CONVERTING ENERGY INTO INTELLIGENCE: THE FUTURE OF AI TECHNOLOGY, HUMAN DISCOVERY, AND AMERICAN GLOBAL COMPETITIVENESS

HEARING

BEFORE THE

COMMITTEE ON ENERGY AND COMMERCE
HOUSE OF REPRESENTATIVES

ONE HUNDRED NINETEENTH CONGRESS

FIRST SESSION

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APRIL 9, 2025

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C O N T E N T S

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WITNESSES

SUBMITTED MATERIAL

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[1] The report has been retained in committee files and is included in the Documents for the Record at https://docs.house.gov/meetings/IF/IF00/20250409/118133/HHRG-119-IF00-20250409-SD095.pdf.

CONVERTING ENERGY INTO INTELLIGENCE: THE FUTURE OF AI TECHNOLOGY, HUMAN DISCOVERY, AND AMERICAN GLOBAL COMPETITIVENESS

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WEDNESDAY, APRIL 9, 2025

House of Representatives,
Committee on Energy and Commerce,
Washington, DC.

The committee met, pursuant to call, at 10:04 a.m. in the John D. Dingell Room 2123, Rayburn House Office Building, Hon. Brett Guthrie (chairman of the committee) presiding.

Members present: Representatives Guthrie, Latta, Griffith, Bilirakis, Hudson, Carter of Georgia, Palmer, Dunn, Joyce, Weber, Allen, Balderson, Fulcher, Pfluger, Harshbarger, Miller-Meeks, Cammack, Obernolte, Bentz, Fry, Lee, Rulli, Evans, Goldman, Fedorchak, Pallone (ranking member), DeGette, Schakowsky, Matsui, Castor, Tonko, Clarke, Ruiz, Peters, Dingell, Veasey, Kelly, Barragán, Soto, Schrier, Trahan, Fletcher, Ocasio-Cortez, Auchincloss, Carter of Louisiana, Menendez, Mullin, Landsman, and McClellan.

Staff present: Ansley Boylan, Director of Operations; Clara Cargile, Professional Staff Member; Marjorie Connell, Director of Archives; Jessica Donlon, General Counsel; Andrew Furman, Professional Staff Member; Sydney Greene, Director of Finance and Logistics; Jay Gulshen, Chief Counsel; Emily Hale, Staff Assistant; Kate Harper, Chief Counsel; Brittany Havens, Chief Counsel; Megan Jackson, Staff Director; Daniel Kelly, Press Secretary; Patrick Kelly, Staff Assistant; Sophie Khanahmadi, Deputy Staff Director; Alex Khlopin, Clerk; Brayden Lacefield, Special Assistant; Giulia Leganski, Chief Counsel; Mary Martin, Chief Counsel; Joel Miller, Chief Counsel; Ben Mullaney, Press Secretary; Elaina Murphy, Professional Staff Member; Kaitlyn Peterson, Policy Analyst; Brannon Rains, Professional Staff Member; Evangelos Razis, Professional Staff Member; Seth Ricketts, Special Assistant; Jake Riith, Staff Assistant; Jackson Rudden, Staff Assistant; Chris Sarley, Member Services/Stakeholder Director; Peter Spencer, Senior Professional Staff Member; Kaley Stidham, Press Assistant; Dray Thorne, Director of Information Technology; Matt VanHyfte, Communications Director; Hannah Anton, Minority Policy Analyst; Rasheedah Blackwood, Minority Intern; Tiffany Guarascio, Minority Staff Director; Lisa Hone, Minority Chief Counsel, Commerce, Manufacturing, and Trade; Kristopher Pittard, Minority Professional Staff Member; Emma Roehrig, Minority Staff Assistant;

Kylea Rogers, Minority Policy Analyst; Harikrishnan Sanil, Minority Press Intern; Andrew Souvall, Minority Director of Communications, Outreach, and Member Services; and Tuley Wright, Minority Staff Director, Energy.

Mr. GUTHRIE. The committee will come to order.

Welcome, everybody, the committee, back. We appreciate everybody being back this morning for, I think, what is going to be an absolutely exciting hearing.

And I will recognize myself for 5 minutes for an opening statement

OPENING STATEMENT OF HON. BRETT GUTHRIE, A REPRESENTATIVE IN CONGRESS FROM THE COMMONWEALTH OF KENTUCKY

And I want to thank our witnesses for being here and traveling a long distance to be here.

This kind of came from our Library of Congress, this hearing, from a presentation that Dr. Schmidt put on his book "Genesis" that he wrote with Henry Kissinger—Henry Kissinger's last book.

And I walked away thinking we needed to have the entire Congress hear your presentation, and so we are doing it with the entire Energy and Commerce Committee, because I think an author always wants to know, when they write a book, will somebody read my book? And then if they read the book, then will it have an impact? Well, today you and all the witnesses are before the full Energy and Commerce Committee.

And our dear colleague and the dear husband of our colleague Debbie Dingell used to say that if it is moving, it is energy; if it stops, it is commerce. Something to that effect. So we have a lot of jurisdiction. I say it takes energy to move commerce. I can't improve on Chairman Dingell, but that is my version of it. And so we are having a full hearing. We typically do this in subcommittee, but this touches all jurisdictions, and I think everybody needs to hear it.

If you think about it, it is going to take enormous energy to beat China to AI. We—in doing that, we have to protect the environment. Our telecom—and privacy—through our commerce and telecom committees will be dealing with this. And AI has particular healthcare applications, so it touches all of our jurisdiction.

And Dr. Schmidt, when I walked away from the Library of Congress and I read your book, it gave me a sense of mission, and the mission—a direction I want to take this committee in the time that I am chairman. And to sum up what you said, it is the U.S. versus China, and who will win the war for AI. And it—essentially, I walked away, this is as important as the dollar being the reserve currency in the world. It is that important, and that is what is before us.

And we—what I hear from people in this space is that we have the brainpower and we have the capital. What we need is the energy and the correct regulatory framework. And we have an example of what not to do, and I believe you said Europe—in your presentation—Europe has chosen not to grow, so we can't look there as an example. We have to work through it ourselves.

And Europe's regulatory framework, their energy framework and the regulatory framework, some of their regulatory framework written specifically to disadvantage American companies, has made them noncompetitive. And Europe and the U.S. had a similar size economy in 2008, and I have read that our economy is up about 80 percent larger.

So what do we need to do? And the reason we want to do a full committee is that we have to have broad consensus on how we work together, it has to be Democrat and Republican.

People who tell me they invest, it is tough to invest based on congressional cycles or presidential cycles if the rules are going to change every 2 to 4 years. And so what I would like to—just hopefully what we could do in this committee is come up with a regulatory framework and an energy policy that we can all—or most of us—can agree on, at least build a broad consensus on how we develop massive amounts of energy while protecting our environment.

And Dr. Schmidt, you said all energy resources are needed, and then AI will develop solutions to deal with climate change. And so Microsoft—to put this in perspective, Microsoft Data Center can use as much power as the City of Seattle, is what I have been told.

And so in the regulation side of it, we have to protect our privacy. Yesterday—we had a hearing on bills yesterday on child—children's privacy and children's safety. And we have to protect our privacy. I think all of us want our privacy protected. We can't do it in a heavy-handed way that stifles innovation. And as I said, we have to look at our friends across the Atlantic.

But I think we need to more intently look across the Pacific to a nation determined to win. China has specifically said they are going to win the war on AI, and we are taking up the challenge to prove to them that the American entrepreneur and the American intellect will win the war on AI, but they have to have the energy and the regulatory environment to do so.

So if this committee gets it right—this committee gets it right, America will win. They may win if—otherwise, but we need to be there to make that happen. And if you look at what if China wins—we just had a hearing of—an oversight—that a medical device from China had an embedded URL to the University of Beijing. So why does that mean—a medical device? Because we know they are using everything they can, everything they can to get information they need on us.

So we must win. We will win. And for the sake of the world, we have to win. And I am determined through this hearing—to the beginning—that all of us will work together, because all of us are dedicated to winning.

[The prepared statement of Mr. Guthrie follows:]

Chairman Brett Guthrie
Opening Statement—Committee on Energy and Commerce:
"Converting Energy into Intelligence: the Future of AI Technology, Human Discovery, and American Global Competitiveness"
April 9, 2025
As prepared for delivery

I want to thank our witnesses for being here and traveling long distances to be here. This hearing came from a Library of Congress presentation that Dr. Schmidt held on his book Genesis, that he wrote with Henry Kissinger, Henry Kissinger's last book.

I walked away thinking we needed to have the entire Congress hear your presentation. So, we're doing it with the entire Energy and Commerce Committee.

Because I think an author always wants to know when they write a book, will somebody read my book? And then if they read the book, then will it have an impact?

Well, today, you and all the witnesses are before the full Energy and Commerce Committee.

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So, we have a large jurisdiction. I say it takes energy to move commerce. I can't improve on Chairman Dingell, but that's my version of it.

So, we're having a full committee hearing. We typically do this in subcommittee, but this touches all jurisdictions, and I think everybody needs to hear it. If you think about it, it's going to take enormous energy to beat China to AI. In doing that, we have to protect the environment.

Our telecom and privacy, through our commerce and telecom committees, will be dealing with this, and AI has particular health care applications. So, it touches all of our jurisdictions.

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And who will win the war for AI? Essentially, this is as important as the dollar being the reserve currency in the world. It's that important, that's why it is before us.

What I hear from people in this space is that we have the brain power, and we have the capital, what we need is the energy and the correct regulatory framework.

We have an example of what not to do, and I believe you said in your presentation, Dr. Schmidt, is that Europe has chosen not to grow. We can't look there as an example, we have to work through it ourselves.

Some of Europe's regulatory framework, written specifically to disadvantage American companies, has made them non-competitive.

Europe and the US had a similar sized economy in 2008, and I've read that our economy is now about 80% larger. So, what do we need to do? The reason we want to have a full committee hearing is that we have to have broad consensus on how we work together. It has to be Democrat and Republican.

People who invest tell me it's tough to invest based on congressional cycles or presidential cycles when the rules are going to change every two to four years. And so, what I would like to do in this committee is come up with a regulatory framework and an energy policy that most of us can agree on and build a broad consensus on how we develop massive amounts of energy while protecting our environment. Dr. Schmidt, you said all energy resources are needed and then AI will develop solutions to deal with climate change.

To put this in perspective, a Microsoft data center can use as much power as the city of Seattle, is what I've been told. On the regulation side of it, we have to protect our privacy. Yesterday we had a markup of our bills on children's privacy and children's safety, and we have to protect our privacy.

I think all of us want our privacy protected. We can't do it in a heavy-handed way that stifles innovation, and as I said, we have to look at our friends across the Atlantic. But I think we need to more intently look across the Pacific to a nation determined to win.

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So, if this committee gets it right, America will win. It may win anyway, but we need to be there to make that happen. And if you look at 'what if China wins?' We just had an oversight hearing addressing how a medical device from China had an embedded URL connected to the University of Beijing.

What did that mean? We know they're using everything they can to get information they need on us.

So, we must win. We will win. And for the sake of the world, we have to win. And I'm determined, through this hearing, that all of us will work together, because all of us are dedicated to winning.

Mr. GUTHRIE. And I will yield back and recognize the ranking member for 5 minutes for an opening statement.

OPENING STATEMENT OF HON. FRANK PALLONE, JR., A REP-RESENTATIVE IN CONGRESS FROM THE STATE OF NEW JER-SEY

Mr. PALLONE. Thank you, Mr. Chairman.

Under normal circumstances, today's hearing would be a bipartisan conversation on ensuring America continues to lead the race on artificial intelligence, or AI. However, these are not normal times. President Trump is single-handedly destroying our economy. Since he unnecessarily instigated a global trade war, our markets are in turmoil, Americans' retirement savings is in freefall, and prices for everyday goods are spiking. In fact, Trump's tariffs are the largest middle-class tax increase in at least 50 years on hard-working American families.

And our efforts to continue to lead the global race on AI innovation are seriously threatened when Trump has just spiked the price on materials we need to compete, such as steel, aluminum, and chips. Instead of winning the future, Trump's economic turmoil could send America's tech leadership into a tailspin.

There is no doubt that the daily chaos and uncertainty that Trump is creating is not good for American business or for the American people. Despite the unwillingness of the President and Republicans to acknowledge any of the harm their actions are having on American families, I want to address the topic of today's hearing because it is so important.

As we have heard in every Energy Subcommittee hearing this year, increased energy demand is coming, largely powered by data centers fueling artificial intelligence tools. And I firmly believe that this increased demand can be a good thing, but it must be managed responsibly. We must make sure that AI-driven energy demand increases don't make electricity unaffordable or unreliable for American families. We must also make sure that consumers aren't stuck bearing the cost for infrastructure investments made necessary by private companies. And we must get a better understanding of just how much energy demand will increase in the coming years.

The committee needs to be talking about all these things. But instead, this week House Republicans are poised to vote on a budget resolution that would set the stage to repeal the energy tax credits incentivizing well over 90 percent of the electricity generation poised to come onto the grid. The Trump administration and Elon Musk's DOGE minions are also putting together a secret list of grants and loans that they want to cancel that would modernize our electric grid and build new energy generation.

Meanwhile, yesterday afternoon Trump signed several Executive orders to allow polluting coal plants to—set for retirement to continue to operate, increasing prices and health risks for American families. And just last month, during a speech to the joint session of Congress, Trump threatened to repeal the CHIPS and Science Act, which invested $52 billion to ensure more semiconductors are produced right here in the U.S.

Semiconductors are critical to the advancement of AI, but right now the overwhelming majority are produced outside the United States, and the CHIPS and Science Act is boosting production of chips here, and now Trump wants to repeal the law. So Republicans constantly talk about winning the AI race, but the actions they are taking make it appear as if they are purposely trying to lose that race to China.

And we should also discuss the tremendous effects AI will have on our everyday lives. We have seen an explosion of AI systems and tools that have been trained on massive amounts of Americans' personal information without our knowledge and consent. Right now, sufficient guardrails do not exist to protect Americans and our data from harmful AI systems that violate our privacy, provide false information, or make unjustifiable, discriminatory decisions.

