthly bill by Census Division and State" (Oct. 5, 2023); https://www.eia.gov/electricity/sales_revenue_price/pdf/table_5A.pdf.

² FRED Economic Data, "Per Capita Personal Income by State, Annual" (2023); <https://fred.stlouisfed.org/release/tables?rid=110&cid=257197#snid=257229>

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However, transmission expansion does not necessarily require brand new transmission infrastructure. Transmission operators run our existing infrastructure at very conservative margins so as not to overload the system and cause cascading blackouts. However, with the invention of new grid technologies, transmission operators can monitor weather and grid conditions in real time which allows for safer operations at greater capacities and optionality. The cost of these advanced technologies typically represents 5% of what brand new construction would cost³ and increases usage of our current infrastructure by up to 40%.⁴ With these inexpensive measures, millions of dollars in new construction can be deferred as well as reducing costly congestion. This has the potential to save New Mexico families hundreds of dollars a year on their electricity bills. Similarly, the increased interconnectedness of the grid, facilitated by these technologies, guarantees that New Mexico residents have access to affordable electricity resources and greater reliability.

Question 2: In New Mexico, we're seeing companies eager to generate and store clean energy onsite – reducing their costs, alleviating stress on the grid, and reducing emissions. Are your members looking at ways to do the same?

Answer: Absolutely. The industrial sector, bolstered by recent federal funding under the Inflation Reduction Act and Bipartisan Infrastructure Law, are investing in clean energy research and development as well as options for generating and storing lower-carbon energy resources to reliably serve their manufacturing operations. The industrial sector is exploring hydrogen capabilities, carbon capture, and small nuclear reactors as on-site, lower carbon solutions that also guarantee additional reliability in cases of grid interruptions.

Question 3: The industrial sector is about a third of U.S. energy consumption¹ and contributes a quarter of greenhouse gas emissions. What are industries doing to reduce energy consumption and emissions, including but also beyond electrification?

The industrial sector is investing in and implementing lower carbon solutions throughout the entire production cycle, from its energy procurement, materials, industrial operations, and waste.

Industrial operations are extremely energy intensive and thus energy procurement and usage are a normal first step for reducing industrial carbon footprints. The industrial sector is increasingly contracting for zero-carbon or renewable electric generation resources as well as investing in on-site lower carbon generation, storage, and energy efficiency measures to lower both carbon emissions and energy usage. Industrial companies are investing in renewable feedstocks for the operations and output of their processes including hydrogen, ammonia, renewable diesel, natural gas, and nitrogen while also monitoring the carbon-intensity and sustainability of the materials and components used in their operations.

³ Sen. Angus King news release: "King to Energy Secretary: U.S. Should Motivate Utilities to Adopt Cost-Saving Grid Enhancing Technologies," (Apr. 16, 2024); <https://www.king.senate.gov/newsroom/press-releases/king-to-energy-secretary-us-should-motivate-utilities-to-adopt-cost-saving-grid-enhancing-technologies#:~:text=The%20grid%2Denhancing%20technologies%20and,buildout%2C%E2%80%9D%20Secretary%20Granholm%20said.>

⁴ Alex Brown, Stateline, "Allowing more juice to flow through power lines could hasten clean energy projects," (Mar. 8, 2024); <https://stateline.org/2024/03/08/allowing-more-juice-to-flow-through-power-lines-could-hasten-clean-energy-projects/>.

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Industrials are investing in carbon, capture, utilization, and sequestration/storage to reduce the emissions from its operations including direct air capture. Many operations are reducing flaring and managing methane emissions while also increasing electrification of operations to cut out emissions all together. Industrials are also better managing other waste from operational processes including molecular, polymer and plastics recycling that can be reused in their processes or sold to other manufacturers.

Question 4: Anyone who's ever paid a utility bill knows that if you lower your energy use, you end up with lower costs. How are your members lowering and adjusting their energy use to reduce stress on the grid?

Answer: Industrials and manufacturers are one of the largest segments participating in demand response programs. Industrials can vary their production, and thus energy use, either through price sensitivity or direct instructions from the local utility. Manufacturers have several time-varying rates that allow for industrials to react to real time price signals, including real-time pricing, variable peak pricing, critical peak pricing, peak time rebates, time of use and coincident peak.⁵ At times of very high prices due to stresses on the grid, manufacturers can reduce production to alleviate electricity demand.

Demand response programs that provide financial incentives for energy use reduction are also utilized in manufacturing operations either by continuous protocols or event driven programs triggered by utilities to increase reliability on the grid.⁶ There are generally four tiers of demand response depending on a manufacturing facility's operating requirements: on-site generation, demand management, energy efficiency, and load elimination. When a demand response event is called, manufacturers can substitute its own generation rather than taking generation directly from the grid (substitute load), implement automated demand management systems that react to specific operating signals and environmental conditions (move load), use less energy to complete its operations (reduce load), and shutting down certain functions or operations (eliminate load).⁷

See Figure 6 below:

⁵ U.S. Department of Energy, "Demand Response in Industrial Facilities," at pp. 9-12 (2022); https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Demand%20Response%20in%20Industrial%20Facilities_Final.pdf.

⁶ *Id.* at p 12.

⁷ *Id.* at pp 16-20.

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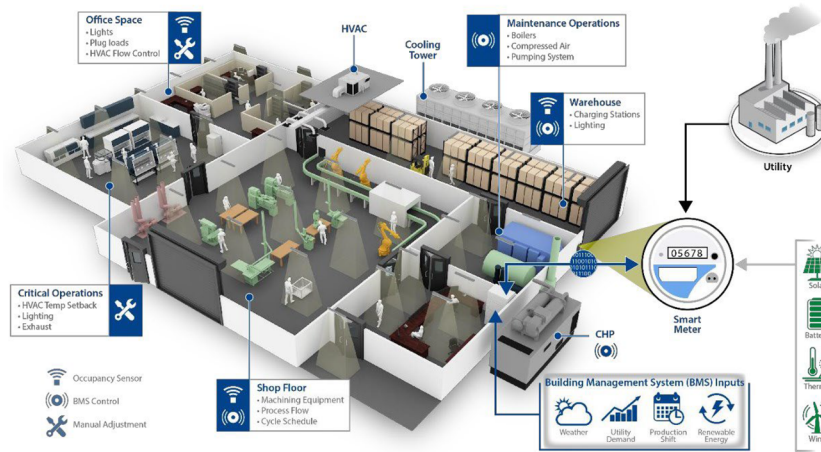


Figure 6: Fine Factories DR system.

SCOTT GATZEMEIER - RESPONSES TO QUESTIONS FOR THE RECORDQuestions from Chairman Joe Manchin III

Question 1: Our country has a once-in-a generation opportunity to on-shore manufacturing, lead in new high-tech industries, and increase our economic competitiveness and in turn national security. But electric power needs to be available, reliable, and affordable to capitalize on these opportunities.

What is at stake nationally—for our economic competitiveness and national security interests—if we can't build out high-tech chip manufacturing and advanced computing facilities here in the U.S.?

Micron is the only U.S. manufacturer of memory and produces the most advanced memory chips in the industry, which power everything from automobiles and medical equipment, to AI, key defense capabilities, critical infrastructure, and data centers. Fundamental to our leadership, and in ensuring the success of the growth of U.S. manufacturing nationally, is that the United States continues to supply affordable, reliable electricity with a resilient national power grid.

With respect to U.S. manufacturing, the U.S. share of DRAM manufacturing has decreased from 90% in 1975 to less than 2% today. Current advanced memory production is heavily concentrated in Asia; in 2021, more than 98% of global DRAM products were produced in China, South Korea, Taiwan, and Japan. These stark figures demonstrate why memory supply chains are vulnerable to disruption in the event of natural or human disasters (such as the Covid-19 pandemic), as well as geopolitical tensions or conflict.

As the only U.S. producer of memory, we want to make these chips domestically to help sustain U.S. high-tech leadership. Micron's U.S. investments will contribute more than any other company to drawing co-location benefits and a renewed US semiconductor ecosystem. The co-location of Micron's R&D fab with Idaho high volume manufacturing and New York's four-fab megafab projects will onshore 50% of Micron's DRAM production to the United States, create approximately 75,000 jobs, and drive supply chain investments across the country.

These investments will ensure we can domestically produce more than what is critically needed for national security and economic security.

Questions from Senator Ron Wyden

Question 1: It is clear that the demand for data centers in the age of Artificial Intelligence will continue to grow rapidly, and the energy demand along with it. While

there has been significant focus on increasing power generation, I am also very interested in the efficiency gains in the chips themselves. Companies in Oregon's Silicon Forest have been leading the way in that effort. What could we do to better advance the development and manufacturability of more energy-efficient chips, or to incentivize their use?

Government research partnerships are essential to the semiconductor ecosystem, and play a key role in advancing efficiency. From the Micron perspective, memory-centric computing is central to increasing semiconductor energy efficiency. For decades, improvements in efficiency have been driven by the shrinking of the various physical elements on a semiconductor chip, both in logic and in memory. But because of physical limitations, this process of scaling has slowed, particularly for logic chips.

To achieve higher energy efficiency, renewed effort is being placed on a fundamental driver of energy consumption in computing systems, known as the "memory wall." It is a performance bottleneck in computer systems created by the physical separation of data storage (memory) and data processing (compute). This separation necessitates frequent data movement between memory and processing units, which drives energy consumption. As data quantities increase due to the requirements of advanced workloads such as AI training and inference, this problem becomes more pronounced. To address this, Micron is developing memory-centric architectures to bring compute closer to data sources and improve overall system performance; thereby decreasing energy consumption.

One way that the government can work to incentivize the development and adoption of these technologies is through R&D partnerships with industry experts like Micron that are uniquely positioned to make these new computing architectures a reality. Experts at government labs, including the Air Force Research Lab, Pacific Northwest National Labs, and Sandia National Lab bring unique perspectives on specific workloads that benefit from and shape the development of memory-centric computing.

At Micron, we recognize we have a role to play in the energy consumption of our chips, and we prioritize ensuring that our chips are as efficient as feasible. Since 2011, we have enabled over a 6 times improvement in system bandwidth, a 10 times improvement in performance, and a 10 times improvement in power efficiency for our products. For example, our latest high bandwidth memory HBM3E chip, which powers AI data centers in the United States and other major tech hubs, is 30% more efficient than competing offers according to customer reporting. Additionally, our 1 β (1-beta) technology provides more than 35%-bit density improvement while creating 15% power savings over our 1 α (1-alpha) technology. We have prioritized energy efficiency and improved performance in our chips,

not just to stay at the cutting-edge of design, but because our customers want it, and it is the right thing to do.

Questions from Senator Martin Heinrich

Question 1: The Department of Energy estimates that semiconductors could consume nearly 20% of global energy production by 2030. We can try to match that by generating a huge amount of energy, or we can increase the energy efficiency of semiconductors. Tell me more about Micron's work to increase the energy efficiency of semiconductors.

Micron is a leader in advocating for industry-level energy efficiency, and we are proud not only of the energy efficiency measures we take in our manufacturing processes, but also in designing cutting-edge chips to be as energy efficient as possible.

For our U.S. manufacturing operations, Micron expects to continue to improve energy efficiency outcomes through design and operation of energy efficient facilities and systems. This includes designing and specifying facility systems and equipment with industry best practices and best-known methods for energy efficiency and performance; enabling and leveraging smart facilities monitoring and control automation systems, including advanced data analytics, to continuously evaluate and optimize facilities, plant, and system operating performance and energy efficiency; deploying on-site renewable energy generation sources where possible; and developing new technology innovations to optimize space, operational, and performance efficiencies.

These kinds of efficiency improvements have produced tangible results in our day-to-day operations. Last year, energy efficiency efforts in our Boise operations reduced energy consumption by 19.5 million kilowatt hours, the equivalent of 1,749 average homes' annual energy use. These kinds of gains not only reduce our costs and improve our bottom line, but they also provide increased supply for other sectors and households.

For the chips themselves, we prioritize ensuring that our chips are as efficient as possible. Since 2011, we have enabled over a 6 times improvement in system bandwidth, a 10 times improvement in performance and a 10 times improvement in power efficiency for our products. Our latest HBM3E chip that powers AI data centers in the United States and other tech hubs is 30% more efficient than competing offers according to customer reporting. Additionally, our 1 β (1-beta) technology provides more than 35%-bit density improvement while creating 15% power savings over our 1 α (1-alpha) technology. We have prioritized energy efficiency and improved performance in our chips, not just to stay at the cutting-edge of design, but because our customers want it, and it is the right thing to do.

Question 2: You shared that Micron has a long history of collaboration with Sandia National Laboratories. Can you tell me more about how you are partnering with Sandia National Labs, and how that work can help folks in New Mexico?

Micron has a long history of partnership with Sandia National Laboratories (Sandia). Working with Sandia's world-leading experts in computing, Micron promotes the development of off-roadmap technological advances in memory and storage. This partnership results in new technologies that increase system efficiency while lowering energy consumption, and ultimately to produce memory and storage technologies that benefit both commercial and critical government applications.

We believe our partnership benefits the people of New Mexico by supporting the growth of New Mexico's highly-skilled workforce and by advancing Sandia's mission to ensure that U.S. national security and economic competitiveness are maintained in advanced technologies such as AI and edge computing. Joint research areas have included: exploring computing-in-memory (CIM) and computing-near-memory (CNM) use cases, applications and algorithms; examining the effectiveness of CIM and CNM architecture with high bandwidth memory (HBM); novel materials and memory device studies; design exploration for effectiveness of logic in memory and storage; and machine learning and AI acceleration near memory. These critical research components complement New Mexico's rich history of advancing U.S. technology and innovation leadership.

U.S. Senate Committee on Energy and Natural Resources
May 21, 2024 Hearing: Opportunities, Risks, and Challenges Associated With
Growth in Demand for Electric Power in the United States
Questions for the Record Submitted to Mr. Mark P. Mills

Questions from Chairman Joe Manchin III

Question 1: Our country has a once-in-a-generation opportunity to on-shore manufacturing, lead in new high-tech industries, and increase our economic competitiveness and in turn national security. But electric power needs to be available, reliable, and affordable to capitalize on these opportunities.

- a. What is at stake nationally—for our economic competitiveness and national security interests—if we can't build out high-tech chip manufacturing and advanced computing facilities here in the U.S.?

ANSWER:

The stakes for the economic competitiveness of the United States and our national security are very high. Specifically, at stake is the long-term, foundational competitiveness, economic strength, and geopolitical power of the nation. Economies are anchored in the ability to invent and produce critical and innovative products, not only computer chips and computing facilities, but also the underlying key inputs that make their production possible in the first place. In order to ensure realization of the “opportunity to on-shore manufacturing” we must recognize and reduce impediments to manufacturing that can obviate inducements and incentives for on-shoring. The impediments to on-shoring are dominated by an array of still extant regulatory barriers that impact manufacturing businesses in particular, as well as policies that can lead to higher cost and lower reliability in energy supplies. Regarding the latter, manufacturing is very energy-intensive and such businesses will be sensitive to planning new capital investments, regardless of subsidy offsets, in the face of prospects for rising energy costs. Thus there is an unavoidable linkage between federal (and state) energy policies and the prospects for effective on-shoring of manufacturing. Until those policies are aligned more closely with keeping energy available, affordable, and reliable over the long term, it will be very difficult to reach reasonable goals for on-shoring of manufacturing.

Questions from Ranking Member John Barrasso

Question 1: I direct your attention to the chart to which I referred during my opening statement. Please provide your observations about the effect of the trends that the chart illustrates. Specifically, I ask you to include your responses to the following questions:

- a. What is the likely impact of China's continued reliance on coal-fueled electric generators on its ability to provide electric power to: a) its manufacturers; b) its digital economy, including its efforts to develop, train and deploy artificial intelligence; c) its economy generally; and d) its national security.

ANSWER: Because China is a major, often dominant, supplier to the world of many energy-intensive products and materials—such as silicon solar cells, and aluminum—and because China is a very large and still growing economy (if more slowly now), the fact of the exits and the new coal plants under construction will mean that the *growth* in China's emissions of CO₂ will exceed any reductions in emissions expected or possible from the U.S. At the same time, China's ability to rely upon a reliable, dispatchable, secure and relatively inexpensive form of electric generation will compound its advantages.

U.S. Senate Committee on Energy and Natural Resources
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Questions for the Record Submitted to Mr. Mark P. Mills

- b. Isn't it true that China is also continuing to install electric generators fueled by natural gas? If so, what is the likely impact of China's continued reliance on these sources of electric generation on its ability to provide electric power to: a) its manufacturers; b) its digital economy, including its efforts to develop, train and deploy artificial intelligence and to its economy; c) its economy generally; and d) its national security.

ANSWER: It appears to be the case that China is continuing to install electric generators fueled by natural gas, even though China is a major importer of all hydrocarbons and will continue to be for years, likely decades. Imports account for nearly half of China's natural gas use, and two-thirds of its petroleum needs. Only 10% of China's coal use is imported, hence the strategic reason for its grid's two-third's dependence on coal-fired power plants, and similarly the reason for its very large domestic wind and solar industry. However, the latter requires flexible, rapid-cycling backup power plants that are mainly available from natural gas turbines. China's need for natural gas will continue to create both geopolitical tensions, and opportunities for the U.S. China meanwhile enjoys a substantial 'negotiating' upper hand in terms of supplying the US and Europe the critical minerals and components to build the wind/solar/battery technologies mandated in the latter regions.

- c. Conversely, what is the likely impact of trends in the United States to retire and not to build new electric generators fueled by coal and natural gas on a) our manufacturers; b) our digital economy, including our efforts to develop, train and deploy artificial intelligence; c) our economy generally; and d) our national security.

ANSWER: If the U.S. fails to build sufficient new gas-fired electric capacity (while maintaining existing coal-fired generation) —capacity that cannot be supplied in time, or affordably by wind and solar— at the scales required, then not only will electric prices rise, and reliability slip, but businesses cannot consume what doesn't exist. The latter means, by definition, that desired expansion (and even maintenance) of manufacturing capacity will not happen.

- d. Is it likely that a quicker "energy transition" to ever higher market share for electric generation from wind and solar generation backed up by storage batteries will improve the competitive position of the United States, our general economic well-being, or our national security

ANSWER: No. In fact, it is unlikely that a quicker "energy transition" to ever higher market share for electric generation from wind and solar generation backed up by storage batteries will improve the competitive position of the United States, our general economic well-being, or our national security. The data show that increased use of wind/solar generation (whether with more batteries or not) leads to higher-cost electricity which will degrade the economic competitiveness of the U.S. The data also show that there has been no "energy transition" away from the use of oil and natural gas; the use of both the latter sources of energy have continued to rise.

Questions from Senator Ron Wyden

U.S. Senate Committee on Energy and Natural Resources
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Question 1: They say that what gets measured gets done. Data center efficiency has traditionally been measured using power usage effectiveness (PUE), a ratio that shows how efficiently a data center uses energy. While companies have made great strides on reducing the PUE of their data centers, progress on this front has stalled. Do you support creating new metrics to measure energy consumption of advanced computing, including at the chip level, that industry can utilize as a target to drive further energy reduction?

ANSWER: No I do not support federal metrics for computer-related energy efficiencies, for two reasons. First the industry is today and has always been obsessed with improving the inherent efficiencies of all classes of computing and communications. Advancing efficiency is in the very nature of the engineering of the underlying technologies. Second, it is both unlikely and more likely infeasible for a government entity to determine a meaningful metric for the diverse, rapidly evolve and complex nature of technologies that underly compute-communications.



May 20, 2024

The Honorable Joe Manchin
306 Hart Senate Office Building
Washington, D.C. 20510

The Honorable John Barrasso
307 Dirksen Senate Office Building
Washington, DC 20510

Dear Chairman Manchin and Ranking Member Barrasso,

Thank you for holding this important hearing to examine the opportunities, risks, and challenges associated with growth in demand for electric power in the United States. Whether it is to supply electricity for data centers, new manufacturing, artificial intelligence, or electrification, the electric sector is facing unprecedented load growth. To meet this demand and to ensure reliable, affordable, clean power for customers across the country, we need to generate more energy - preferably domestically - and build out the necessary transmission to deliver it. Earlier this month, the Federal Energy Regulatory Commission (FERC) took a significant step in the right direction by issuing its landmark Order No. 1920 to work through some of the planning and payment issues; however, there are still planning and permitting issues that create enormous barriers to building transmission. ACP urges the Committee to pass comprehensive permitting reform to address reliability challenges and to help meet our future energy needs.