Because many of these systems are trained on massive amounts of data that big tech has collected on all of us, the lack of nationwide protections around what data companies can collect, use, and sell to train these AI systems should concern every American. Clearly defined privacy and data security rules are critical to protect consumers from existing harmful data collection practices and to safeguard them from the growing privacy threat that AI models pose.

So I strongly believe that the bedrock of any AI regulation must be privacy legislation built on the principle of limiting the amount of consumer data collected, used, and shared. It is the best way to address the aggressive and abusive data collection practices of Big Tech and data brokers, ensure our children's sensitive information is protected online, and put consumers back in control of their data.

So I look forward to hearing from today's witnesses and intend to continue to focus on developing policies that will harness the transformation power of AI while safeguarding the rights and well-being of all Americans.

[The prepared statement of Mr. Pallone follows:]

Committee on Energy and Commerce

Opening Statement as Prepared for Delivery
of
Ranking Member Frank Pallone, Jr.

Hearing on "Converting Energy into Intelligence: the Future of AI Technology, Human
Discovery, and American Global Competitiveness"

April 9, 2025

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April 9, 2025
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I look forward to hearing from today's witnesses and intend to continue to focus on developing policies that harness the transformative power of AI while safeguarding the rights and well-being of Americans.

Mr. PALLONE. And with that I yield back. Thank you, Mr. Chairman.

Mr. GUTHRIE. Thank you. The gentleman yields back, and we now conclude with Member opening statements.

The Chair would like to remind Members that, pursuant to the committee rules, all Members' opening statements will be made part of the record.

I would also remind Members that, once we get to the 5-minute questioning, we will have to strictly enforce that. We have a time constraints with some of our witnesses, and I want everybody to have the chance to ask their questions.

I would like to thank the witnesses for being here today. It is— and you are taking time to testify before this committee. It is greatly appreciated. You will have the opportunity to give an opening statement, followed by a round of questions from Members and our witness.

I will read the witnesses, and I will call on you individually to read—for your opening statement.

So first we have Dr. Eric Schmidt, chair of the Special Competitive Studies Project. Dr. Schmidt previously served as the chief executive officer and chairman of Google. In addition to serving as executive chairman and technical advisor, his time at Google would turn the company into the global tech giant we know it today. In 2021 he founded the nonpartisan Special Competitive Studies Project to strengthen America's long-term competitiveness regarding AI and America's future, and also the author, as we have said, of—and a Library of Congress spokesman of the book "Genesis" he wrote with Dr. Kissinger.

So thank you for being here.

Dr. Manish Bhatia. Mr. Manish Bhatia, executive vice president of global operations with Micron Technology. Mr. Bhatia has been with Micron since 2017, and has 25 years of engineering and operations experience. He has previously held positions at Western Digital Corporation, SanDisk Corporation, and Matrix Semiconductor, to name just a few.

The Honorable David Turk, a visiting fellow with the Center on Global Energy Policy at Columbia University School of International and Public Affairs. Mr. Turk served as the Deputy Secretary of the U.S. Department of Energy during the Biden administration. Before his time as Deputy Secretary, Mr. Turk spent several years at the International Energy Agency.

Thank you for being here, as well.

And Mr. Alexandr Wang, the founder and chief executive officer of Scale AI. Mr. Wang founded Scale AI as a 19-year-old student at MIT, focusing on the concept of humanity-first artificial intelligence. Currently, Scale AI has a team of over 900 and is valued at nearly $14 billion. At 24, he is the youngest self-made billionaire in the world.

So I thank you all for being here today, and I will call on each of you, and I will begin with Dr. Schmidt. You have 5 minutes for your opening statement. Thank you.

And you will see—before you get started—there are—you will have a green light, and when it gets to 4 minutes, I think a light turns yellow, so it will kind of give you a warning in front of you,

you have a minute, and when it turns red it will be—wrap it up, so we can make sure we get all our questions in.

So Dr. Schmidt, your 5 minutes, you are recognized.

STATEMENTS OF ERIC SCHMIDT, Ph.D., CHAIR, SPECIAL COMPETITIVE STUDIES PROJECT; MANISH BHATIA, EXECUTIVE VICE PRESIDENT OF GLOBAL OPERATIONS, MICRON; DAVID M. TURK, DISTINGUISHED VISITING FELLOW, CENTER ON GLOBAL ENERGY POLICY, COLUMBIA UNIVERSITY SCHOOL OF INTERNATIONAL AND PUBLIC AFFAIRS; AND ALEXANDR WANG, FOUNDER AND CHIEF EXECUTIVE OFFICER, SCALE AI

STATEMENT OF ERIC SCHMIDT, Ph.D.

Dr. SCHMIDT. Thank you, Mr. Chairman, and thank you, Ranking Member. Thank you all for being here. This is incredibly important.

I am here to tell you that I honestly believe that the AI revolution is underhyped, and here is why. The arrival of this new intelligence will profoundly change our country and the world in ways we cannot fully understand. And none of us, including myself and, frankly, anyone in this room, is prepared for the implications of this.

What is happening at the moment in our industry is that we are very, very quickly, for example, developing AI programmers, and these AI programmers will replace traditional software programmers. We are building in the next year AI mathematicians that are as good as the top-level graduate students in math. This is happening very quickly. You can look at this in a number of the products. Today you think of AI as ChatGPT, but what it really is is a reasoning and planning system that we have never seen before. The implication of this is profound.

In terms of the way the algorithms work, they are going to need a lot more computation than we have ever had. They are going to need a lot more energy, and I will talk about that. What does the industry need? We need high skills immigration. We talk to you about this every day. Light touch regulation around cyber and bio threats. We can talk about that. And most importantly, we need the energy. And the numbers are profound.

What we need from you, if I may say that directly, is we need energy in all forms, renewable, nonrenewable, whatever. It needs to be there, and it needs to be quickly. I and others are investing in things like fusion, which are incredible, but they are not going to arrive soon enough for the need. And I will frame this at the end by my comments about China.

So people are planning 10 gigawatt data centers. Now, just to do the translation, an average nuclear power plant in the United States is 1 gigawatt. How many nuclear power plants can we make in 1 year, where we are planning this 10-gigawatt data center? It gives you a sense of how big this crisis is. Many people think that the demand in—of—energy part that our industry takes will go from 3 percent to 99 percent of total generation. One of the estimates that I think is most likely is that data centers will require an additional 29 gigawatts of power by 2027, and 67 more

gigawatts by 2030. It gives you a sense of the scale that we are talking. These things are industrial at a scale I have never seen in my life.

In the terms of energy planning, the current model is mostly natural gas, peaker plants plus renewables. And that is probably going to be the path we are going to have to follow, right, to get there, and for all the reasons that you can imagine. We have a bunch of regulatory issues around fixing the energy grid. It takes, on average, 18 years to get the power transmissions and so forth to put these things in place. We need to find Federal ways to preempt that and make it happen faster in order to deal with the needs.

Many of these data centers, by the way, are in the heartland. They have a huge economic impact positively on areas that typically do not have the kind of growth that they would like.

Now, why is this all important? When you build these systems, you have intelligence in the computer, and then eventually human-level intelligence. Some people think it is within 3 to 4 years. Then, after that, you have something called superintelligence, and super-intelligence is the intelligence that is higher than of humans. We believe, as an industry, that this could occur within a decade. It is crucial that America get there first.

What is China doing? They are leading in some open source. They are very close behind us. You all have done a great job in doing chip restrictions and things like that to try to slow them down. They are clever and they are smart. They have industrial programs, huge grants going into these companies, and they are weaponizing up in the sense of competition. If you look at DeepSeek, DeepSeek showed up, right, nobody expected this. It turns out it is on par now with some of the top models. Welcome. China has arrived into the competition.

What would happen if China beat us? Let's think about it. The path to intelligence, that superhuman intelligence, think of the national security implications of that competition. This is why I believe—and I will say it directly to you—that although everyone is concerned about Taiwan, I am much more concerned about this. Because if they come to superintelligence, the strong form of intelligence, first, it changes the balance of power globally in ways that we have no way of understanding, predicting, or dealing with.

Thank you, Mr. Chairman.

[The prepared statement of Dr. Schmidt follows:]

SPECIAL
COMPETITIVE
STUDIES
PROJECT

Written Testimony of Dr. Eric Schmidt
U.S. House Committee on Energy & Commerce
"Converting Energy into Intelligence: The Future of AI Technology,
Human Discovery, and American Global Competitiveness"
Wednesday, April 9, 2025 | 10:00 AM EST | 2125 Rayburn House Office Building

Chairman Guthrie, Ranking Member Pallone, and Members of the Committee, thank you for the opportunity to address you today.

I am here to speak about two inextricably linked imperatives that will define America's future in the 21st century: artificial intelligence (AI) and energy. Our nation stands at a pivotal moment. Our capacity to lead, innovate, and secure our interests hinges directly on our strategic mastery of these two domains. The sheer speed of AI development is outpacing our societal and governmental ability to adapt, making strategic foresight and decisive action more critical than ever. Failure is not an option in the face of intensifying global competition. This is what we saw coming in the National Security Commission on Artificial Intelligence (NSCAI), which was set up by the foresight of Congress, and why I continue that work with the Special Competitive Studies Project.

AI is no longer a distant prospect; it is a present reality, actively reshaping our economy, national security, and daily lives. Its potential is immense – accelerating medical breakthroughs, potentially curing diseases, optimizing manufacturing, hardening our defenses, transforming finance, and even improving education. But let me be clear: this technological revolution and the prosperity it promises depend entirely on a modern, resilient, and *vastly expanded* energy infrastructure. Without it, AI's potential remains tragically unrealized.

This challenge is magnified by the strategic competition with the People's Republic of China (PRC). The PRC understands the foundational power of AI and energy, and they are investing massively and strategically to achieve global dominance in both. They are pouring resources into AI R&D while simultaneously building the world's leading renewable energy capacity and modern grid infrastructure. Our response must be equally ambitious, coordinated, and decisive. We are in a race, and we must win.

The relationship between AI and energy is profoundly synergistic. AI development is inherently power-hungry; its computational demands will only escalate, with discussions already underway for data centers demanding 1 to 5, even up to 10 gigawatts of power – facilities costing tens of billions in hardware alone. Yet, AI itself offers the keys to unlocking a modernized, efficient, and secure energy future. AI can optimize grid operations, predict failures, enhance resilience against disruptions – both

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physical and cyber – and accelerate the development of next-generation energy sources. This synergy is a critical strategic advantage if we choose to seize it.

Conversely, inaction carries severe penalties. Failing to invest strategically in *both* AI leadership and energy modernization will erode American competitiveness, weaken our national security, and diminish our global standing within the next decade. We risk ceding our technological edge, hamstringing our most innovative industries, and leaving our critical infrastructure vulnerable. This convergence of failures is unacceptable, especially given the potential for AI misuse – from enhancing bio and cyber threats, including finding zero-day exploits or modifying pathogens, to eroding our very notion of truth.

The U.S. government cannot win this technological race alone. We must reignite America's unique "innovation power" – the potent collaboration between government, private industry, and academia. This model secured our leadership in semiconductors, aerospace, computing, and the internet itself. Today, facing the dawn of artificial general intelligence (AGI) and fierce competition, we must revitalize this proven playbook. The government must set the strategic direction and foster the ecosystem; the private sector must drive innovation and commercialization at speed; academia must fuel the pipeline of foundational research and talent. Our adversaries, particularly China, are attempting to replicate this through state-controlled mandates. We must counter by unleashing the true potential of our free-market, democratic model, potentially leveraging open-source approaches strategically to accelerate innovation. America must lead the next century of innovation.

I. Strategy in the Modern AI Era: A U.S. Strategic Imperative

A. The Transformative Power and Strategic Importance of AI

Artificial intelligence has exited the laboratory and is now a fundamental driver of national power and progress, potentially reshaping society on the scale of the Enlightenment. The speed of adoption is staggering – consider OpenAI's ChatGPT reaching a million users in five days, a milestone that took Gmail five years. And last month, OpenAI added one million ChatGPT users in only 60 minutes after the launch of its new image generation feature. This velocity underscores AI's transformative potential across every sector: revolutionizing healthcare, optimizing complex manufacturing, providing decisive advantages in intelligence and defense, and reshaping financial markets.

Maintaining clear leadership in AI research, development, and deployment is not merely an economic goal; it is a strategic imperative for preserving American economic dynamism, military superiority, and global influence. Our capacity to innovate, create new industries, and solve national challenges is now directly tied to our AI prowess.

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While the United States currently leads in foundational AI research, thanks mainly to our dynamic private sector and global talent attraction, this lead is fragile, and the gap is closing. It requires deliberate cultivation through smart policy, sustained investment, international cooperation on safety, and a national commitment to staying ahead, unhindered by the "anti-science regime" detrimental to American exceptionalism.

B. The Potential of Artificial General Intelligence (AGI)

The accelerating pace of AI development, including the emergence of systems capable of self-learning and autonomous "agents," brings the prospect of artificial general intelligence – AI with human-level cognitive abilities – into sharper focus. AGI represents a potential step-change for humanity, promising unprecedented breakthroughs but also carrying profound disruptive potential and risks, including unpredictable "emergent behavior."

While predicting the exact arrival of AGI is difficult, policymakers cannot afford to wait. We must proactively grapple with its societal, economic, and ethical implications now. The potential for mass automation demands foresight regarding workforce transitions. Ensuring AGI aligns with human values and is safeguarded against misuse – ensuring humans, not machines, remain in control, particularly regarding lethal systems – requires careful ethical frameworks, robust governance structures, and potential regulation focused on liability in extreme cases.

A key marker of the shift to AGI will be AI's ability to produce knowledge based on its own findings, not merely retrieval and recombination of human-generated information. The real magic will occur when systems reach a point at which they become scale-free, meaning that they can train themselves on self-generated data through a process known as recursive self-learning, relying only on electricity to advance. The two domains particularly ripe for this kind of scale-free advancement are mathematics and programming.

Unlike biology and other fields that require real-world experimentation, these disciplines are largely self-contained. A mathematical proof can be checked and verified within the system itself. Similarly, AI could identify the code it needs to complete a defined objective, develop that code and improve on it — all without human intervention. These systems would then engage in self-directed research, iterating through possible solutions. Not only would they feed answers back into themselves to refine their approaches, but they could also draw on the collective knowledge of the internet and of other models. Such superintelligent mathematical tools could be combined with frontier models that are proficient in natural language, bridging the gap between formal and semantic reasoning. This integration could lay the foundation for further advances in reasoning and unlock new discoveries in

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other fields like physics and economics. I expect AGI will then move beyond the current limits of knowledge.

C. China's Advancements and Strategic Ambitions in AI

Let us be unambiguous: while the United States holds an edge today, China is out-organizing us as a nation. China is a determined and rapidly advancing competitor in AI. Fueled by massive state investment, explicit national goals articulated by the CCP, and a vast domestic talent pool, China's capabilities are growing formidable. The recent emergence of sophisticated Chinese large language models, like DeepSeek-V3, signals a shift: China is moving beyond imitation to become a true innovator.

China's approach is fundamentally different – a centralized, state-directed fusion of government, industry, and academia, all laser-focused on achieving geopolitical objectives. This allows rapid translation of research into commercial products and global deployment, exemplified by companies like DeepSeek and Manus AI. The risk includes not only competition but also potential IP theft or modification of systems and the possibility of China achieving a monopoly leadership position or initiating preparatory attacks.

China's stated goal is global AI leadership by 2030. Achieving this would allow Beijing to set global technology standards, and norms, and potentially dominate key future industries, fundamentally altering the global balance of power. Their parallel, aggressive investments in energy infrastructure underscore the comprehensive nature of their strategy. While competition is fierce, dialogue remains crucial. Channels between the United States and China are necessary to address shared existential risks like AI enabling bioterrorism or accidental escalation. However, we must compete vigorously while managing these risks.

There is also a debate regarding openness. While some worry about China exploiting Western open-source models, there's a strong case that *Western leadership* in open-source AI is vital for our own innovation speed, transparency, and competitiveness, preventing us from falling behind due to overly closed systems. This requires a strategic approach – fostering openness while implementing safeguards.

D. Recommendations to Organize the United States and Maintain AI Leadership: The Technology Competitiveness Council

To effectively compete and secure our AI leadership, the United States requires a unified national strategy that aligns government action with the dynamism of the private sector. A critical missing piece, as recommended by the NSCAI in 2021, on which I served, is a central coordinating body. To

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address this, we proposed the creation of a small, elite Technology Competitiveness Council, or TCC, within the White House, ideally led by the Vice President. We need this leadership on technology competition now more than ever.

Under the first Trump administration, the Space Force was created through a wargaming and strategy process led by the Office of the Vice President. This demonstrated the clarity and leadership that the White House can bring. Similarly, the TCC's mandate would be clear: identify critical emerging technologies, develop national action plans, coordinate disparate agency efforts, and, crucially, ensure continuous, high-level collaboration with private sector leaders. The TCC must be empowered to cut through bureaucracy and drive implementation at the speed of relevance, mirroring the agility of the private tech sector and methodically bringing them into the process. It is the necessary structure to harness our full national innovation power, including strategically embracing open-source development, and ensure America remains the world's leading technological force.

Yet, four years later, this essential high-level coordinating function still does not exist, leaving our national efforts fragmented precisely when AI development is outpacing our ability to adapt.

E. Strategic Significance of Space as the Frontier of Competition and Innovation

The strategic competition increasingly extends to the ultimate high ground: space. This domain is critical for national security – communications, intelligence, surveillance, reconnaissance, navigation – and economic prosperity. The war in Ukraine provided a stark lesson: commercial space capabilities like Starlink can be geopolitically decisive.

China recognizes this and is rapidly advancing its space program. Their progress demands an urgent and robust American response. AI is central to future space dominance, powering autonomous systems, optimizing satellite constellations, managing space traffic, and analyzing Earth observation data in real-time.

America must maintain its leadership in space. Our positional advantage will not be secured by chance any more than Apollo grew naturally from the private sector. This requires significant federal investment in next-generation space infrastructure, policies that foster commercial space innovation, and strong public-private partnerships. Space is foundational to 21st-century power. The intersection of AI, energy, and space will define the competitive landscape for decades.

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II. Securing America's Energy Future in the Age of AI

A. Vulnerabilities of the Current U.S. Energy Infrastructure

Our current energy infrastructure faces critical vulnerabilities. Much of it is aging, designed for a different era, and ill-equipped for the staggering demands of the 21st century, particularly the immense power requirements of large-scale AI – potentially needing gigawatts per facility. It is increasingly susceptible to disruption from extreme weather events, sophisticated cyberattacks, and physical threats.

These vulnerabilities directly threaten our economic activity, military readiness, and societal stability. The growing digitization of energy systems expands the attack surface for cyber threats, potentially allowing adversaries to cripple essential services.

B. Strategic Importance of Modernizing Energy Infrastructure

Therefore, modernizing our energy infrastructure is not just an economic upgrade but a national security imperative. A resilient, efficient, secure, and *abundant* energy supply is the bedrock of a modern economy and the enabler of technological leadership, especially in AI. It underpins our military capabilities and the basic functioning of our society.

Without significant modernization and expansion, our energy system will become the Achilles heel of our AI ambitions. We simply cannot power the future of computation – requiring potentially 100x more energy – and thus the future of our economy and security on yesterday's grid.

C. The Role of AI in Enhancing Energy Security

AI is not just a consumer of energy; it is also a critical tool for securing and optimizing our energy future. AI algorithms can revolutionize grid management, optimizing generation and distribution for maximum efficiency and reliability. Predictive maintenance can prevent costly failures. AI can enhance grid resilience, enabling faster detection and response to disruptions.

Crucially, AI is essential for bolstering cybersecurity in the energy sector. AI-driven threat detection systems can monitor networks in real time, identifying and neutralizing sophisticated cyber threats like zero-day exploits far faster than human operators alone. This capability is vital for protecting our critical energy infrastructure.

Our goal should be to make energy so abundant that it is nearly free for our people and exportable to the world. Driving this factor of production down can account for labor costs in America and keep our nation as the destination for building AI companies.

D. China's Role and the Global Energy Landscape

Looking through a competition lens, we must recognize China's strategic, state-driven efforts to dominate the global energy landscape. They are investing heavily in modernizing their grid, deploying renewable energy at scale, and pursuing next-generation technologies like fusion. Their dominance in manufacturing solar panels, wind turbines, and batteries gives them significant global leverage.

China's comprehensive approach to energy, coupled with its AI ambitions, presents a direct competitive challenge. Failure to accelerate our own energy transition and innovation risks ceding leadership in technologies that will define the future global economy and geopolitical influence.

E. Recommendations for Federal Investments in Grid Modernization, Energy Integration, and Cybersecurity

Securing America's energy future requires bold, strategic federal action and investment. We must prioritize:

1. **Massive Grid Modernization, Expansion & AI-optimization:** Deploying grid-enhancing technologies, building out significant new high-capacity transmission, and investing in smart grid capabilities to handle the gigawatt-scale demands of AI and integrate diverse sources.
2. **Energy Integration and Abundance:** Supporting the seamless integration of diverse and abundant energy sources, including advanced nuclear and fusion, alongside significant investments in long-duration energy storage.
3. **Hardened Cybersecurity:** Dramatically increasing funding for energy sector cybersecurity, mandating high standards, promoting AI-powered defense tools, and ensuring robust information sharing.
4. **Domestic Innovation and Manufacturing:** Fostering the development and onshoring of next-generation energy technologies and manufacturing capabilities to ensure supply chain security and technological leadership.
5. **Strategic Open-Source AI:** Fostering a vibrant open-source AI ecosystem in the West through infrastructure support and collaboration to accelerate innovation and maintain competitiveness while developing necessary safeguards.

F. The Potential of Next-Generation Energy Technologies Like Fusion

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Looking ahead, we must make strategic bets on game-changing technologies. Fusion energy holds the ultimate promise: virtually limitless, safe energy. Achieving leadership in fusion would be a profound strategic advantage, securing energy abundance for the AI era and beyond.

The United States must declare fusion a national priority, as recommended by SCSP. This requires dedicated fusion leadership, a clear national strategy, robust public-private partnerships, and targeted investments. Leading the fusion revolution would solidify American technological supremacy for generations.

III.   Securing American Dominance in the 21st Century

To conclude, U.S. leadership in artificial intelligence and a modernized, secure, and abundant energy infrastructure are the twin pillars of American power and prosperity in the 21st century. They are inseparable.

We face a strategic inflection point, grappling with technology advancing faster than our institutions and carrying risks alongside immense promise. The choices we make now – the investments we prioritize, the strategies we adopt, the urgency with which we act – will determine our ability to out-compete rivals like China, harness AI for unprecedented progress while managing its perils, ensure human values guide its development and secure our future.

By embracing AI's potential, rebuilding and vastly expanding our energy foundations, fostering open innovation where appropriate, engaging in critical international dialogues on safety, and reigniting our national innovation engine, the United States can and must secure its technological leadership, economic vitality, and national security for the decades ahead.

Thank you again for the opportunity to appear before you, and I look forward to our discussion.

# # #

Mr. GUTHRIE. Thank you. Thank you for that sober assessment. It is why we wanted to have this hearing. We appreciate that very much. Now we will recognize Mr. Bhatia.

You have your 5 minutes for your opening statement.

STATEMENT OF MANISH BHATIA

Mr. BHATIA. Thank you, Mr. Chairman, Ranking Member Pallone, and members of the committee. My name is Manish Bhatia, and I serve as executive vice president of global operations at Micron.

Micron was founded in 1978 in Boise, Idaho, and over the last several decades has become one of the world's most innovative companies, with more than 58,000 U.S. patents granted. And Micron is America's only manufacturer of memory chips, and the only U.S. semiconductor company with worldwide technology leadership today. Micron is truly a national treasure.

Micron has become fundamental to America's economic competitiveness because our fabs manufactured the world's most advanced memory chips and are at the heart of the AI revolution. For each AI chip that Nvidia sells, there are 96 high-bandwidth memory chips integrated with it. Without our chips, there simply is no AI.

Micron is the only company planning to invest more than $100 billion over the next 20 years to build leading-edge memory fabs here in the United States. These investments will power America's AI leadership, they will serve domestic demand for other industries, and drive U.S. semiconductor exports. Our investments are projected to create 11,000 high-paying direct Micron jobs, 9,000 construction jobs, and ultimately, between direct and indirect, 80,000 new jobs created across our expansions planned in Idaho, New York, and Virginia.

The President and Congress have made clear that the United States needs to continue to lead on AI and increased domestic manufacturing. The success of our investments will keep the U.S. at the forefront of the AI revolution, strengthen the economy, and make America more secure.

To make our historic U.S. investments, we need reliable and affordable energy. One of the most important factors that made upstate New York and Boise, Idaho, attractive for our planned investments is reliable, low-cost power. And in Virginia, where we have been operating for two decades, grid reliability has been critical to our operations. Each of these full-scale fabs built here will run 24/7, 365 days a year and consume, at full build-out, about 400 megawatts of power. By 2040 we expect our U.S. energy demands to reach 2 gigawatts. This demand comes from a variety of highly complex manufacturing process steps, including using extreme ultraviolet lasers to create advanced nanoscale features on our chips.

Beyond scale, we also need power to be reliable. Even fractions of a second of power loss or even just power sag or droop forces us to reset equipment, check for inconsistencies and deviations in the material, and ultimately can cost tens or even hundreds of millions of dollars. Reliable power is critical to our U.S. expansion.

Historically, the United States has maintained low electricity prices due to the abundance of energy resources and its all-of-the-above approach. From oil and natural gas to solar and nuclear, this

was a bright spot for Micron as we built here at home, and is one of America's key competitive advantages in manufacturing. However, after years of matched supply and demand, we are now seeing significant electricity demand growth, and supply may struggle to keep pace. By one estimate, U.S. electricity demand could rise by 128 gigawatts, more than 15 percent over the next 5 years alone. This risks the United States losing leadership in AI and in the technologies that enable it.

Meeting this energy demand means the Federal Government needs to take an all-of-the-above approach and cut through red tape to bring generating projects to life. We also need to invest in energy equipment and supply chains. When I visited the Idaho National Lab last month to discuss their cutting-edge work on advanced nuclear technologies, it became clear how much investment is needed in uranium fuel supply chains and other new technologies.

Beyond generating capacity and energy supply chains, we need to ensure that U.S. transmission infrastructure is fit for the 21st century. Without new and updated transmission infrastructure, new generation won't deliver—won't be able to be delivered to customers like us. This is why permitting reform to accelerate transmission infrastructure is so important.

Taking a step back and looking at manufacturing and AI more broadly, this also means continued investment in manufacturers that enable the AI revolution. Micron and other U.S. semiconductor companies building and operating fabs in the U.S. experience cost deltas with our Asian competitors of 35 to 45 percent. To ensure U.S. global competitiveness, we are calling for an extension and expansion of the expiring Semiconductor Manufacturing Investment Tax Credit. This will continue to enable the success of America's semiconductor manufacturing renaissance.

Finally, to echo Chairman Guthrie's remarks, having consistent, reliable regulations, particularly in energy and permitting, allows Micron to make long-term manufacturing investments at home so the country can lead in manufacturing and in AI.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Bhatia follows:]

WRITTEN STATEMENT OF MANISH BHATIA
MICRON EXECUTIVE VICE PRESIDENT, GLOBAL OPERATIONS

BEFORE THE U.S. HOUSE COMMITTEE ON ENERGY AND COMMERCE
"Converting Energy into Intelligence: The Future of AI Technology, Human Discovery, and American Global Competitiveness"

April 9, 2025

Opening

Chairman Guthrie, Ranking Member Pallone, and members of the Committee: thank you for the opportunity to testify today regarding the significant growth in electricity demand in the United States, and how this coincides with American competitiveness and the future of AI. Expanding U.S. energy production and improving electric power transmission are vital to ensuring America's AI technology leadership, manufacturing renaissance, and the future of the American economy all in parallel. 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.