The U.S. Department of Energy (DOE) estimates we need to expand our transmission system 60% by 2030, make significant process improvements, and increase private sector investment to meet growing clean energy demands. The bad news is that, according to ACP's own 2023 Market Report, only 255 miles of high-voltage transmission were energized in 2023. To put that in context, developers are pursuing 10,000 miles through 2030. Unfortunately, long-haul transmission is rarely getting planned for under the current process, essentially ensuring that it will not get built. Further, while high-impact transmission lines, on average, take six and a half years to build, it can often take 10 years or more for them to get through the interstate permitting process. Our permitting system is simply broken. Without fixing it, we will not be able to meet future demand or ensure reliability of the grid, and we will miss the opportunity to unlock more than \$3 trillion in clean energy investments over the next decade.

FERC has taken a significant step in the right direction, with Order No. 1920, to address regional transmission planning needs. However, it did not tackle the current substantial impediments to *interregional* transmission permitting or planning. Our fragmented grid makes it almost impossible to deliver power on an interregional basis. Enhancing the nation's energy independence, increasing reliability and resilience, and driving economic growth cannot occur without reforming the process for permitting and planning for high-impact interregional transmission lines that can carry large amounts of energy from one region to another.



First, we need to fix our broken interstate permitting system for transmission. The limited role that Congress granted the federal government in the Energy Policy Act of 2005, to ensure transmission in the national interest, has proven to be entirely ineffective. Unfortunately, not a single line has been permitted using this authority in the almost two decades that this “backstop” siting authority has been on the books. We must enhance the federal role for siting interstate transmission lines. This will streamline the permitting process, so that we can timely build out these lines to deliver large amounts of energy across our currently balkanized grid—from one state and region to another, improving reliability and helping meet growing demand.

Second, we need to tackle the convoluted approach for interregional transmission planning. FERC’s 2011 rule on transmission planning and cost allocation, Order No. 1000, attempted to address both regional and interregional lines. While FERC created a relatively coherent process for regional lines in that rule, a decade of experience has proven its ineffectiveness for interregional lines. In fact, no significant interregional transmission project has been approved through the Order No. 1000-driven process. As FERC has not mandated the joint consideration of interregional projects and the multiple benefits these projects provide across regions, it is no wonder that these lines are almost never found to be more efficient or cost effective than regional alternatives—leaving them on the chopping table. This fact, combined with the numerous studies finding that such projects would often yield significant benefits over regional lines if built, demonstrate the need for a new approach. Congress should require FERC to issue a rule requiring planning regions to create a formal procedure with their neighboring regions for the identification and evaluation of *interregional* facilities and ensure these critical lines get built.

ACP appreciates the Committee’s effort to work towards bipartisan permitting legislation. To that end, ACP urges the Committee to redouble efforts and continue this pursuit. Our national economic competitiveness and security demand that our processes for permitting and planning for interregional transmission evolve to meet current needs. The current process is not aligned with achieving the national interest that these lines serve. Failure to act on these reforms, as well as other permitting reforms detailed in the attached document, will hinder the clean energy industry’s ability to meet the growing demand for power, while delivering affordable, reliable power to more American families across the country.

Sincerely,

A handwritten signature in black ink that reads "Jason Grumet".

Jason Grumet
Chief Executive Officer
American Clean Power Association



May 20, 2024

The Honorable Joe Manchin
Chairman Senate Energy and
Natural Resources Committee
United States Senate
Washington, DC 20515

The Honorable John Barrasso
Ranking Member Senate Energy and
Natural Resources Committee
United States Senate
Washington, DC

Dear Chairman Manchin and Ranking Member Barrasso:

On behalf of the [Clean Energy Buyers Association](#) (CEBA), whose more than 400 members represent over \$15 trillion in market capitalization and include one fifth of the Fortune 500, I am writing to urge you to continue working toward modernizing federal siting and permitting that upgrades the nation's power grid system through new generation and improved electricity transmission capacity in the United States.

Collectively, CEBA's membership is driving billions in new investments across the country. Our ability to continue to grow and innovate is directly tied to our ability to access affordable, reliable, and clean energy to power our operations.

The U.S. electric grid is vital to our economy, our healthcare system, our national defense, and our homes and schools. It is one of the greatest engineering feats of the 20th century, but it is in urgent need of 21st-century modernization. Right now, outdated federal permitting policies and aging grid infrastructure are standing in the way of new investments in the U.S. economy.

The pace of demand growth for electricity across the nation is expected to nearly [double](#) in the next five years. This real and sizable growth is coming from a variety of [sectors](#), including reshoring of manufacturing, oil and gas production, electrification, and huge growth in the needs of a data-driven economy. We want to clear the path for more investment and innovation to happen here in the U.S. and a modern electric grid is crucial to doing so.

As large electricity customers, we are already experiencing barriers to reliable power across the country. Currently, nearly 2.6 terawatts of generation and storage of all types remain stuck in interconnection queues across the nation, in part due to transmission congestion that prevents these projects from coming online. At the same time, extreme weather events increasingly threaten the power grid's reliability and stability, which comes at a huge cost to all power consumers. Under our current transmission system, one severe thunderstorm, as we've seen this past week in Houston, Texas, can deprive thousands of consumers and businesses of power, and productivity in turn, and even lives lost, in an instant. This should not be the case in 21st century America.

Clean Energy Buyers Association
1425 K St. NW, Suite 1110, Washington, DC 20005
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cebayers.org

Modernizing and expanding the U.S. power system will lower energy customer costs, improve reliability, and help meet the growing demand for electricity across the country. This will attract investment and manufacturing that advances our shared goals of creating jobs for American workers, protecting national security through grid resilience, fostering innovation, and growing the economy.

We applaud you for holding a full Committee hearing to examine the opportunities, risks, and challenges associated with growth in electric power demand across the United States. We respectfully urge the Committee to continue working in earnest to develop and pass bipartisan legislation reforming federal transmission siting and permitting.

The recent rules from the Federal Energy Regulatory Commission (FERC), permitting reform legislation passed by this Congress last year, and actions from the U.S. Department of Energy are important steps, but only Congress can make the deeper, legislative reforms that are ultimately needed. We look forward to working with you on this important legislation. The backbone of the modern economy cannot wait.

Sincerely,



Rich Powell
CEO, Clean Energy Buyers Association (CEBA)

CC: Senate Energy and Natural Resources Committee Members

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ELECTRICITY CUSTOMER ALLIANCE

May 20, 2024

The Honorable Joe Manchin
Chairman
Senate Energy and Natural Resources
Committee
304 Dirksen Senate Office Building
Washington, DC 20510

The Honorable John Barrasso
Ranking Member
Senate Energy and Natural Resources
Committee
304 Dirksen Senate Office Building
Washington, DC 20510

Dear Chairman Manchin and Ranking Member Barrasso:

The Electricity Customer Alliance (ECA) is a coalition comprised of commercial, industrial, and residential energy customers. ECA seeks to convene, harness, and scale an aligned customer voice to expand and improve the nation's electricity systems, providing increased value to all energy customers.

As part of these efforts, ECA wants to work with Congress, particularly the Senate Energy and Natural Resource Committee, to enhance reliability of the United States' electricity grid. ECA commends the Senate Energy and Natural Resources Committee for holding this incredibly timely and important hearing to "examine the opportunities, risks, and challenges associated with growing demand for electric power in the United States."

The U.S. is experiencing a resurgence of domestic manufacturing, largely driven by the growing needs of America's digital economy. This resurgence is boosting economic development, increasing the number of high-quality jobs, and addressing the imbalance within our existing supply chains.

Alongside this new growth, an emerging challenge is facing the country. For companies to invest and expand operations in the U.S., they need an ever-increasing number of reliable, clean and secure electrons to power their supply, information technology infrastructure, and skilled workforce.

However, the U.S. electric grid is not prepared for this significant load growth.

As policymakers and regulators seek to enhance the reliability of our nation's grid, electricity customers, large and small, want to and can be an active part of the solution.

ECA would like to collaborate with the Committee, in a bipartisan fashion, to help develop legislative policies that not only enhance reliability and resiliency of the existing grid, but also make certain that the grid is able to meet the U.S.' growing demand, which will drive our economy for years to come. These policies could include:

- Liberating supply, particularly prioritizing permitting, interconnection reform, interregional transmission, and market integration.



ELECTRICITY CUSTOMER ALLIANCE

- Unleashing customer solutions, including reducing barriers to flexible demand and self-supply, which can slash rotating outage needs and reduce costs.
- Integrating economic development, specifically working to modernize and align economic readiness with utility load demand growth projections.

We look forward to working with the Senate Energy and Natural Resources Committee to build a better electricity system, particularly enhancing reliability of the nation's electricity grids, to power our economy into the future.

Sincerely,

Electricity Customer Alliance



WE MAKE CLEAN ENERGY HAPPEN®

May 21, 2024

The Honorable Joe Manchin, Chairman
Committee on Energy & Natural Resources
United States Senate
304 Dirksen Senate Building
Washington, DC 20510

The Honorable John Barrasso, Ranking Member
Committee on Energy & Natural Resources
United States Senate
304 Dirksen Senate Building
Washington, DC 20510

Dear Chairman Manchin and Ranking Member Barrasso:

We commend you for holding a Full Committee Hearing to “Examine the Opportunities, Risks, and Challenges Associated with Growth in Demand for Electric Power in the United States.” As a trusted energy industry leader, Williams is committed to safely, reliably, and responsibly meeting the nation’s growing energy demand. We use our 33,000-mile pipeline infrastructure to move a third of the nation’s natural gas, each day, to where it is needed most, supplying the energy used to heat our homes, cook our food, and generate low-carbon electricity.

As you know, electricity demand is experiencing three times faster growth per year this decade than what we have seen in prior decades, driven by increasing electrification, the emergence of new, large-load data centers, and a growth in manufacturing. Data centers alone present a challenge, which is projected to add nearly 30 gigawatts (GW) of electric demand by 2030.ⁱ This increase in growth reflects a major opportunity for our country and underscores the need for more natural gas infrastructure to keep up with this growing demand. A comprehensive solution that includes holistic reforms to all federal infrastructure permitting will help America realize a lower-carbon future while still satisfying the country’s energy needs.

Natural Gas = Reliable, Affordable, and Clean

As a country, we can proudly say that the United States is the leader in emissions reductions and clean energy innovations. Between 2005 and 2023, the technological advancements occurring as part of the “Shale Revolution” resulted in significant increases in natural gas production and significant decreases in carbon dioxide emissions. In fact, the shift to natural gas generated electricity reduced energy-related carbon dioxide emissions nationally by unprecedented levels. There were 860 million metric tons of emissions reductions in the U.S. electric power sector from 2005-2021. Sixty percent, or ~500 million metric tons, of this reduction was from coal-to-gas switching, a reduction equivalent to ~111 million gasoline-powered passenger vehicles taken off the road for one year.

U.S. energy-related carbon dioxide emissions decreased another 3 percent in 2023, with over 80 percent of those emissions reductions coming from the electric power sector’s increased use of natural gas and solar.ⁱⁱ

When power grid regulators assign capacity factors to natural gas, they assign nearly 100 percent of nameplate capacity to dispatchable natural gas but only 10-30 percent to variable solar and wind.ⁱⁱⁱ And power grid regulators rely on natural gas capacity up to 3.5 times more, on average, than wind and solar capacity when planning for future demand needs.

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 The Honorable John Barrasso, Ranking Member
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To state the obvious, it will not be possible to increase reliance on intermittent wind and solar power without a solid foundation of dispatchable natural gas power.^{iv}

When looking at carbon neutrality goals, especially those set by states, it is important to understand what it would take to reach 100 percent electrification through wind and solar generation only – and how much such an electrification pathway would cost citizens.

For example, The Climate Act requires New York to reduce economy wide GHG emissions 40 percent by 2030 and 85 percent by 2050 from 1990 levels.^v To replace the energy supplied by natural gas to New York’s homes and businesses in February 2023 alone, New York would need 285 times more utility scale solar installations than the state had in 2022 and enough solar panels to cover 549,000 football fields – and it would require \$1 trillion in solar construction costs.

John Howard, long-time state employee who served in the Cuomo Administration and as the energy advisor for then-Assembly Energy Committee Chair, Paul Tonko, recently questioned New York Governor Kathy Hochul’s Climate Plan due to its “near total lack of transparency on how much each of us will have to pay to finance [climate] mandates.”^{vi}

While wind and solar and other low-carbon sources have an important place in our energy mix, they are intermittent and cannot be implemented or accelerated, nor can electrification occur, without natural gas as a reliable complement. And natural gas cannot play this vital complementing role without supporting infrastructure.

Natural Gas Can Meet Soaring Energy Demands from Data Centers, AI

The electrification of heating, transport, data centers, and an AI-driven future will create growth in power demand not seen in the past two decades – three times faster growth per year this decade than the previous one. According to *The Wall Street Journal*, projections in power growth “come after efficiency gains kept electricity demand roughly flat over the past 15 years...”^{vii} *The Washington Post* notes that a major factor behind the skyrocketing demand is the rapid innovation in artificial intelligence (AI), which is driving the construction of large warehouses of computing infrastructure that require exponentially more power than traditional data centers.^{viii}

These data centers will drive strong regional growth in baseload and peak power demand, as they tend to operate around-the-clock, a tailwind for natural gas, wind, and solar demand. Energy expert Robert Bryce notes that “Microsoft’s electricity use has tripled since 2018...now using more electricity than Iceland, a country that’s renowned for its carbon-free power grid.”

While there are already numerous data centers operating across the country, more are being planned, especially in Texas, on the East Coast, and the Northwest. These centers’ power demand needs are projected to approach 46 GW by 2030, 2.3 times higher than in 2023 alone, requiring as much as 4 Bcf/d of incremental natural gas demand. To put that in context, Williams’ Transco pipeline that extends along the East Coast from Texas to New York currently has 19.5 Bcf/d of delivery capacity.^{ix} The pipeline system is fully subscribed by our firm transportation customers, which is notable, particularly for a system of this size.

The Honorable Joe Manchin, Chairman
 The Honorable John Barrasso, Ranking Member
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Expansion of infrastructure along our Transco system provides the ability to continue to meet peak demand of our customers and serve growth to fill the large power generation resource need with natural gas.

We are currently progressing seven growth projects along this system to bring delivery capacity to over 21.2 Bcf/d, representing approximately 20 percent of Lower 48 natural gas demand in 2022.

While there is a push to meet this growing demand with wind and solar, natural gas plays a crucial role in creating resilient data centers by providing a reliable source of baseload power and quick response backup power when needed, compared to solar and wind, which provide intermittent power.

Onshoring Manufacturing Requires Affordable, Reliable, Baseload Power

In recent years, there has been a significant shift for manufacturers to “onshore” or “reshore” plants, factories, and jobs back to the United States. The COVID-19 pandemic exposed our over-dependence on foreign supply chains and significant legislation urged companies to invest in onshoring their operations.

Federal incentives to boost funding for onshoring manufacturing projects include \$15 billion from the Inflation Reduction Act (IRA), \$50 billion from the CHIPS and Science Act, and \$370 billion from the Infrastructure Investment and Jobs Act. A recent article in *Construction Dive* cites TSMC’s \$40 billion plan in Arizona, Micron’s \$100 billion investment in New York, and Texas Instruments’ \$11 billion semiconductor plant in Utah as “megaprojects” being built here in the U.S. to take advantage of tax incentives from these new laws.^x The fastest growing manufacturing markets are in the Sun Belt, near large ports of entry or distribution – largely to accommodate growth in the electric vehicle industry and the semiconductor industry.^{xi}

American-produced natural gas that can be safely and reliably transported from the wellhead to the manufacturing floor supports our competitiveness. As The Natural Gas Solution explains, “the price of energy – from the electricity needed to run a factory to the [gasoline] powering the delivery truck – impacts the final cost of every item you purchase.”^{xii}

Our country’s plentiful supply of natural gas supports jobs and gives U.S. energy-intensive manufacturers an advantage over foreign competitors. In 2016, the National Association of Manufacturers (NAM) estimated that total natural gas demand is expected to increase by 40 percent over the next decade, with the manufacturing and power generations sectors driving that need.^{xiii} That was before passage of the IRA, CHIPS and Science Act, and the Infrastructure Investment and Jobs Act – and well before recent talks about growing needs for data centers to support AI and technological growth.

Natural gas is also used for petrochemical manufacturing, which is necessary for plastics, fertilizers, synthetic fibers, cosmetics, and medicines. Last year, the American Chemistry Council reported that U.S. chemical industry investment linked to natural gas is over \$200 billion, due to the natural gas and its plentiful supplies and ability to support chemical manufacturers’ emissions reductions efforts.^{xiv}

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Natural Gas Pipeline Capacity is Required for Power Needs

U.S. power demand expectations are repeatedly underestimated by forecasters. For example, since 2015, forecasts such as the U.S. Energy Information Administration (EIA) have repeatedly underestimated the year-ahead gas demand in the power sector by about 3 Bcf/d, on average. In 2022, forecasters dramatically missed annual demand by a whopping 24 percent.

Some of Williams' largest customers have made the following predictions about the continued and increased need for electricity:^{xv}

- Georgia Power says its current load growth projections are 17 times higher than what was forecasted in 2022. This will require a mix of energy sources, including additional gas-powered generation.
- A report from Duke Energy indicates that North Carolina and South Carolina together are experiencing eight times the load growth they projected just two years ago. Said another way, for every power plant built over the last 60 years, Duke would need to build half of that again in the next decade to meet expected demand.
- Dominion Energy also is forecasting power load needs from new data centers to grow 2.5 times over the next ten years in Virginia, already home to more than 35 percent of all hyperscale data centers worldwide, including facilities owned by Amazon, Alphabet, and Microsoft.

When building out energy infrastructure, plans consider peak volumes, not averages. And peak natural gas infrastructure providers and customers must plan for increasing peak demand needs for those extreme weather days or seasonal demand peaks, rather than for annual average volumes. Peak natural gas demand is increasing due to AI- and EV-driven electricity demand and intermittent wind and solar capacity, which tends to increase the variability and peaks for natural gas demand. Demand for natural gas has steadily grown, with a 6 percent increase in annual natural gas demand and peak day demand from 2022 to 2023. In July 2023, a new peak day record was set at 53 Bcf/d.

Lack of Adequate Pipeline Capacity Creates Price and Emissions Spikes During Peak Demand

There is a need for incremental gas capacity, or volume above technically available capacity at existing interconnection points between two market areas. In other words, there is a need to create new interconnection points to meet growing demands for natural gas. As prices in pipeline-constrained markets, such as New England and Chicago, continue to spike each winter with high demand, Southwest Pennsylvania prices tend to be more moderate, due to better pipeline access to abundant natural gas supplies from Appalachian natural gas basins.^{xvi}

Additionally, the lack of adequate natural gas infrastructure leads to the use of more carbon-intensive fuels on peak days of demand. For example, during Winter Storm Elliott, when natural gas was infrastructure-constrained and wind and solar could not keep up, significantly more carbon-intensive fuels were added to meet power generation needs, which corresponded to a 42 percent increase in carbon dioxide emissions, due to the burning of fuels that are 2.5 times more carbon-intensive than natural gas.^{xvii}

There is a growing need for reliable natural gas infrastructure investment, as demand for gas continues to grow, but the infrastructure being built to deliver that gas has not grown as quickly.

The Honorable Joe Manchin, Chairman
 The Honorable John Barrasso, Ranking Member
 May 21, 2024
 Page 5

Specifically, natural gas demand has grown 43 percent since 2013, while infrastructure to deliver natural gas has only increased 25 percent. And notably, storage delivery capacity has only grown 2 percent. A streamlined permitting process would allow for faster and more cost-effective development of infrastructure.