My name is Manish Bhatia, and I serve as the Executive Vice President for Global Operations at Micron Technology, the only American manufacturer of memory and storage semiconductor solutions.

Micron is building new large-scale semiconductor factories, or "fabs" as we call them, that will manufacture leading-edge memory chips in two states, Idaho and New York. Micron is also planning efforts to modernize and add new capabilities to our existing facility in Virginia, which makes chips used by the U.S. defense industrial base, the automotive sector, and a diverse range of other customers. Micron plans to invest approximately $50 billion in capex for leading-edge American memory manufacturing through 2030 and more than $100 billion over the next 20 years.

In order to support a rapidly growing market for memory (by several estimates, the global memory market will grow to more than $300 billion annually by 2030), our U.S. expansion will include a leading-edge R&D and manufacturing center in Boise, Idaho, a megafab in Clay, New York, and a modernization and expansion of our site in Manassas, Virginia. Our investments will create 11,000 direct Micron jobs, 9,000 construction jobs, and tens of thousands of additional indirect jobs, ultimately creating 80,000 jobs across our expansion locations.

The U.S. is on the cusp of a manufacturing renaissance, breakthroughs in AI and other technologies, meanwhile, are driving increasing demand for data centers thanks to business and tax incentives passed by Congress and President Trump. While this manufacturing resurgence and AI leadership are both vital for America's national security and economic security, the demand for electricity is expected to grow faster than it has in decades. The U.S. will not be able to meet this projected demand unless it expands electrical generation capacity and modernizes the nation's electrical grid for all these planned projects.

About Micron Technology

Micron plays a vital role in the semiconductor ecosystem. Micron was founded more than 46 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 50,000 people worldwide and has operations in 18 countries. We are one of the world's most innovative companies with over 58,000 U.S. patents.

Micron serves customers across many industries, ranging from aerospace and defense to data centers and automobiles. I am confident that if you look inside the phones, computers, TVs, and other devices that Members

of the Committee use every day, you would find Micron chips. We estimate that half of all cars in America have a Micron chip made nearby in Manassas, Virginia. As a Michigan native and having started my career in the auto industry, it's an honor to have the responsibility to lead the global team responsible for manufacturing the leading-edge memory chips that are used by all auto manufacturers.

Why Memory Matters

I know that President Trump, Congress and many Members of this Committee have been focused on the value and importance of ensuring a strong U.S. supply chain for semiconductor manufacturing, maintaining America's semiconductor leadership for more than five years. There is a widespread recognition in Congress that the U.S. needs to produce more leading-edge logic chips—the types of chips that serve as the processors for computers, phones, and other devices.

But it is equally important that the U.S. reclaim leadership in manufacturing memory chips, the type of chip that Micron manufactures. Memory and storage account for 60% of advanced semiconductor production by volume, and they also account for almost 40% of industry sales. Memory, which is how information is stored, is essential to all aspects of modern technology. Without memory, computers, phones, data centers, airplanes, medical devices, and other technologies would not be able to store or process information. There would be no data on which to train AI systems. The United States government—from the Department of Defense and Intelligence Community to NASA—cannot operate advanced satellite communications without massive memory banks needed to accumulate data and relay it back to Earth. Without memory, Members of this Committee would not be able to record videos or text, and there would be no data centers on which to store digital records of America's laws. Simply put, without memory, there is no AI.

Today, while the U.S. continues to lead in semiconductor R&D and design, the U.S. only manufactures about 12% of chips globally. But when we talk about manufacturing memory, that percentage is even lower. Less than 2% of the world's memory chips are manufactured in the U.S.—all of them at our facility in Manassas, Virginia. Almost all of the rest of the world's memory is manufactured in Asia, making memory chips vulnerable to potential geopolitical events and supply chain disruptions.

Micron's Technology Leadership

Micron is a world leader in memory technology, and America's memory manufacturing champion for the digital ecosystem. Micron's memory products include dynamic random-access memory (DRAM), an advanced type of memory, which Micron will manufacture in the United States at our planned fab expansion projects, as well as non-volatile storage memory NAND and NOR, as well as legacy dynamic random-access memory (DRAM), which remain important products for many American customers and computing applications.

Micron also manufactures High Bandwidth Memory, or HBM, which is an innovative product that is essential for AI and other high performance computing applications. Micron's HBM3E is the fastest, and lowest power high bandwidth memory product available across the industry. It is what enables today's generative AI models and allows these models to break through the data bottlenecks they face.

Our chips are increasingly energy-efficient, one of our key competitive advantages. This allows our customers, from data centers to automakers to smartphone users, to have greater operating capacity for the same, or less, electricity use. After making strong energy efficiency gains for our HBM3E chip by reducing power demand by more than 50% relative to our previous HBM2E chip, we estimate that our advanced chips are 30% more efficient than our competitor chips. For a data center customer with a 10,000-GPU data center using Micron chips, this means significant power savings compared to competitor chips, and would translate to the equivalent energy reduction of hundreds of U.S. households just for one data center.

Global Competitiveness and U.S. Semiconductor Manufacturing

America's semiconductor manufacturers operate in a highly global and intensely competitive environment. This environment evolved not just from the investment decisions and innovation from companies, but also from a variety of policies and tools developed by countries around the world to incubate and grow semiconductor supply chains, manufacturing, and R&D.

For the U.S. to remain competitive in semiconductor manufacturing, it is vital for the government to understand where we're starting from and what tools can be deployed to even the playing field. The cost gap between constructing a fab in the United States can be 35-45% higher than building a similar fab in Asia.

This cost gap largely comes down to a few factors, all of which are addressable by the government: **1) supporting greater semiconductor for R&D and manufacturing by extending and expanding the semiconductor investment tax credit (48D) (ITC); 2) addressing duplicative codes and policies that delay construction without providing any meaningful increase in safety or environmental protection; 3) ensuring policies keep energy prices down through increased generating capacity, and updating and expanding transmission infrastructure through permitting reform; and 4) increasing federal investments in workers and upskilling to ensure the industry has the workforce it needs.**

Before the U.S. took steps to incentivize domestic chip manufacturing, heavy overseas subsidies created a significant cost disparity in which **it now costs 35-45% more to build and operate a fab in U.S. than abroad**. As a result of this disparity, the U.S. share of global fabrication capacity **declined from 37% in 1990 to 10% in 2022.**

According to reports, as a result of inflationary pressures from the pandemic, for large-scale construction projects in the United States today costs have increased across the board. Construction costs have gone up by as much as 30-40% just since 2020, while labor costs have risen 20-35% due to increased spending in manufacturing and energy sectors. In addition, bulk material costs such as those for concrete and steel have increased by 45-60%, and equipment prices have increased 35-50% due to global supply chain disruptions. These all represent significant challenges for sectors wishing to expand their U.S. manufacturing footprint, including the semiconductor industry.

Supporting the Advanced Manufacturing Investment Credit (IRC §48D)
Because these inflationary pressures have increased the cost gap between the United States and other markets, the advanced manufacturing investment credits has become even more critical to maintain America's manufacturing competitiveness and AI leadership. The advanced manufacturing investment credit (IRC §48D) has helped reverse the decades-long decline in U.S. semiconductor manufacturing capacity, with the U.S. now projected to triple its manufacturing capacity between 2022 and 2032.[1] However, this credit is expiring, threatening the ability to make additional, sustained, long-term investments to meet market demand and increase America's chipmaking capacity and expand U.S. semiconductor exports. **It is critical for the IRC §48D tax credit to be expanded for at least 5 years and increased to 35%; this will secure the $500 billion+ semiconductor investments[2] by semiconductor companies such as ours and will generate further investments for years to come.**

Addressing Duplicative Regulations While Maintaining Critical Safeguards
With respect to building and construction codes and associated environment laws, the biggest driver of delays for economic development projects like our projects in the United States have been the environmental review

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[1] Semiconductor Industry Association. Winning the Chip Race. 2025, p. 8. https://www.semiconductors.org/wp-content/uploads/2025/01/SIA_WINNING-THE-CHIP-RACE_2025.pdf.
[2] Semiconductor Industry Association. SIA Comments on Reciprocal Trade Practices. 2025. https://www.semiconductors.org/wp-content/uploads/2025/03/SIA-Comments-Reciprocal-Trade-Practices-03-11-25.pdf.

process. For example, for our four-fab project in Central New York, Micron is the only semiconductor company that must undergo an environmental impact statement mandated by both federal and state laws while other semiconductor companies in other states have been exempted from federal environmental reviews or must only complete federal environmental assessments with shorter timelines.

New York is one of a handful of states with a more stringent state environmental review than the federal NEPA process. The failure to address the duplicative federal and state environmental process requirements has delayed our NY project by two years and increased costs for Micron across the board.

Promising legislation may address this thorny issue. The Infrastructure Project Acceleration Act led by Reps. Langworthy and Collins will give the lead federal agency the ability to ensure that critical environmental protections have been thoroughly considered before expediting the federal National Environmental Policy Act (NEPA) process for projects such as ours while maintaining state-level regulations, and would cover only states with more stringent environmental reviews than NEPA, including California, Massachusetts, Montana, New York, Indiana, North Carolina, and Georgia.

There has been an additional burden with the number of federal and state inconsistencies in the application of Supreme Court rulings. The Administration's reconsideration of the Particulate Matter National Ambient Air Quality Standards (PM 2.5) is positive as this rule, as currently implemented, limits opportunities for American manufacturing.

And to be clear, we comply with safety and environmental laws in other locations in Asia, but these laws from our experience seem to be more streamlined, and with less duplication among national and local laws.

Additionally, there are notable differences between the United States and building codes in Asia, particularly in the context of semiconductor fabrication facilities. For example, the US FAB Construction Limitations - Code Environmental 2025-02-19 document highlights that the International Building Code (IBC) in the United States restricts the number of building stories above ground to four stories above ground, whereas Taiwan does not limit the number of stories in a semiconductor fabrication facility. Similarly, there are no restrictions on building height above ground in Taiwan, while the United States' H-5 Occupancy restricts it to 160 feet. Additionally, Taiwan allows for basement levels, whereas the US's H-5 Occupancy requires all levels to be above ground. While these distinctions may seem obscure, they can significantly impact how quickly and cost-effectively we can expand our U.S. footprint.

Maintaining America's Competitive Edge in Energy Pricing and Reliability
Finally, it is critically important that the federal government act to protect one of America's strongest competitive advantages compared to other markets in Asia: reliable power at affordable prices. **This advantage is critical, as energy is the second highest input cost for semiconductor fabs, after labor costs.**

As I will note in my testimony below, U.S. power prices have historically been a key strength in manufacturing, with power prices typically between one-half and one-third the price of energy in Asian markets. This is due to an abundance of domestic energy resources that many Asian countries lack, such as hydropower, natural gas supply, expanded carbon-free sources, and a stable nuclear fleet. **The United States must maintain this key competitive advantage by building out generating capacity to meet the expected short-term surge in energy demand after 20 years of flat growth. It must also improve transmission infrastructure through permitting reform to ensure that this new generating capacity can actually get to the manufacturers, small businesses, and consumers that will need it.**

Addressing Workforce Needs
With the evolution of AI in the workplace and shifting worker demand, the U.S. also needs to continue to invest in training tomorrow's workforce and upskilling the existing workforce to best position our industry's talent

pipeline. At current rates, the U.S. will not keep up with demand for skilled workers in the semiconductor industry — including for the construction of new fabs — and among all critical technology sectors.[3]

Addressing this shortfall requires a comprehensive approach. More must be done to encourage U.S. students to: 1) pursue education and training in critical areas for the industry; 2) engage in semiconductor-related research and pursue advanced degrees in larger numbers; and 3) choose the semiconductor industry over other competing technology fields.[4]

For upskilling, the federal government should continue to invest in upskilling existing workforces through the National Science Foundation, the Department of Commerce, and the Department of Labor. Micron, for example, is proud of our work to upskill our own workers, with a particular focus on veterans. More programs like ours should be incentivized so companies can do their part to train tomorrow's semiconductor workforce.

Micron's Expansion

With our historic U.S. investments and expansion, we expect that these fabs will produce as much as 40% of Micron's DRAM chips here in the United States, create 80,000 jobs across the country, strengthen U.S. and national security, and cement Micron as a leader in American innovation.

There are many reasons we chose Central New York for our high-volume production, where we are poised to build as many as four fabs. When we were exploring sites for our new fabs, we considered several elements across 28 potential U.S. sites, including: the ability to partner with excellent universities and community colleges to train our workforce; a 1,400-acre site that fit our needs for a megafab site based on the growing global market demand for memory; and easy access to abundant water supplies. All of these were critical factors in the ultimate selection of Clay.

But **access to reliable, affordable, carbon-free electricity was also a key factor. Consistent power is crucial for fabs that will operate around the clock, 24 hours a day, 7 days a week. We cannot afford to suffer even a fraction of a second of electricity loss because outages would cost Micron tens or even hundreds of millions of dollars of production at any given time**. Any drop in power forces us to reset equipment and check for inconsistencies or deviations on the work in progress, which can take days or weeks to fix and slow or halt production. And when we slow down, so do our customers, ultimately leading to supply chain disruptions and shipment delays of the phones, autos, and the systems powered by our memory.

We estimate that each of our fabs will use approximately 400MW, or the equivalent of power to an estimated 300,000 homes. Micron will need that level of power even after we implement a variety of energy-saving controls across our manufacturing operations.

This demand comes from the more than 1,500 processing steps required that take the base silicon wafer (which is made from crystalline sand) into the amazing chips that power our world. These processes take place in high purity clean rooms with precise climate and particle control systems, advanced precision tools including the world's most advanced Extreme Ultraviolet (EUV) lasers to create the nano-scale features for our advanced chips.

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[3] Semiconductor Industry Association. Winning the Chip Race. 2025, p. 8. https://www.semiconductors.org/wp-content/uploads/2025/01/SIA_WINNING-THE-CHIP-RACE_2025.pdf.
[4] Semiconductor Industry Association. Winning the Chip Race. 2025, p. 8. https://www.semiconductors.org/wp-content/uploads/2025/01/SIA_WINNING-THE-CHIP-RACE_2025.pdf.