The Need to Modernize our Nation's Permitting System

Williams is encouraged by your leadership, as Chairman and Ranking Member, to further bipartisan interest in reforming permitting processes for our nation's energy infrastructure.

Permitting reform is vitally needed for natural gas pipelines. Although it only takes six-to-nine months to build a pipeline across multiple states, the regulatory process that precedes such a project currently takes about four years. Virtually every pipeline project encounters costly and time-consuming delays due to duplicative permitting processes, a lack of cooperation between agencies, and inadequate judicial review standards.

We appreciate that this Committee's leadership remains committed to pressing forward with more comprehensive reforms. To that end, Williams strongly supports the Spur Permitting of Underdeveloped Resources (SPUR) Act, introduced by Ranking Member Barrasso.

Targeted improvements to the Natural Gas Act were included in H.R. 1, the Lower Energy Costs Act, introduced by Rep. Steve Scalise (R-LA), which passed the House on March 30, 2023, and the SPUR Act S. 1456 (SEC. 3004 and SEC. 3011) which was introduced in the Senate and referred to the ENR Committee. Under these changes:

- No longer can a state use the Clean Water Act Section 401 process to wield a one-state veto of a critical interstate infrastructure project. Instead, a state can raise concerns about a project's water quality impacts as a participating agency under the FERC-led NEPA process: the proper forum to address potential concerns.
- FERC is authorized, based on state and EPA input, to include, in any order or certificate for a project, those terms and conditions that FERC finds necessary to ensure the project's compliance with applicable water quality requirements – provided the finding is supported by clear and convincing evidence. This includes the ability to remedy a state's water quality concerns.
- Long-standing NEPA case law is preserved whereby the NEPA lead agency must give due consideration to input from states and other participating agencies (the "hard-look" requirement).
- To address the problem of endless and often frivolous lawsuits, Section 3011 of the SPUR Act ("Judicial Review") requires a reviewing court to remand any federal or state agency denial of a permit for an interstate pipeline project if the permit denial is not supported by clear and convincing evidence.

The SPUR Act will unlock the Nation's full energy potential by eliminating inefficient bottlenecks in federal permitting and approval procedures.

The Honorable Joe Manchin, Chairman
 The Honorable John Barrasso, Ranking Member
 May 21, 2024
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Williams is a Committed Partner in Our Nation's Leadership Toward a Lower-Carbon Future

With its abundant natural gas supplies, the United States is perfectly positioned to move to a lower-carbon future that meets growing energy demands from electrification, data centers, AI, and onshoring manufacturing. Reforms to federal permitting and review processes will help us realize this future.

Williams appreciates the bipartisan and committed efforts of this Committee to further these issues for the benefit of the American people. We stand ready to be a resource and constructive, solutions-oriented partner.

Sincerely,

THE WILLIAMS COMPANIES, INC.



T. Lane Wilson
 Sr. Vice President and General Counsel

ⁱ <https://www.williams.com/2024/03/05/natural-gas-is-powering-ai-and-ev-innovation/>

ⁱⁱ <https://www.eia.gov/todayinenergy/detail.php?id=61928&src>

ⁱⁱⁱ Data source: IHS North America wind and utility-scale solar PV fundamental REC values, June 2022

^{iv} S&P Global Commodity Insights © 2024. Based on estimated U.S. annual average capacity values through 2040 for PV solar and onshore wind assigned by power grid regulators to assess reliability for future demand needs. Natural gas reliability based on PJM's assigned capacity credit for combined cycle for 2025/2026.

^v <https://www.nyserda.ny.gov/Impact-Greenhouse-Gas-Emissions-Reduction>

^{vi} <https://www.timesunion.com/opinion/article/commentary-what-exactly-energy-transition-19448746.php>

^{vii} https://www.wsj.com/business/energy-oil/data-centers-energy-georgia-development-7a5352e9?mod=Searchresults_pos1&page=1

^{viii} <https://www.washingtonpost.com/business/2024/03/07/ai-data-centers-power/>

^{ix} <https://etfdb.com/energy-infrastructure-channel/williams-wmb-golden-age-natural-gas/>

^x <https://www.constructiondive.com/news/manufacturing-construction-onshoring-ancillary-projects/699500/>

^{xi} <https://www.cbre.com/insights/briefs/us-industrial-market-benefits-from-rise-in-onshore-manufacturing>

^{xii} <https://naturalgassolution.org/natural-gas-makes-u-s-manufacturing-competitive/>

^{xiii} https://nam.org/wp-content/uploads/2019/05/NAM_NG_Report_042816.pdf

^{xiv} [US Chemical Industry Investment Linked to Shale Gas Tops \\$200 Billion - American Chemistry Council](#)

^{xv} <https://www.williams.com/2024/03/05/natural-gas-is-powering-ai-and-ev-innovation/>

^{xvi} Source: S&P Global Commodity Insights © 2024 Algonquin city-gates was used as the proxy for New England. Chicago city-gates as the proxy for Chicago. EGT South was used as the proxy for SW PA

^{xvii} [Williams Winter Storm Elliott Case Study](#)



March 2024

Modernizing U.S. Permitting to Unlock a Reliable and Secure Energy Future

There is an urgent need for new interstate natural gas pipelines to bolster U.S. energy security, support our allies, and reduce greenhouse gas emissions at a global scale. Critical natural gas infrastructure is also vital to support grid resiliency and reliability necessary for the continued buildout of intermittent energy sources, like wind and solar.

Modernizing U.S. Infrastructure Requires Targeted Improvements to the Natural Gas Act:

The Federal Energy Regulatory Commission (FERC) leads the National Environmental Policy Act (NEPA) review of proposed interstate natural gas projects. State evaluation of interstate natural gas projects should be brought into this existing FERC review process, including the Clean Water Act 401 review. This would result in a more comprehensive review process that does not sacrifice environmental considerations or the ability to meet growing domestic and international demand for clean, reliable, and affordable U.S. natural gas.

Targeted improvements to the Natural Gas Act were included in H.R. 1, the “Lower Energy Costs Act” (SEC. 10009), and S. 1456, the “Spur Permitting of Underdeveloped Resources” (SPUR) Act (SEC. 3004 and SEC. 3011). Under these changes:

- A state can raise concerns about a project’s water quality impacts as a participating agency under the FERC-led NEPA process: the proper forum to address potential concerns. No longer can states use the Clean Water Act Section 401 process to wield a one-state veto of a critical interstate infrastructure project.
- FERC is authorized, based on state and EPA input, to include, in any order or certificate for a project, **those terms and conditions that FERC finds necessary to ensure the project’s compliance with applicable water quality requirements** – provided the finding is supported by clear and convincing evidence. **This includes the ability to remedy a state’s water quality concerns.**
- Long-standing NEPA case law is preserved whereby the NEPA lead agency must give due consideration to input from states and other participating agencies (the “hard look” requirement).
- To address the problem of endless and often frivolous lawsuits, Section 3011 of the SPUR Act (“Judicial Review”) **requires a reviewing court to remand any federal or state agency denial of a permit for an interstate pipeline project if the permit denial is not supported by clear and convincing evidence.**

Natural Gas-Fired Electricity Generation is Essential for A Clean, Secure, and Affordable Grid:

Natural gas heats homes throughout the country and fuels our domestic manufacturing base. According to a [McKinsey study of potential energy transition pathways](#), natural gas generation plays an essential role by providing affordable and dispatchable power supply to balance the intermittency of renewables across all scenarios. In addition, exports of [liquefied](#) natural gas (U.S. LNG) support our allies, whether in Europe or Asia, and aids those countries in their move away from more carbon-intensive fuels like coal.

Natural gas cannot provide these benefits if it cannot be delivered from where it is produced to where it is needed.



March 2024

Permitting Reform Must Include Improvements for Interstate Natural Gas Pipelines:

The current federal permitting review process stymies new investments in interstate natural gas pipelines. It has allowed a few states to thwart development of new infrastructure by manipulating the Clean Water Act 401 review to obstruct and delay project permitting.

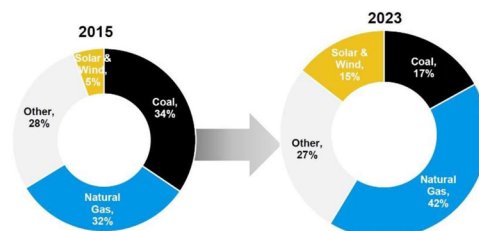
Often minimal, temporary, and mitigated water quality impacts are used as a pretense to block interstate natural pipeline projects. The denials have been directed almost exclusively against pipelines that FERC has already determined are in the public interest and that do not, based on the multi-agency NEPA review, have the sort of water quality impacts that should prevent the project from receiving 401 certification and moving forward.

This enables a single state to stand in the way of another state's citizens' access to reliable and clean energy resources by blocking additional interstate natural gas pipelines. In some cases, this has even forced entire regions to rely on uncertain imports of higher emission foreign energy during the winter. For example, the Northeast's restrictions on pipelines and permitting challenges continue to cause the region (i.e. New York, New Jersey, Massachusetts) to rely on burning expensive and high-emitting heating oil and/or importing foreign energy from Trinidad and Tobago and from Russia. Not only does heating oil have significantly higher emissions than natural gas, but it also means that that the [region continues to import energy from overseas instead of building the interstate pipelines](#) needed to deliver clean, reliable, and affordable natural gas to their citizens from prolific shale-gas fields in neighboring Pennsylvania, Ohio, and West Virginia.

American natural gas is also needed to support the country's desire to add renewable energy sources to the grid, as natural gas power plants can provide the reliable, always-available, 'load-following' generation that backstops the intermittent generation from renewable resources.

U.S. natural gas-fired power generation is increasing alongside renewables

Market Share of Net Generation by Energy Source
for U.S. Utility-Scale Electric Utilities and
Independent Power Producers



U.S. natural gas power generation market share increased 10% while coal declined 17% & renewables only increased 5%, highlighting the need for dispatchable & reliable energy resource

**The need for
dispatchable gas**

As coal capacity continues to retire, the expectation of rapid electricity demand growth requires **dispatchable natural gas, even with increasing renewables in all regions**

Source: U.S. Energy Information Administration (EIA). Note: market share for 2023 is 12-month rolling average ending November 2023. "Other" category includes nuclear, hydro and "other" category.

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The need for reliability

Carbon neutrality goals call for ambitious renewables buildout

What it would take to electrify the NY res/com sector with solar on a peak day of demand

solar panels to cover

549K



football fields

which is

285x



more than NY state
has today¹

and would require

\$1T



in solar
construction cost
excl. transmission & distribution costs

Sources: Williams' analysis utilizing data from S&P Global Platts, US Energy Information Administration, Environmental Protection Agency and National Renewable Energy Laboratory. ¹To replace the natural gas Bus that NY state's residential/commercial customers used on 02/3/2023, it would take 285x more utility scale solar installations than the state had in 2022.

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Dispatchable natural gas more reliable than intermittent renewables

Power grid regulators rely on natural gas capacity **up to 3.5x more¹** on average than wind and solar capacity when planning for future demand needs

Dispatchable
Natural Gas



Variable
Solar & Wind¹



Power generation reliability

Natural gas capacity is quickly dispatchable and will be relied upon to backstop renewables during days of peak demand

Renewables have much lower reliability metrics due to the intermittent nature of wind and solar

Source: S&P Global Commodity Insights © 2024. ¹Based on estimated U.S. annual average capacity values through 2040 for PV solar and onshore wind assigned by power grid regulators to assess reliability for future demand needs. Natural gas reliability based on PJM's assigned capacity credit for combined cycle for 2025/2026.

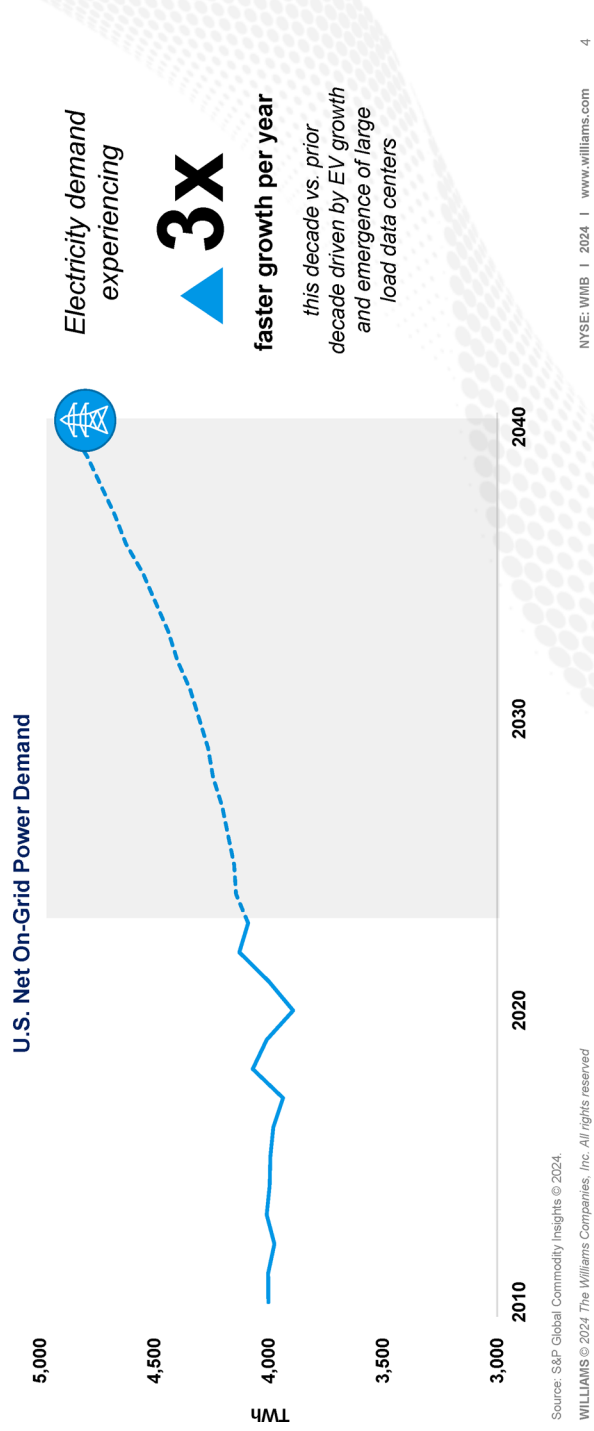
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3

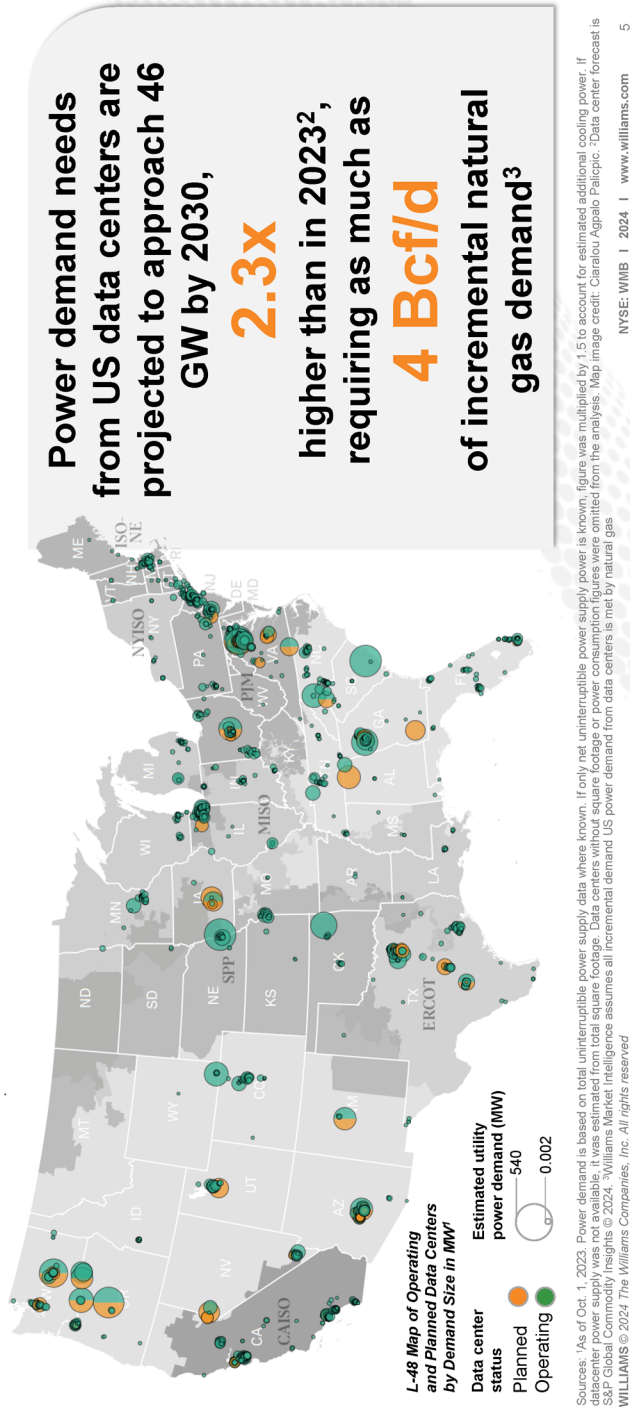
Growing electricity demand requires additional backup generation

Electrification of heating and transport, data centers and AI-driven future will create growth in power demand not seen in past two decades



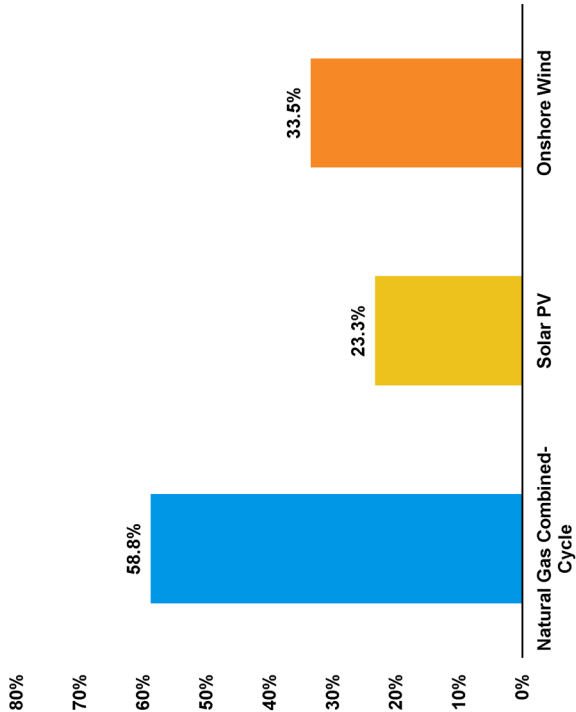
AI is expected to drive more power demand from data centers

Data centers will drive strong regional growth in baseload and peak power demand as they tend to operate around-the-clock, a tailwind for natural gas and renewables demand



Utilization rates for solar and wind power are comparatively lower than those of natural gas power sources

EIA 2023 Average Capacity Factors for Utility Scale Generators



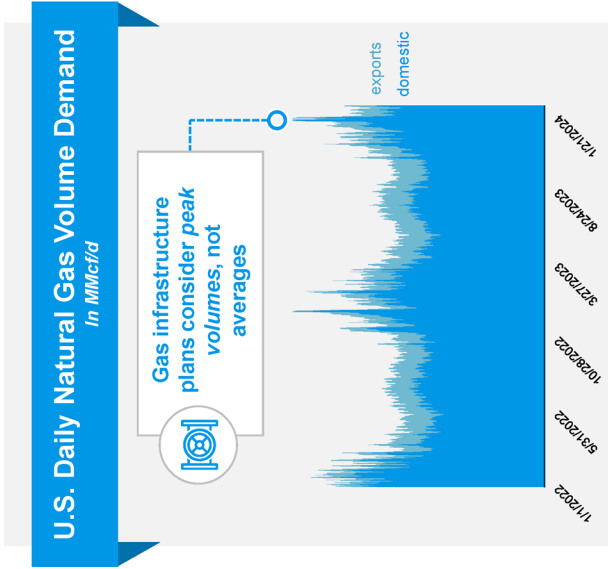
Source: U.S. Energy Information Administration (EIA)
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The need for

reliability

- A power plant's **nameplate capacity** indicates its theoretical maximum electricity output
- A power plant's **capacity factor** is the ratio of the average output of a facility to its theoretical maximum output
- The capacity factor is not about how much energy a power plant can potentially generate, but **how consistently it produces energy over a period**
- A power plant with **100% capacity factor** means the power plant is producing electricity at its full potential all the time; however, this is **not operationally possible**
- The **lower the capacity factor, the less electricity that is generated**
- Because **solar and wind are variable** and reliant on weather conditions, the average energy produced over time is quite less than dispatchable natural gas