Micron's Domestic Energy Efforts

Given the size and profile of our energy load, as well as our proximity to the Nine Mile Point and Fitzpatrick Nuclear Stations in upstate New York, we support efforts to expand nuclear generating capacity to meet the needs of our expansions as well as other customers and ratepayers in the region. We were pleased to be able to reach an agreement with the local power operator in New York to guarantee us the initial electricity we need at an affordable rate.

In addition to our efforts to ensure that our future fabs in New York conserve energy, we have also **honed our operations and manufacturing processes to increase energy efficiency** at our fab in Boise 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 reduce the electricity our tools use and give our process engineers visibility on electricity consumption data using smart controls and real-time data. **These efforts allowed us to reduce our Boise facility's electricity consumption in 2024 by 8.6 million kilowatt hours—equivalent to removing 1,400 cars from the road,** according to the U.S. EPA. 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, and carbon management.

Micron does not just try to save power across our own manufacturing and business operations. The chips we manufacture all require power to operate, and Micron has taken steps over the years to improve power efficiency in our chips. Our current industry-leading 1β (1-beta) technology provides a 15% power savings over our previous technology, 1α (1-alpha). Whether through our policies or products, in our past, our present, and our future— Micron is a leader in taking steps to increase energy efficiency.

Energy and the Future Demand from Data Centers, AI, and Manufacturing

Under both Republican and Democratic administrations and Congresses, the federal government has recognized that winning the leadership race in AI is a priority for our country's economic strength and national security. Likewise, the United States has become the world's hub for data centers, many of which are developed by our customers: the amount of data capacity in northern Virginia alone is greater than the entire data center capacity of Europe or China.[5] This is due to the fact that hyperscalers, the most important large scale cloud service providers for computing and storage at enterprise scale, maintain a significant position in the region. Northern Virginia alone accounts for approximately 13% of global data center capacity, and nearly 40% of global hyperscaler storage capacity.[6]

Additionally, the demands of AI have only grown as the scale of AI's potential has become more firmly integrated in products from phones and cars to medical devices. The level of computing power required to power AI has exploded as the growth in AI has exceeded initial expectations; in the last 5 years, generative AI models have gone from 1.5 billion parameters (the adjustable values within a model during training) to more than 100 billion as tasks have become increasingly complex and uses have accelerated rapidly.

The U.S. is also undergoing a manufacturing renaissance as both Republicans and Democrats have recognized the importance of securing local domestic production in supply chains to improve resilience. By the end of last year, manufacturing as a value-added output of the U.S. economy rose to nearly $3 trillion and represented 10% of the

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[5] Synergy. Virginia Still Has More Hyperscale Data Center Capacity Than Either Europe or China. September 2022. https://www.srgresearch.com/articles/virginia-still-has-more-hyperscale-data-center-capacity-than-either-europe-or-china.
[6] Joint Legislative Audit and Review Commission of Virginia. Data Centers in Virginia. 2024. https://jlarc.virginia.gov/landing-2024-data-centers-in-virginia.asp#:~:text=Northern%20Virginia%20is%20the%20largest,of%20capacity%20in%20the%20Americas.

total value-added output for the entire economy. Additionally, for every $1 spent in manufacturing in the United States, the total return to the U.S. economy is nearly $2.70.[7]

Combined, these trends mean the U.S. must plan for unprecedented growth in modern electricity demand: data centers, AI, and manufacturing are all highly energy-intensive industries, and their explosive growth in the last few years has had a significant impact on both U.S. and global electricity demand projections.

In Virginia, electricity utility Dominion estimates that power demand for the state will double in the next 15 years and annual demand growth will exceed 5%, with data centers being the largest contributor to this demand growth.[8] Nationally, we may see a 15% increase in demand over the next 5 years, the equivalent of more than 90 million homes in the same period.

The Government Must Act as Energy Demands Rise

This bring me to a stark point that I need to make: meeting this growth will require major shifts in how the U.S. thinks about both power generation and power transmission, especially after years of largely flat power demand in the United States. At this point, the U.S. is not on track to keep pace with projected demand, and unless the U.S. makes substantial policy shifts, access to affordable and reliable power will begin constraining America's manufacturing renaissance, data center growth, and technological leadership. **Investments in energy-intensive industries, such as semiconductor manufacturing, may even become uncompetitive or even unviable unless action is taken now.**

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.

Generation: With respect to power generation, future electricity demand is likely to outpace existing generation capacity. With as much as 128 GW of projected future demand over the next 5 years, the U.S. government needs to take an all-of-the-above approach to ensure that power generating capacity can continue to outpace demand and keep electricity prices low for customers and competitive for manufacturers like Micron.

To address this challenge, the federal government needs to pursue strong and growing federal investment in electricity-generating capacity through targeted incentives such as subsidies and tax breaks, honed to expand capacity and increasing support for R&D in new and promising technology developments. This means expanding nuclear power, investing in cutting-edge technologies, including battery and storage innovation, looking to advances in natural gas and LNG, exploring large projects in zero-emission energy, and removing red tape across the energy ecosystem.

We do not have the luxury to debate which energy resource is better; we need them all – at low cost. The government needs to explore an **all-of-the-above approach** with electricity generation because rising demand from industry and consumers gives us no other option if we want to address our manufacturing needs and keep costs low for consumers and industry.

This also includes the equipment needed to turn energy resources into the electricity used by manufacturers, data centers, and consumers. For example, expanded natural gas exploration will not lower domestic prices if there are production bottlenecks for gas turbines and other equipment necessary for generating electricity from that natural gas. Indeed, public reporting has indicated that orders of U.S.-company manufactured gas turbines are likely to be

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[7] National Association of Manufacturers. Facts About Manufacturing. 2024. https://nam.org/manufacturing-in-the-united-states/facts-about-manufacturing-expanded/.
[8] Data Center Dynamics. Dominion Energy Outlines Long Term Strategy for Virginia Power Infrastructure. 2024. https://www.datacenterdynamics.com/en/news/dominion-energy-outlines-long-term-strategy-for-virginia-power-infrastructure/.

sold out through the end of 2028 within just a few months, after demand increased 5-fold last year. The lessons from America's experiences in critical materials supply chains have made this clear: **every step of the energy ecosystem needs greater resilience, supply, and investment, and bottlenecks must be addressed swiftly.**

<u>Transmission</u>: With respect to power transmission, Micron is unfortunately very familiar with the extensive regulatory delays that have slowed the transmission of existing generating capacity to businesses and consumers. With constrained transmission infrastructure in the northwest, Micron has looked to the Boardman to Hemingway (B2H) transmission line as a promising opportunity to provide critically needed electricity from Oregon to Idaho. This line would provide Idaho with up to 500 MW of affordable, reliable power from the Pacific Northwest in the summer, when a surplus of energy is available there.

However, the B2H project, which began in late 2006, still has not been constructed as developers await federal permitting approval. For nearly 20 years, this potential generating capacity has languished in Oregon with permitting costs now exceeding $220 million – all while customers in Idaho, such as Micron, are expanding our presence with energy demands are only expected to grow.
This type of delay is unacceptable and severely undermines our nation's ability to rebuild U.S. manufacturing to support resilient businesses and growing communities, as well as to meet our nation's AI leadership goals. These delays drive up the cost of electricity, making the United States a less competitive destination for companies like ours.

Changing this process through permitting reform is fundamentally important for this Congress to address. Decades of delays in infrastructure are now running up against massive increases in electricity demand. This is leading to escalating electricity costs and a weakening of America's position in manufacturing and AI, all of which are undesirable outcomes. We were encouraged last year by strong bipartisan, bicameral calls for permitting reform, particularly by Senators Barrasso and Manchin, and we look forward to continuing these efforts in this Congress. **But if electricity demand is going to rise by more than 100GW in the next 5 years, and double in key markets such as Virginia, this cannot be an issue to address in the next Congress, or 5 to 10 years down the line. <u>This issue needs to be addressed right now.</u>**

Above all, Micron supports efforts that ensure affordable and reliable electricity –permitting reform that utilizes all avenues to support the growth of domestic manufacturing, improving reliability of the grid, maintaining low electricity costs, standardizing the definition of renewable at all levels of government, and investing in additional carbon-free energy sources such as nuclear.

With Micron committed to regulatory compliance and protecting the environment, we also recommend actions to reduce permitting burdens related to the National Environmental Policy Act (NEPA), specifically unnecessary and duplicative state and federal environmental review processes, as noted above. Doing so would help speed up implementation of economic development investments, like Micron's, and ensure every federal dollar is well-spent, while also continuing to protect the environment through compliance with other applicable environmental regulations.

Conclusion

In closing, I will leave you with this: Micron's main product is memory chips, and memory is an intensely competitive business, and is at the very core of AI. **Therefore, Micron's access to low-priced, reliable power is fundamental to Micron's ability to compete globally and even domestically as the only U.S. semiconductor manufacturer of memory.**

Micron is expanding its capacity in the United States to meet a growing global demand for advanced memory chips. With growing demands from AI-enabled technologies, Micron is now ramping up to meet peak demand in the coming years. We have been planning for years to meet this demand in the latter part of the decade. We would

appreciate support from Congress and the U.S. government in ensuring a competitive environment to meet the domestic demand.

It is imperative that the whole of the federal government plan address the electricity demands of the data-driven economy of today and tomorrow, so that the United States can preserve its competitive advantage. **This means expanding and extending tax credits like the semiconductor investment tax credit (ITC) (48D)**, supporting programs across-the-board that are generating energy capacity and reforming our transmission infrastructure permitting processes to get new capacity online as quickly as possible.

Without addressing these issues now, America's manufacturing renaissance and AI leadership will both become deeply uncertain. Let us take this opportunity to work together and meet the demands of today and the future.

Thank you.

Mr. GUTHRIE. Thank you. Thank you for your testimony.

Mr.—the Honorable Mr. Turk, you are recognized for your 5-minute opening statement.

STATEMENT OF DAVID M. TURK

Mr. TURK. Chairman Guthrie, Ranking Member Pallone, and distinguished Members, thank you for the opportunity to testify today.

More importantly, let me thank you for this committee's concerted, sustained focus on both the opportunities and the risks surrounding artificial intelligence.

As someone who has spent a lot of time in windowless rooms, including giving my last 4 years as Deputy Secretary of the U.S. Department of Energy, let me clearly state my bottom line up front: Housing as many AI data centers as possible, especially cutting-edge AI training models, within our country is both an economic and a national security imperative. There is no more powerful and transformational technology facing our world.

I have also found that the experts who understand AI the best are the ones who most forcefully stress the need for thoughtful, effective guardrails and protections.

As the title of this hearing suggests, we need to quickly and affordably convert energy into intelligence. The best numbers I have found come from Lawrence Berkeley National Lab, in terms of what we need to prepare for. In 2023, data centers used 4.4 percent of the overall electricity in the United States. By just 2028, data centers' total usage will increase to between 6.7 to 12 percent.

Let me share a three-part strategy to satisfy this increasing electricity demand.

First, we need to maintain the full range of tax incentives, grants, loans, and other tools in our tool belt. Now is exactly the wrong time to make it more expensive to bring online new electrons.

Getting rid of just the technology-neutral production and investment tax credits 45Y and 48E will substantially raise the costs and delay our ability to power AI. A repeal of just these tech-neutral tax credits would also increase prices on average U.S. households between $140 to $220 each and every year.

Grants and loans, including from the Bipartisan Infrastructure Law, are also vital. Utility CEOs, developers, rural electric cooperatives are all urging Congress to retain these important tax, grant, and loan tools.

Let us also remember that, among others, the Independent Energy Information Administration predicts that a full 93 percent of additional capacity added to our grids in 2025 will be with renewables and storage.

Finally, uncertainty, whether caused by deliberations in Congress or President Trump's tariff policy, will also chill needed near-term investment to power AI.

Second, we need to redouble all our efforts to more quickly permit new power generation and new transmission in our country without sacrificing important protections. Recent bipartisan efforts, such as the Barrasso-Manchin Energy Permitting Reform Act, provide a promising foundation for further progress.

And third, we should more fully leverage public-private partnerships, including with strategic use of Federal land for cutting-edge AI, something advanced by both the Biden and the Trump administrations. Ensuring cutting-edge AI data centers remain in the United States also gives our democracy a fighting chance to provide effective and efficient guardrails on AI technology. Companies by themselves simply do not have all the requisite expertise, nor do they have a perspective that takes into account all relevant considerations.

We need to fully leverage our biological, chemical, and nuclear government experts to help companies red-team new models to ensure they don't inadvertently empower terrorists and rogue states. We have made some progress, including voluntary cooperation with companies, but we must do more and we must make this a requirement. Safeguards against misinformation, deepfakes, model hallucinations, and privacy infringement must also be a top priority to protect public trust and democracy.

Let me conclude by reiterating what I heard from you very clearly, Mr. Chairman, and I think we will hear again and again throughout this hearing. We are in a global AI race. The stakes are too high for us to lose. I think Dr. Schmidt put it incredibly eloquently with his opening statement. To win, we must all work together, and we cannot take any tools off our toolbelt to quickly power AI.

Mr. Chairman, Mr. Ranking Member, and other committee members, thank you again for your diligent, your bipartisan, and your urgent focus on AI. I look forward to your questions.

[The prepared statement of Mr. Turk follows:]

One Page Summary of David M. Turk Testimony

Housing cutting-edge Artificial Intelligence (AI) data centers in the United States is both an economic and national security imperative. AI is the most transformational technology of our time, with the potential to revolutionize health care, manufacturing, energy systems, emergency response, and national defense.

Data center electricity consumption is rising rapidly. In 2023, data centers used 4.4% of total U.S. electricity. By 2028, that share is projected to reach as high as 12%. This surge is occurring alongside broader load growth driven by industrial reshoring, transportation and building electrification, and increased manufacturing capacity.

To maintain global AI leadership, the U.S. should adopt a three-part strategy:

1. **We need to utilize the full range of tax incentives, grants, and loans in our toolbelt to quickly and affordably bring new electrons online**. Rolling back tax credits like the tech-neutral tax credits (45Y and 48E) would delay AI development and raise consumer costs. (U.S. household would pay $140-220 more annually.) Grants and loans, including from the Bipartisan Infrastructure Law and DOE's Loan Program, are also critical to expedite AI build out, lower costs, and improve overall grid resilience.
2. **Accelerate permitting for power and transmission projects** without sacrificing environmental protections. Recent bipartisan efforts – such as the Barrasso-Manchin Energy Permitting Reform Act – provide a promising foundation for streamlining electricity infrastructure development.
3. **Leverage public-private partnerships**, including with strategic use of federal land for cutting-edge AI, something advanced by both the Biden and Trump Administrations.

For a variety of market dynamics, the quickest way to power new AI data centers over the near term will be by using solar, wind, and storage. We also need to continue to push chip and data center efficiency, fully utilize smart demand response, more widely deploy various grid-enhancing technologies, and build new transmission. While the U.S. possesses abundant natural gas resources, there are real and immediate constraints. Chief among these is the supply chain for natural gas turbines. Longer-term, clean firm power sources such as geothermal and nuclear (fission and fusion) can be powerful and complementary tools.

Maintaining domestic control over advanced AI models is critical to our national security. Federal expertise – including within DOE's national labs – must be fully leveraged to prevent misuse of AI for developing weapons of mass destruction or enabling other forms of harm. Voluntary and mandatory frameworks for public-private collaboration are necessary to ensure safe, ethical, and secure AI deployment. Private sector companies simply do not have all the requisite expertise by themselves, nor do they have a perspective that takes into account all relevant considerations. Safeguards against misinformation, deepfakes, and model hallucinations must also be a priority to protect public trust and democratic institutions.

We are in a global AI race. The stakes are too high for us to lose. We cannot take any tools off the table that could help us quickly bring on new electrons to power cutting-edge AI data centers here in the United States. We must also confront AI risks and challenges head-on, with important – and complementary – responsibilities in the private sector and in the government.

TESTIMONY OF DAVID M. TURK

DISTINGUISHED VISITING FELLOW
CENTER ON GLOBAL ENERGY POLICY, COLUMBIA UNIVERSITY, SIPA

BEFORE THE COMMITTEE ON ENERGY AND COMMERCE
UNITED STATES HOUSE OF REPRESENTATIVES

HEARING ON "CONVERTING ENERGY INTO INTELLIGENCE: THE FUTURE OF AI
TECHNOLOGY, HUMAN DISCOVERY, AND AMERICAN GLOBAL COMPETITIVENESS"

APRIL 9, 2025

Introduction

Chairman Guthrie, Ranking Member Pallone, and distinguished Members, thank you for the

opportunity to testify before this Committee on a topic of immense importance – Artificial

Intelligence (AI). I want to particularly thank all of you, as I know this is not a one-off hearing,

but rather this Committee has demonstrated a concerted, sustained focus on both the

opportunities and risks surrounding this powerful technology.

As someone who has spent a lot of time in windowless rooms on the issue of AI given my past

role as Deputy Secretary of the U.S. Department of Energy (DOE), let me start by stating my

bottom-line-up-front as clearly as possible: <u>housing as many AI data centers as possible –</u>

<u>especially cutting-edge AI training models – within the United States is both an economic and</u>

<u>national security imperative</u>.

AI is Transformational, including for Energy Systems

I have had the honor to work with top AI experts within the DOE over the past four years and

have continued engaging with top experts during my time as a Distinguished Visiting Fellow at

Columbia University's Center on Global Energy Policy. I can say without any hesitation that

there is no more powerful and transformational technology facing our world today than AI. And I

have also found that the experts who understand the technology the best, are the ones who most

forcefully stress the need for thoughtful, effective guardrails and protections.

As the Chairman, Ranking Member, our fellow witnesses, and many others have elaborated, AI's

ability to improve the lives of Americans and other people around the world is immense.

Advances in AI are enabling enormous progress and breakthroughs that can help address key

challenges of our time – from more effective cancer screening and targeted treatments to world-

changing advanced manufacturing, from improving the reliability of our electricity grid to

responding to natural disasters, and from discovering important new materials for clean energy

technologies to enhancing state-of-the-art production capabilities for our nuclear stockpile.[1]

Let me give two specific examples of where AI is already helping our electricity grid:

The deployment of wind, solar, energy storage, electric vehicles, controllable building loads, and

other smart grid devices increases the complexity of energy system planning and operations by

orders of magnitude, and utilities and regulators across our country are struggling to keep up.

Machine learning algorithms are recommending the optimal size and location of solar and wind

power projects, performing complex calculations on topics such as weather patterns and grid

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[1] David Sandalow et al., *ICEF Artificial Intelligence for Climate Change Mitigation Roadmap (Second Edition)* (Tokyo: Innovation for Cool Earth Forum, November 2024), https://www.icef.go.jp/wp-content/themes/icef_new/pdf/roadmap/icef2024_roadmap_AI-Climate-Second-Edition.pdf; David Turk, "Testimony of Deputy Secretary David Turk, U.S. Department of Energy, Before the Committee on Energy and Natural Resources, United States Senate, Regarding Artificial Intelligence," September 7, 2023, https://www.energy.senate.gov/services/files/A04CFF0E-0EA4-46AE-8F84-AB881BE9C74A.

constraints.[2] AI can help transmission expansion planning, determining the best location and capacity of new transmission lines, especially for optimal power flow and dynamic line rating.[3] In these ways, AI-enabled modernization of our nation's integrated electricity delivery system can help speed up deployment to reliably provide energy to every last community and simultaneously help achieve affordability, carbon neutrality, reliability, and resilience to extreme (both natural and intentional) events.

Large language models can also accelerate permitting, something that was a top effort during my time in the DOE as well as a priority for the current Administration and bipartisan Members of this Committee. Working across an array of our national labs, our DOE team is extracting text from past permit applications and using AI to more quickly help applicants and permitting authorities to consider new applications.[4]

Three-Part Strategy to Quickly, Affordably and Effectively Convert "Energy into Intelligence"

To fulfill the full promise of AI – and to reap its rewards – we need to, as the title of this hearing suggests, "Convert Energy into Intelligence." Specifically, to ensure the United States is able to

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[2] E. Engel & N. Engel. A Review on Machine Learning Applications for Solar Plants. Sensors-Basel 22 (2022). https://doi.org/10.1016/j.nexus.2021.10001110.3390/s22239060.; R. Ahmed et al. A review and evaluation of the state-of-the-art in PV solar power forecasting: Techniques and optimization. Renew Sust Energ Rev 124 (2020). https://doi.org/10.1016/j.rser.2020.109792; L. Ekonomou et al. Estimation of wind turbines optimal number and produced power in a wind farm using an artificial neural network model. Simul Model Pract Th 21, 21-25 (2012). https://doi.org/10.1016/j.simpat.2011.09.009; S. A. Renganathan et al. Data-driven wind turbine wake modeling via probabilistic machine learning. Neural Comput Appl 34, 6171-6186 (2022). https://doi.org/10.1007/s00521-021-06799-6.
[3] M. Mahdavi *et al.* Transmission Expansion Planning: Literature Review and Classification. *Ieee Syst J* 13, 3129-3140 (2019). https://doi.org/10.1109/Jsyst.2018.2871793.
[4] Keith J. Benes, Joshua E. Porterfield & Charles Yang. AI for Energy: Opportunities for a Modern Grid and Clean Energy Economy; US Department of Energy (DOE), Washington, D.C., https://www.energy.gov/sites/default/files/2024-04/AI%20EO%20Report%20Section%205.2g%28i%29_043024.pdf (2024); Symbium. Symbium Solar Permits: Join Symbium's solar permitting pilot; San Francisco, California, https://symbium.com/instantpermitting/solar/california/sb379 (Accessed August 2024); US Department of Energy (DOE). DOE Announces New Actions to Enhance America's Global Leadership in Artificial Intelligence; Washington, D.C., https://www.energy.gov/articles/doe-announces-new-actions-enhance-americas-global-leadership-artificial-intelligence#:~:text=DOE%20is%20investing%20%2413%20million,used%20to%20develop%20software%20to (2024).

stay ahead in the global AI race, we must adopt a <u>focused, real-world strategy that uses all tools in our toolbelt</u> to quickly build, upgrade, and power the data centers of the future.

It is useful to start by appreciating the scale of the challenge in front of us. The most rigorous, bottom-up estimate of how many new electrons we are going to need over the next few years to power AI and other data centers comes from Lawrence Berkley National Lab. Their latest analysis came out publicly late last year, and estimated that in 2023, data centers used 4.4% of the overall electricity in the United States. Not all of this is for AI – consider crypto mining and Netflix streaming – but a growing percentage going forward will be. By 2028, Lawrence Berkley estimates that data centers' total usage will increase to between 6.7% to 12%.[5]

While headlines about AI-driven load growth often grab the most attention, it is essential to place the adequacy of our electricity infrastructure to meet this demand in the broader context of overall load growth. After nearly two decades of flat electricity demand in our country, grid planners are now facing a surge of electricity demand.[6] In the last two years, the projected load growth over a five-year period has risen significantly, increasing from 23 gigawatts to 128 gigawatts.[7] And, the latest estimate from the U.S. Energy Information Administration (EIA) expects sales of electricity to increase 3% just in 2025.[8] This demand is coming from many quarters, including the reshoring of manufacturing, semiconductor fabrication, and the further electrification of transportation and building.

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[5] Arman Shehabi et al., *2024 United States Data Center Energy Usage Report* (Berkeley, CA: Lawrence Berkeley National Laboratory, December 2024), https://eta-publications.lbl.gov/sites/default/files/2024-12/lbnl-2024-united-states-data-center-energy-usage-report.pdf.
[6] North American Electric Reliability Corporation, *2024 Long-Term Reliability Assessment* (December 2024), https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_Long%20Term%20Reliability%20Assessment_2024.pdf.
[7] John D. Wilson, Zach Zimmerman, and Rob Gramlich, *Strategic Industries Surging: Driving US Power Demand* (Washington, D.C.: Grid Strategies LLC, December 2024), https://gridstrategiesllc.com/wp-content/uploads/National-Load-Growth-Report-2024.pdf.
[8] U.S. Energy Information Administration (EIA), *Short-Term Energy Outlook: March 2025* (Washington, DC: U.S. Department of Energy, 2025), PDF file, https://www.eia.gov/outlooks/steo/pdf/steo_full.pdf.

In order to satisfy this increasing electricity demand – and to keep cutting-edge AI training models here in the United States – we need to use <u>all</u> the tools in our toolbelt to affordably, securely, and resiliently increase our electricity supply. Let me share three ideas for how to best do that:

1) <u>We need to maintain – and even increase – the full range of tax incentives, grants, loans, and other tools in our toolbelt to quickly and affordably help bring these new electrons online</u>. Now is exactly the <u>wrong</u> time to make it more expensive to bring online any new electrons onto our grids, especially those that can be brought on quickly. Uncertainty itself, whether caused by deliberations in the U.S. Congress or over President Trump's tariff policy, also chills near-term investment.

   Let me be even more specific: getting rid of just the technology-neutral production and investment tax credits, 45Y and 48E, respectively, will raise the costs – and delay – the ability to power new AI data centers. And getting rid of these tax incentives will also put upward price pressures on everyone else, including consumers. A repeal of just the tech-neutral production and investment tax credits would increase prices to an average U.S. household between $140-220 annually. Some residents would be hit particularly hard, with household energy costs rising more than $400 per year in Missouri, Arkansas, Texas, New York, Iowa, and Kansas.[9]

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[9] https://energyinnovation.org/report/federal-clean-energy-tax-credits-make-energy-more-affordable-a-meta-analysis/. For additional analysis by others please refer to analysis by the Rhodium Group, finding that repealing energy tax credits and weakening key greenhouse gas pollution standards—such as vehicle emissions regulations—would result in an additional burden of $111 to $184 per household annually by 2030, rising to $277 to $371 per household by 2035. Ben King et al., "The Stakes for Energy Costs in Budget Reconciliation," Rhodium Group, March 20, 2025, https://rhg.com/research/the-stakes-for-energy-costs-in-budget-reconciliation/.

One of the witnesses from a recent hearing – CEO and General Manager of Basin Electric Power Cooperative Todd Brickhouse – put it this way, "The immediate removal of [the production tax credit] will not allow utilities to plan for and avoid increased costs, and this will also <u>immediately</u> harm ratepayers." (emphasis added)[10]

There are also a wide variety of grants and loans, including from the Bipartisan Infrastructure Law (BIL) – that are also vital in adding electrons quickly (including for AI), strengthening our grid, and keeping costs down. For example, the BIL allocates over $10.5 billion in grants specifically for grid upgrades.[11]

Here is how a few rural electric cooperatives characterized the importance of grants:

- Concordia Electric Cooperative in Louisiana: "100% of grant money received from USDA to Concordia Electric will flow directly to its members...the New ERA grant funds will directly reduce Concordia Electric's member rates by approximately 2.5% and will result in annual savings of approximately 4% of total power costs for the next 20 years."[12]

- Great River Energy: "These domestic power supply projects...provide certainty and clarity of downward rate pressure, representing a 4% annual wholesale rate

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[10] Ethan Howland, "Basin Electric Says Clean Energy Tax Credits Could Save Co-Op Members $8.6B," *Utility Dive*, March 26, 2024, https://www.utilitydive.com/news/basin-electric-clean-energy-tax-credits-ptc-southern-congress/741734/.
[11] Jeff St. John, "Biden Admin Awards $2B in New Grid-Resilience Grants," *Canary Media*, October 18, 2023, https://www.canarymedia.com/articles/transmission/biden-admin-awards-2b-in-new-grid-resilience-grants.
[12] Clay Koplin, "Letter to Secretary Rollins," March 20, 2025, Cordova Electric Cooperative, Inc., https://www.electric.coop/wp-content/uploads/2025/03/Secretary-Rollins-USDA-Letters-03_20_25.pdf.

savings over the next 20 years."[13]

- Inland Power & Light: "The absence of New ERA [grant] funding would result in a nearly 20% increase in Inland's cost of energy over 20 years."[14]

I would also point you to the importance of maintaining – and even approving new – loans in the DOE's Loan Program, which help utilities to more broadly benefit from the full range of applicable technologies available. For example, in January 2025, the DOE announced nearly $23 billion in conditional loan commitments to utilities across 12 states through the Energy Infrastructure Reinvestment (EIR) Program. Notable allocations include up to $8.8 billion to DTE Energy Company for pipeline replacements and up to $5.23 billion to Consumers Energy Company for renewable energy investments and gas pipeline replacements.[15] These strategic investments are pivotal in modernizing our nation's energy infrastructure and enhancing grid reliability. Utilities can leverage the EIR Program to access cost-competitive financing for capital investments that greatly improve operational efficiency.[16] By utilizing these loan's, utilities are better positioned to undertake significant infrastructure projects that might otherwise be financially prohibitive, ensuring that the benefits of advanced energy technologies are broadly realized across the sector.