Natural gas pipeline capacity required to handle peak volume demand



Gas pipeline capacity required for peak demand needs

Natural gas infrastructure providers and customers must plan for increasing **peak demand needs** for those extreme weather days or seasonal demand peaks rather than for lower annual average volumes

Peak natural gas demand is increasing due to AI- and EV-driven electricity demand growth, increasing intermittent renewables capacity and strong LNG export demand which tend to increase the variability and peaks for natural gas demand

Source: S&P Global Commodity Insights © 2024
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US power demand expectations are repeatedly underestimated by forecasters

The need for reliability

Our natural gas pipeline contracted capacity is critical to ensure electric grid reliability on peak days



Growing demand for natural gas
Annual demand for natural gas has steadily grown ~4% CAGR since 2015

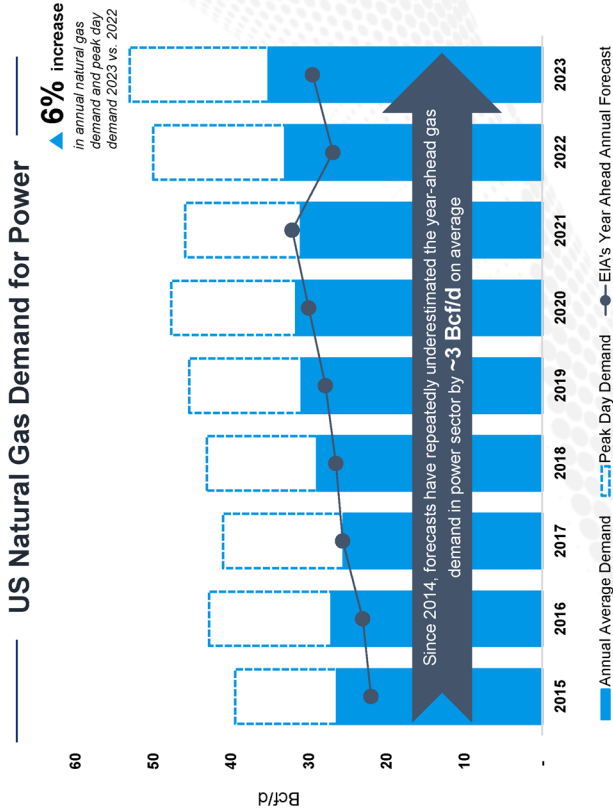


Setting new peak day records
Hit record day demand for natural gas in July 2023 of 53 Bcf/d



Forecasters underestimating the need for gas
Year ahead forecasts historically underestimate gas demand and dramatically missed 2022 annual demand by 24%

Accurate planning is vital to ensure sufficient transmission will be available when and where it is needed.



Source: S&P Global Commodity Insights © 2024 and U.S. Energy Information Administration (EIA).
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Power utility customers recognizing need for more natural gas

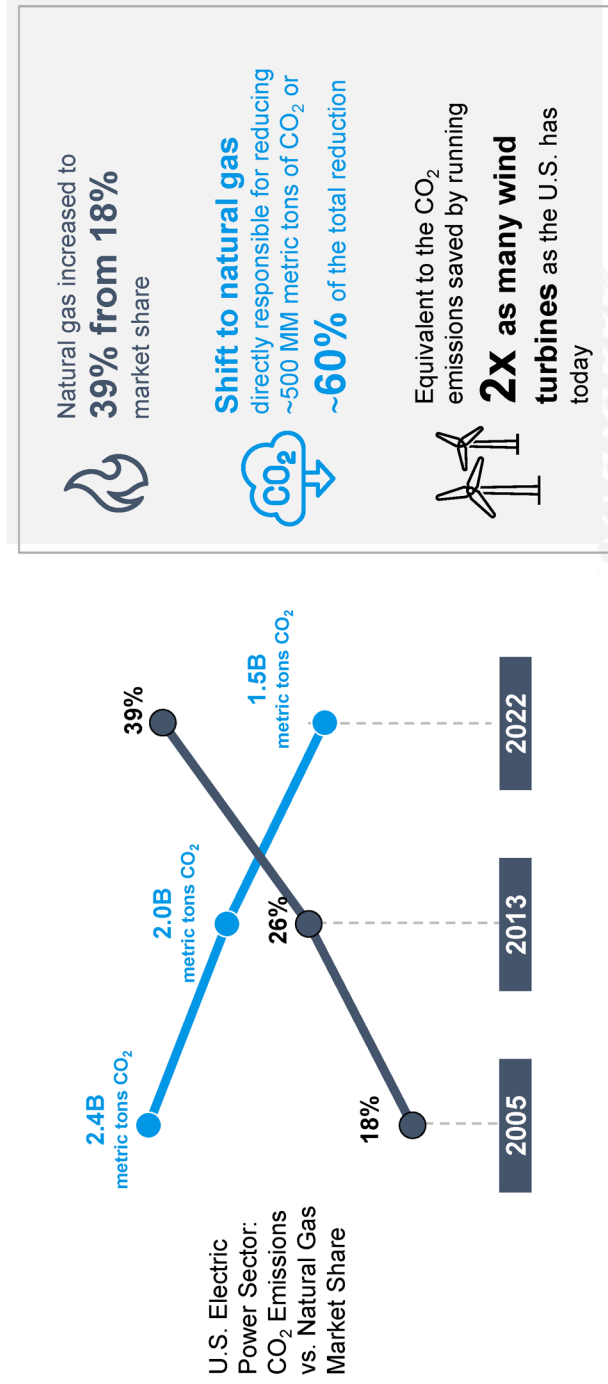




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Natural gas is a tool to reduce emissions

U.S. CO₂ emissions declined with increased natural gas generation



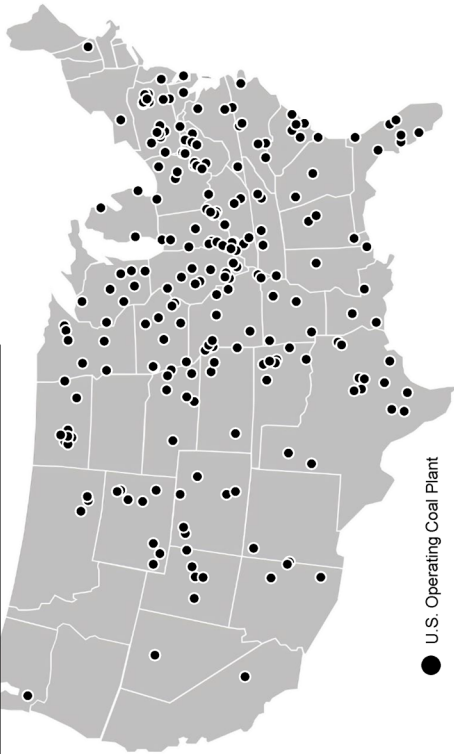
Sources: U.S. Energy Information Administration (EIA), January 2024; Environmental Protection Agency (EPA) Greenhouse Gas Equivalencies Calculator.
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Continued opportunity to reduce CO₂ emissions by replacing coal with gas

There are **217** operating coal plants in the U.S. today



Replacing existing U.S. coal plants with natural gas-fired generation could:



Cut CO₂ power emissions by **27%**

Equivalent to



Removing **~80% of the cars** off the road today

Sources: Operating coal plant data sourced from Wood Mackenzie North America Power Service Tool. The data and information provided by Wood Mackenzie should not be interpreted as advice and you should not rely on it for any purpose. You may not copy or use this data and information except as expressly permitted by Wood Mackenzie in writing. To the fullest extent permitted by law, Wood Mackenzie accepts no responsibility for your use of this data and information. Coal and natural gas plants emissions rates and heat rate assumptions per U.S. Energy Information Administration (EIA). Metric tons of CO₂ emitted by a typical passenger vehicle per year per Environmental Protection Agency (EPA). As of January 2024.

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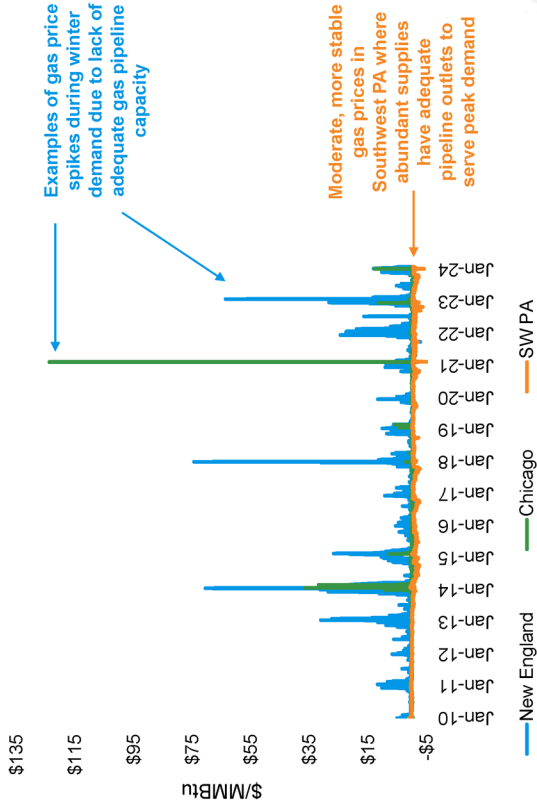
12



Lack of adequate natural gas pipeline capacity creates price and emissions spikes during days of peak demand

Lack of adequate natural gas pipeline capacity creates price spikes during days of peak demand