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[13] David Saggau, "Letter to Secretary Rollins," March 20, 2025, Great River Energy, https://www.electric.coop/wp-content/uploads/2025/03/Secretary-Rollins-USDA-Letters-03_20_25.pdf.
[14] Jasen Bronec, "Letter to Secretary Rollins," March 20, 2025, Inland Power and Light Cooperative, https://www.electric.coop/wp-content/uploads/2025/03/Secretary-Rollins-USDA-Letters-03_20_25.pdf.
[15] Timothy Gardner, "US Announces Nearly $23 Billion in Loans to Energy Utilities across 12 States," *Reuters*, January 16, 2025, https://www.reuters.com/business/energy/us-announces-nearly-23-billion-loans-energy-utilities-across-12-states-2025-01-16/.
[16] U.S. Department of Energy, "Understanding Energy Infrastructure Reinvestment Loan Program Eligibility for Regulated Utilities," *Loan Programs Office*, last modified January 2024, https://www.energy.gov/lpo/articles/understanding-energy-infrastructure-reinvestment-loan-program-eligibility-regulated.

For a variety of market dynamics, the quickest way to power new AI data centers over the near term is by using solar, wind, and storage. (We, of course, also all need to be hyper-focused on continuing to push the bounds of efficiency of cutting-edge chips and data centers as a whole.) Solar and storage have, in particular, been the most recent superstar technologies in terms of bringing new electrons onto our grid. The independent Energy Information Administration (EIA) predicted that 93 percent of additional capacity to our grids in 2025 will be with renewables and storage.[17] Looking further ahead, the March 2025 EIA Short Term Energy Outlook (STEO) put it this way:

> *Increased generation from renewable energy is the main contributor to growth in U.S. electricity generation over the STEO forecast. The latest data received from power plant developers indicates that the electric power sector is planning to add 32 gigawatts (GW) of solar generating capacity in 2025 compared with an increase of 30 GW of solar in 2024. We expect this new capacity will lead to a 73 billion kWh increase (33%) in U.S. solar generation in 2025 followed by a 54 billion kWh increase (19%) in 2026. An expected 35 GW increase in battery storage capacity over the next two years allows solar generators to supply electricity for more hours of the day.*

> *Increased overall electricity demand along with higher natural gas prices leads to a forecast 39 billion kWh increase (6%) in U.S. coal generation in 2025. U.S.*

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[17] EIA, In-Brief Analysis, February 24, 2025, "Solar, batter storage to lead new U.S. generating capacity additions in 2025," https://www.eia.gov/todayinenergy/detail.php?id=64586.

natural gas generation declines in the forecast by 44 billion kWh (3%) as a result of higher fuel costs. In 2026, we expect coal generation will fall 55 billion kWh (8%), while natural gas generation stays relatively flat.[18]

John Ketchum, CEO of NextEra put it this way: renewables and batteries are the "cheapest, fastest, and easiest way to meet surging power demand – you can build a wind project in 12 months, a storage facility in 15, and a solar project in 18." In a recent earnings call, Ketchum added, "if you take renewables and storage off the table, you're going to force electricity prices to the moon."[19]

As this Committee knows full well, we need to have a coherent, reality-based, cost-efficient strategy to deal with the increase of intermittent sources of power like solar and wind. We need additional storage and to get the most out of smart demand response and virtual power plants. We need to be laser-focused on incenting the wider utilization of various grid-enhancing technologies to get the most out of our existing transmission system. And we all need to work with a sense of urgency and ambition to build out new transmission, something which I know many Members of this Committee are rightfully focused.

Another reason it is critical that we do not cut or curtail the clean energy tools already in our tool belt is that, while the United States possesses abundant natural gas resources,

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[18] EIA, *Short-Term Energy Outlook*, March 2025.
[19] *Forbes*, "Solar-Plus-Storage: Fastest, Cheapest Way To Meet Surging Power Demand," last modified March 18, 2025, https://www.forbes.com/sites/energyinnovation/2025/03/18/solar-plus-storage-the-fastest-cheapest-way-to-meet-surging-power-demand/?utm_source=chatgpt.com.

there are real and immediate constraints on natural gas to power the growing demands of AI, especially by itself and especially over the near term. Chief among these constraints is the supply chain for natural gas turbines. Manufacturers are facing overwhelming demand, with order backlogs now stretching beyond 2029. These delays have already resulted in project cancellations and cast doubt on the feasibility of rapidly scaling natural gas infrastructure to meet near-term power needs.[20]

As NextEra Energy CEO John Ketchum – whose company operates 26 GW of natural gas generation – recently noted, the landscape for building new gas plants has changed dramatically. The company's last commercial gas-fired facility, completed in 2022, cost approximately $785 per kilowatt. Today, he estimates that building the same combined-cycle gas unit would cost around $2,400 per kilowatt, citing inflation, supply constraints, and a shortage of qualified labor. Ketchum concluded, "When you look at gas as a solution…you're really looking at 2030 or later."[21]

Looking ahead, having additional complementary, affordable, clean, baseload power options in our tool best will be critical. In addition to much greater utilization of Carbon, Capture, Utilization and Storage, I would recommend this Committee focus attention and resources on:

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[20] Jason Plautz, "Gas Turbine Gridlock," *CTVC*, February 6, 2024, https://www.ctvc.co/gas-turbine-gridlock-236/.
[21] Paul Gerke, "NextEra CEO Warns Against Scorning Renewable Generation Amidst Long Lead Times for Gas and Nuclear Development," *Renewable Energy World*, March 10, 2025, https://www.renewableenergyworld.com/energy-business/policy-and-regulation/nextera-ceo-warns-against-scorning-renewable-generation-amidst-long-lead-times-for-gas-and-nuclear-development/.

- **Geothermal Power**: Geothermal energy offers a promising solution for powering data centers in the medium-to-long term. Google has already partnered with Fervo Energy to develop a geothermal power system in Nevada, utilizing advanced drilling techniques to provide carbon-free energy for its data centers.[22] Similarly, Meta is collaborating with Sage Geosystems to harness geothermal power for its data centers, using innovative technology to extract energy from previously untapped sources.[23] These partnerships highlight geothermal's potential to deliver reliable, sustainable energy, utilizing the phenomenal drilling expertise of U.S. companies and workers.

- **Nuclear Power (Fission and Fusion)**: One of the nearest-term options for nuclear fission and data centers is Constellation Energy's plan to restart the Three Mile Island Unit 1 reactor by 2028 in partnership with Microsoft. Similarly, Holtec International's plan to deploy small modular reactors at the Palisades Nuclear Plant offers an additional 600 megawatts of reliable, clean energy, demonstrating the role of nuclear power in sustaining AI-driven infrastructure.[24] Tangible, real-world progress – thanks to the leadership of this Committee and others – is also being made in the United States on fusion energy, supported, in part, by the application of cutting-edge AI technologies.

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[22] Tim Latimer, "Tim Latimer on How He's Helping to Solve the Climate Crisis," *Time*, last modified December 12, 2024, https://time.com/7172602/tim-latimer-climate/?utm_source.
[23] Cindy Taff, "How Cindy Taff Is Making Sure Her Career Helps Shape the Future of Clean Energy," *Time*, last modified December 12, 2024, https://time.com/7172576/cindy-taff/?utm_source.
[24] Holtec International, "HH-40-05," *Holtec International*, February 25, 2025, Holtec Launches "Mission 2030" to Deploy America's First SMR-300s at the Palisades Site in Michigan - Holtec International.

We need to make investments in these promising clean firm power sources now to continue expanding the size of our toolbelt going forward.

2) <u>We need to redouble all our efforts to more quickly permit new power generation and new transmission in our country</u>. Having studied this issue in some depth, I am firmly convinced we can do a better job of permitting more quickly and, at the same time, <u>not</u> sacrificing important environmental and other values. Together, we have made some progress on this front over recent years, but we need to do more. I want to particularly thank those Members working in Congress – on a bipartisan basis – for your legislative efforts. I would like to specifically lend my support to the constructive provisions on electricity permitting that were included in the Barrasso-Manchin Energy Permitting Reform Act of 2024.[25] While the Act did not pass in the last Congress, I sincerely hope that its power sector elements are able to move forward in this Congress.

3) And we should continue leaning in on <u>powerful public/private collaborations to troubleshoot specific problems to help bring new power on quickly for cutting-edge AI data centers</u>. I want to specifically highlight an effort that has now spanned both the Biden and Trump Administrations. President Biden issued an Executive Order on "Advancing U.S. Leadership in Artificial Intelligence (AI) Infrastructure" late in his term to explore the use of federal land – including Department of Defense and Department of Energy land – to quickly bring online cutting-edge data centers. I was very pleased to recently see the current Secretary of Energy Chris Wright release a follow-up Request for

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[25] S. 4753, 118th Congress, "A Bill to Address Energy Efficiency in the U.S.," introduced in the Senate on March 20, 2024, https://www.congress.gov/bill/118th-congress/senate-bill/4753.

Information to Inform Public Bids to Construct AI Infrastructure requesting input on opportunities to leverage federal land for the development of AI Infrastructure that built on the Biden Administration's EO. This demonstrates a bipartisan commitment to finding innovative solutions to quickly build out AI infrastructure in the United States that will be critical to securing our competitiveness.

Ensuring AI Is Built in the United States Is also a <u>National Security</u> Imperative

Having cutting-edge AI data centers here in the United States is also vital for our national security. Having the most advanced training models here in the United States gives us the ability to ensure that we both maximize the benefits we can get from AI but to also provide effective and efficient guardrails and to minimize potential harms. Mr. Chairman, I want to specifically associate myself with your comments about needing to achieve the "right balance."

We simply must ensure that cutting-edge AI models do not inadvertently allow bad actors to more easily do us harm, including to develop weapons of mass destruction. We need to fully engage our biological, chemical, and nuclear experts (including in our DOE national labs) to help companies red-team new models to ensure that these models don't inadvertently empower terrorists and rogue states. I know this is a public hearing, so I will speak more generally, but I am convinced that we need to fully leverage this government expertise to help ensure the safety of AI going forward. Private sector companies simply do not have all the requisite expertise by themselves, nor do they have a perspective that takes into account all relevant considerations. We have made some progress on this vital private/public partnership – including voluntary cooperation with companies – but we must do more and make this a requirement.

I also know that many – I would hope all – Committee Members want to ensure that AI models don't unduly suck up and misuse the personal information of our fellow Americans. As with any new technology – and especially so with one as powerful as AI – we need to have the right incentives and guardrails to protect Americans and our personal information.

Fortunately, there has been a bipartisan commitment to establishing such safeguards. In the Senate in 2023, Senators Richard Blumenthal (D-CT) and Josh Hawley (R-MO) announced a legislative framework aimed at creating guardrails for AI, including the establishment of an independent oversight body to allow both enforcers and victims to seek legal accountability for harms, promote transparency, and protect personal data. Building on this, in 2024, Senators Gary Peters (D-MI) and Thom Tillis (R-NC) introduced the PREPARED for AI Act (S. 4495), which further seeks to ensure that the federal government can harness AI's potential while safeguarding against its risks and harms.[26]

As we advance the development of AI technologies, we must also address the potential harms associated with deepfakes, misinformation, and model hallucinations. These AI-generated challenges can undermine public trust, disrupt societal stability, and even pose risks to our national security. It is crucial that, alongside fostering innovation in AI, we implement safeguards to prevent the malicious use of AI models in spreading false information or creating deceptive content. Establishing ethical guidelines and technological solutions to mitigate these risks will be

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[26] Senate Homeland Security and Governmental Affairs Committee, "Peters and Tillis Introduce Bipartisan Bill to Ensure Federal Government Safely and Responsibly Purchases and Uses Artificial Intelligence," News Release, June 11, 2024, https://www.hsgac.senate.gov/media/dems/peters-and-tillis-introduce-bipartisan-bill-to-ensure-the-federal-government-safely-and-responsibly-purchases-and-uses-artificial-intelligence/.

essential to ensuring AI remains a force for good while proactively and continually protecting society from its unintended consequences.

Conclusion

Let me conclude by reiterating what I have heard from many Members on this Committee: We are in a global AI race. The stakes are too high for us to lose. To win, we must all work together. We cannot take any tools off the table that could help us quickly bring on new electrons to power cutting-edge AI data centers here in the United States. We must also confront AI risks and challenges head-on, with important – and complementary – responsibilities in the private sector and in the government.

Mr. Chairman, Mr. Ranking Member, and other Committee Members, thank you again for giving me the opportunity to testify today and, even more importantly, for your continued diligent, bipartisan, and urgent focus on these issues. I look forward to your questions.

Mr. GUTHRIE. Thank you. I appreciate your testimony.

Mr. Wang, you are now recognized for 5 minutes for your opening statement.

STATEMENT OF ALEXANDR WANG

Mr. WANG. Chairman Guthrie, Ranking Member Pallone, and members of the committee, thank you for the opportunity to be here today to discuss the steps that must be taken to ensure U.S. leadership in AI.

My name is Alexandr Wang. I am the founder and CEO of Scale AI. Today's hearing is personal for me. I grew up in Los Alamos, where my parents were physicists at the National Lab, the birthplace of the atomic bomb. They taught me that America's leadership in science and technology is vital to our national security and global strength.