Historical Natural Gas Price Basis to Henry Hub-Northeast Region



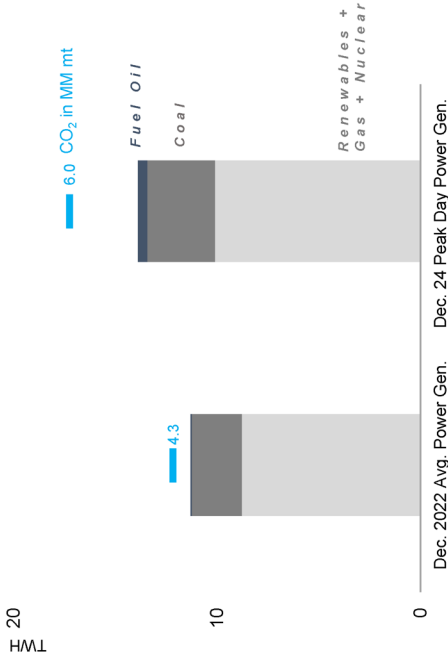
The need for **incremental gas capacity**

As prices in pipeline constrained markets, such as New England and Chicago, continue to spike each winter with high demand, SW Pennsylvania prices tend to be more moderate due to better pipeline access to gas abundant supplies

Lack of adequate natural gas infrastructure leads to use of more carbon-intensive fuels on peak days of demand

Spotlight: Winter Storm Elliot

L-48 Dec. '22 Average Daily Power Generation vs. Peak Day Power Generation (Dec. 24, '22) by Fuel Type with Associated CO₂ Power Emissions



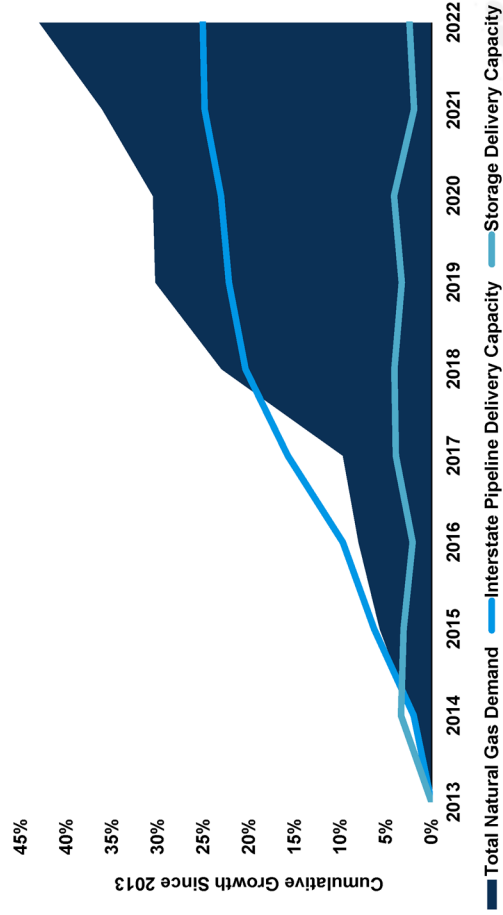
Gas pipelines needed to **reduce emissions**

51% more coal + fuel oil generation on peak day of demand vs. average generation

42% increase in CO₂ emissions due to burning more fuels that are ~2.5x more carbon-intensive than gas when gas is constrained, and renewables can't keep up on peak days of demand

There is a growing need for reliable infrastructure investment

Cumulative Percentage Growth in L-48 Natural Gas Demand versus Growth in Interstate Natural Gas Pipeline Capacity and Natural Gas Storage Delivery, 2013-2022



Since 2013 demand for gas has grown by **▲ 43%** while infrastructure to deliver gas has increased by **▲ 25%** and storage delivery capacity has grown only **▲ 2%**

Source: U.S. Energy Information Administration (EIA).
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Natural gas is the most affordable decarbonizing solution

Natural gas is the cheapest fuel for residential consumers

Avg. Unit Costs of Energy for U.S. Mid Atlantic Residential Energy Sources



Residential natural gas bills are

4X

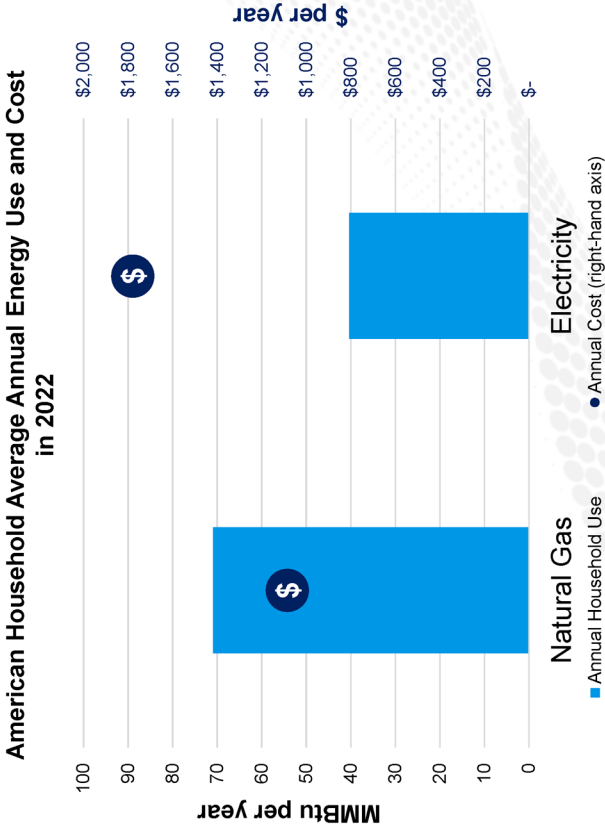
less expensive

than electric bills **today** and will remain the most affordable solution for residential customers for the **next 20 years**

Source: U.S. Energy Information Administration (EIA), Annual Energy Outlook, 2023.
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Natural gas is the cheapest fuel for residential consumers

Natural gas makes up
65%
of the average
American household
energy usage but only
makes up
40%
of the household
energy bill

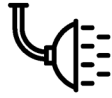


Source: U.S. Energy Information Administration (EIA)
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Natural gas affordability in the home



It costs **\$1.40** to cook one egg every day for a year using a gas stove, versus **\$4.25** using an electric stove



It costs **\$0.15** to take the average shower utilizing a natural gas water heater, with an electric water heater it costs about **\$0.40**



The average U.S. household utilizing gas for home heating this winter will spend **\$600**, where homes using electricity for heat will pay **\$1,080**



It costs **\$0.15** to dry one load of laundry in a gas dryer, compared to **\$0.45** in an electric dryer

Sources: U.S. Energy Information Administration (EIA) Electric Power Monthly, January 2023; EIA Residential Natural Gas Prices January 2023; DOE Estimating Appliance and Home Electronic Energy Use; ENERGY STAR Market & Industry Scoping Report Residential Clothes Dryers; EIA Short-Term Energy Outlook. Note: Cost values rounded

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Natural gas meets the trifecta for energy solutions

CLEAN RELIABLE AFFORDABLE



Sources: ¹Energy Information Administration (EIA) Carbon Dioxide Emissions Coefficients by Fuel; ²S&P Global Commodity Insights © 2024. Based on U.S. annual average capacity values through 2040 assigned by power grid regulators to assess reliability for future demand needs. Onshore wind and PV solar; ³U.S. Energy Information Administration (EIA), Annual Energy Outlook, 2023, Avg. Unit Costs of Energy for U.S. Mid-Atlantic Residential Energy Sources

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Natural gas is a tool to solve energy challenges

RELIABLE

Natural gas is an available backup and easily dispatchable

EMISSIONS REDUCTION

Continued opportunity to reduce emissions using natural gas to replace dirtier fuels like coal



AFFORDABLE

Natural gas remains cheapest energy source for residential consumers

ABUNDANT

Vast resource of gas supplies to serve demand domestically and abroad creating energy security for the U.S.

Natural gas is an immediate and scalable climate solution that works towards reducing global emissions while providing affordable and reliable energy.

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**Statement for the Record submitted by the Zero Emission Transportation Association
(ZETA)**

**Senate Committee on Energy and Natural Resources
Hearing to Examine the Opportunities, Risks, and Challenges Associated with Growth in
Demand for Electric Power in the United States
May 21, 2024
Submitted: May 20, 2024**

Dear Chairman Manchin and Ranking Member Barrasso:

Thank you for holding the oversight hearing on Tuesday, May 21st to “Examine the Opportunities, Risks, and Challenges Associated with Growth in Demand for Electric Power in the United States.” The Zero Emission Transportation Association (ZETA) is an industry-backed coalition of member companies that span the entire electric vehicle (EV) supply chain, including critical minerals and materials, battery production, vehicle manufacturing, battery recycling, and utilities.

The domestic EV industry is investing in American workers and communities, with over 242,000¹ American jobs announced to date. The ongoing expansion of this field presents immense opportunities for the United States, from boosting economic growth and improving American competitiveness in advanced manufacturing to reducing emissions from the transportation sector. The rapid expansion of advanced manufacturing across the economy requires planning and coordination to ensure sufficient power is available to meet the needs of all Americans. The EV industry is fully prepared to meet this challenge, and we look forward to working with utilities, states, and the federal government to meet our collective goals in the future.

The growing electric vehicle industry is also contributing to the modernization of the electrical grid. With emerging technologies such as managed charging, energy storage, load forecasting, and time-of-use rates, electricity providers can integrate EVs to reduce usage during peak hours and minimize spikes in the power system.

Another key challenge we face in developing a domestic EV supply chain is the permitting process for mining, manufacturing, and refining projects. Expedient and predictable permitting is crucial for our industry to thrive. ZETA strongly supports continued efforts for federal permitting reform, and we urge Members of the Committee, your colleagues in the Senate, and Members of the House of Representatives to prioritize this issue and work towards a bipartisan agreement.

¹ BlueGreen Alliance, EV Jobs Hub, <https://evjobs.bgafoundation.org/>

Thank you again for holding this important hearing.

Sincerely,

A handwritten signature in black ink, appearing to read 'AGore', with a stylized flourish at the end.

Albert Gore
Executive Director
Zero Emission Transportation Association (ZETA)