At MIT, I learned that progress in AI depends on three key elements: data, compute, and algorithms. While most of my classmates pursued expertise in compute and algorithms, few were focused on the data challenge. That inspired me to start Scale. We deliver expert-level data and offer technology solutions to leading AI labs, multinational enterprises, and the U.S. Government and our allies. At Scale we keep humans at the center of everything we do because AI should always work for us, not the other way around.

Over the past decade, it has become clear that the United States faces intense global competition in determining how AI should evolve and who should lead. In 2018 the Chinese Communist Party's AI master plan started taking shape. They were already developing advanced AI capabilities and using that technology to surveil and suppress their people.

Fast forward to today. Their plan is more sophisticated and expansive. It includes four key areas of focus: first, the CCP is taking a whole-of-country approach, having recently launched their AI+ initiative; second, the CCP is outinvesting us in data, spending billions on AI-ready data, and unlocking vast public data sets to fuel AI systems; third, they are finding ways to catch up on compute and building out their physical infrastructure; and lastly, they are developing leading AI models and exporting them to the world.

But we are not here today to just talk about what China is doing but to identify how the U.S. can lead. Given how close the competition is across all foundational elements, the policies this Congress promotes could determine the outcome. Global AI dominance is not about trying to level the playing field by mimicking China's authoritarian way of government and AI adoption.

Instead, the United States must charter our own course, one that is anchored in American values. This is vital to our long-term national security. This requires decisive action by the United States across four main themes: dominate, unleash, innovate, and promote.

To dominate, we need to win on data. The U.S. Government is one of the largest producers of data in the world, but currently most of that data is unavailable to advance American AI leadership.

There are three immediate actions that would move us forward towards data dominance. First, establish a national AI data reserve. This resource should serve as a centralized hub for the Government's AI work, housing relevant government data and allowing it to be easily shared between agencies and enabling widespread AI adoption. Second, make all Government data AI-ready, and stand up AI data infrastructure to enable scaled implementation. And third, Congress should invest to position data dominance as a national priority.

The next theme is unleash, meaning we must unleash AI technology and establish an agentic government. An agentic government is one that uses AI under human supervision to enhance its operations. For example, Federal agencies could leverage AI to streamline veteran healthcare paperwork, improve fraud detection at the IRS, and boost efficiency and information-sharing across agencies. This will improve the lives of public employees and the American people. Congress should require each agency to set up at least one flagship agentic government program.

Next, we must maximize the ability of companies to innovate. I believe the right regulatory framework is one that allows for innovation while still creating proper guardrails. Congress should take three actions: first, confirm a use-case-based regulatory framework and conduct an analysis to address regulatory gaps; second, establish one single Federal AI governance standard to avoid patchwork legislation at the State level; and third, implement policies that enable American workers to become the AI workforce of the future. These policies would provide the skills necessary to train, fine-tune, and evaluate AI systems.

The final theme is promote, meaning we need to promote U.S. technology globally. Countries around the world, what I call AI geopolitical swing states, will soon be forced to choose between Western or CCP-controlled technology. To help make sure they choose Western technology, Congress and the administration should empower NIST to complete all relevant measurement science for AI and export it to the world through the global network of AI safety institutes.

America led the Industrial Revolution, the Space Race, the Internet Age. AI is the next frontier, and, with your assistance, I am confident we will lead again.

Thank you for the opportunity to be here today, and I look forward to your questions.

[The prepared statement of Mr. Wang follows:]

STATEMENT BY
ALEXANDR WANG
FOUNDER AND CHIEF EXECUTIVE OFFICER
SCALE AI

BEFORE THE
HOUSE COMMITTEE ON ENERGY AND COMMERCE

APRIL 9, 2025

Chairman Guthrie, Ranking Member Pallone and Members of the House Committee on Energy and Commerce. Thank you for the opportunity to be here today to discuss the steps that the United States must take to stay ahead of China in the emerging global race for leadership in Artificial Intelligence (AI). Today's hearing comes at a critical moment in this competition, and I greatly appreciate the Committee's bipartisan interest in ensuring—and advancing—our country's continued leadership.

Introduction

My name is Alexandr Wang and I am the Founder and CEO of Scale AI (Scale). Today's hearing is deeply personal for me, as I grew up surrounded by scientists committed to American leadership in cutting edge technology. I was fortunate to be born and raised in Los Alamos, New Mexico where my parents worked as physicists at the National Lab. During my childhood, I saw firsthand how the development of world-leading technology is critical to our national competitiveness.

After high school, I enrolled at MIT and started studying AI. From day one, I knew it would be the most transformative technology of our time, much like nuclear technology had been for my parents' generation. Early on, I learned that progress in AI depends on three foundational elements: compute, algorithms, and data. Compute is the processing power that drives AI systems. Algorithms guide that compute, turning raw data into large language models (LLMs) like Gemini,

ChatGPT, Grok, Llama, and others. Data is AI's oil, gas, wind, solar all wrapped into one. It is the raw material that enables AI to learn, adapt, and improve over time. When I was in school, most of the field focused on compute and algorithms, and almost no one was thinking seriously about data. That's what pushed me to leave MIT after my freshman year and start Scale. In our early days, Scale delivered high-quality data for autonomous vehicle companies. Today, we provide advanced, expert-level frontier data to leading AI labs like Google DeepMind, Meta, OpenAI, and xAI.

Data is unique because it is fundamentally human. Every major AI advancement is grounded in data shaped by human expertise. For AI model training, we operate a global marketplace powered by hundreds of thousands of human experts dedicated to enhancing the quality and intelligence of data for AI models. This marketplace has created significant economic opportunities for participants, who are located in over 9,000 cities and towns in the United States. The marketplace paid out nearly $500 million globally in 2024.

Apart from providing frontier training data to AI labs, Scale is also helping to prepare enterprises and the U.S. Government for an Agentic World. This will be a world where AI agents, autonomous intelligent systems capable of performing a wide range of tasks, go beyond conversations and recommendations to actively assist humans across every industry.

Scale now partners with global enterprises, including media companies like Time, law firms like DLA Piper, and tech companies like Cisco to train proprietary AI models on their vast data ecosystems and provide solutions for building agentic AI applications.

Scale also partners with the United States Government, particularly the Department of Defense, to equip our military with cutting-edge commercial technology for their missions. One such example is a recent prime contract that was awarded to Scale by the Defense Innovation Unit (DIU) for Thunderforge. This flagship AI program will see agentic AI leveraged for US military planning and operations. As part of our work with the United States Government, we operate a St. Louis AI Center, which produces millions of high-quality geospatial data annotations, builds out Generative and Agentic AI applications, and has created hundreds of AI jobs in the greater St. Louis region.

As AI continues to advance, and we shift from chat-centric Large Language Models (LLMs) like ChatGPT to new agentic applications, making sure that we keep humans at the center of all major advancements is imperative. AI should always work for us, not the other way around.

The Chinese Communist Party's AI Master Plan

I saw first hand the beginnings of the Chinese Communist Party's (CCP) AI master plan in 2018 when an investor invited me to visit. I witnessed how advanced their AI capabilities were, and how they were leveraging them in a variety of useful ways, but also to surveil and suppress their population.

Later that same year, China President Xi Jinping declared China's plans to
dominate AI by 2030[1] and they are working to do just that. From Scale's
perspective, today, China leads on data, the United States leads on compute, and
the two are tied on algorithmic development. It's a neck-and-neck race, which is
why the policies this Congress promotes will likely determine the outcome.
The master plan that I saw pieces of seven years ago is now much clearer. It
includes:

- **A whole of government approach:** In order to compete more aggressively,
  and win, the CCP has launched their AI plus initiative[2] to implement a "whole
  of country" approach, utilizing its government, industry, and military to
  accelerate efforts to become the global standard for AI. The CCP
  understands that, if deployed properly, AI can serve as the engine of
  efficient government and—for the first time in history—China is
  benchmarking its AI investments against leading technology companies
  rather than the United States government.

- **Widening their lead on data:** When it comes to building out their data
  pipeline, China has spared no expense. Our analysis of publicly available
  materials has determined that China spends billions per year on AI ready
  data alone. The government has also unveiled a new data strategy[3] which
  includes unlocking all of its vast array of "public" data to train AI systems as

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[1] See,
https://digichina.stanford.edu/work/full-translation-chinas-new-generation-artificial-intelligence-development-plan-2017/
[2] See, https://www.globaltimes.cn/page/202403/1308210.shtml
[3] See, https://babl.ai/china-unveils-comprehensive-plan-to-boost-data-labeling-industry-growth/

well as providing large subsidies for this work through vouchers, tax breaks and other means.[4] In May 2024, the National Data Bureau announced the construction of seven specialized data annotation bases[5]: Chengdu (Sichuan), Shenyang (Liaoning), Hefei (Anhui), Changsha (Hunan), Haikou (Hainan), Baoding (Hebei), and Datong (Shanxi).[6]

- ***Catching up on compute and physical infrastructure:*** When it comes to compute and infrastructure the CCP has continued to advance their domestic capabilities. While export controls have helped – for the time being – maintain the United States lead on compute, China's homegrown chips from companies like Huawei and SMIC are quickly closing the "capability" gap with their foreign competition.[7] In 2025, they're expected to spend at least $110 billion in chip manufacturing[8] and recent studies have shown that between 2018 and 2023, Chinese authors published 50% of the published research papers on foundational chip research compared to the only 22% published by United States' authors.[9]

The CCP has also long recognized that winning in AI also requires a robust government strategy to ensure the availability of energy and infrastructure.

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[4] See, https://english.www.gov.cn/news/202501/14/content_WS67859ba1c6d0868f4e8eeca1.html
[5] See, https://www.globaltimes.cn/page/202404/1309974.shtml
[6] See, https://dub.sh/SySgFXA
[7] See, https://s201.q4cdn.com/141608511/files/doc_financials/2025/q4/177440d5-3b32-4185-8cc8-95500a9dc783.pdf
[8] See, https://www.reuters.com/technology/china-seen-leading-chipmaking-investment-again-2025-semi-group-says-2025-03-26/#:~:text=China%20is%20the%20largest%20consumer.imposed%20by%20the%20U.S.%20government.
[9] See, https://www.nature.com/articles/d41586-025-00666-3

In response to the Stargate announcement[10], the Bank of China announced a 1.4 trillion yuan investment into AI infrastructure[11] and is setting up a National Venture Capital fund specifically focused around technologies like AI.[12]

- ***Develop leading tech, implement it rapidly and export it to the world:***
  Deepseek may have sent shockwaves around the world, but it is not the only advanced Chinese model. Since the launch of Deepseek, China has also released or announced multiple additional open-source models like Baidu's Earnie series[13], Moonshot's Kimi[14], 01.ai's Yi[15] and Alibaba's Qwen[16] each rivaling leading United States tech companies' top models.[17]
  As competition in AI intensifies, China is both rapidly implementing and looking to export itsAI systems. The People's Liberation Army issued 81 contracts with Large Language Model companies in the first half of 2024 alone[18] and similar to their Belt and Road initiative[19] and 5G ambitions[20] the

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[10] See, https://openai.com/index/announcing-the-stargate-project/
[11] See,
https://www.medianama.com/2025/01/223-bank-of-china-announces-1-trillion-yuan-ai-industry-investment/
[12] See,
https://www.reuters.com/world/china/china-set-up-national-venture-capital-guidance-fund-state-planner-says-2025-03-06/
[13] See, https://research.baidu.com/Blog/index-view?id=185
[14] See, https://kimi.moonshot.cn/
[15] See, https://github.com/01-ai/Yi
[16] See,
https://www.reuters.com/technology/artificial-intelligence/alibaba-prepares-flagship-ai-model-release-soon-april-bloomberg-news-reports-2025-04-01/
[17] See,
https://www.cnbc.com/2025/03/18/baidu-shares-jump-10percent-following-release-of-new-open-source-ai-models-.html
[18] See,
https://www.scmp.com/tech/tech-trends/article/3267866/chinas-public-sector-accelerates-ai-adoption-2024-zhipu-and-iflytek-emerge-winners
[19] See, https://www.cfr.org/backgrounder/chinas-massive-belt-and-road-initiative
[20] See, https://www.noemamag.com/the-world-china-is-building/

Chinese Government is also working to export their technology to the rest of the world, and is wholly committed to positioning themselves as the global standard.

If China leads on Generative AI and Agentic AI, there could be serious consequences for the United States. President Trump rightly called the proliferation of Chinese AI a "wake up call."[21] Which begs the question, how should the United States respond?

The United States' Four Pillars to Win—Dominate, Unleash, Innovate and Promote

If the United States wants to beat China, we must not only match but exceed the CCP's intensity on AI. President Trump has already made this aspiration clear, stating: "It is the policy of the United States to sustain and enhance America's global AI dominance in order to promote human flourishing, economic competitiveness, and national security".[22] Global AI dominance is not about trying to level the playing field by mimicking China's Authoritarian way of government, it's about the Administration and Congress working together to take bold steps. Scale believes the path forward must include decisive action on four main pillars—Dominate, Unleash, Innovate and Promote.

Pillar One: Dominate **–** As evident by China's investments, the country that wins on data will almost certainly win the AI race and this has been made abundantly clear by nearly every recent AI advancement being rooted in a data advantage.

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[21] See, https://www.nbcnews.com/tech/innovation/trump-china-deepseek-ai-wake-call-rcna189526

[22] See, https://www.whitehouse.gov/presidential-actions/2025/01/removing-barriers-to-american-leadership-in-artificial-intelligence/

Over the past few years, we've seen Congress and Administrations prioritize the onshoring of chip manufacturing as well as renewed focus on domestic energy production. This should help us maintain our lead in chips and algorithms, but it won't help the United States with data.

The United States Government is already one of, if not, the largest producer of data quantity and diversity in the world, but today nearly all of that data is unavailable to improve our AI systems in contrast to the Chinese approach. If we want to win on AI, we must turn our data asset into an advantage. To achieve Data Dominance, we need a whole of government approach, which should:

- ***Establish a National AI Data Reserve:*** The National AI Data Reserve would serve as a centralized data hub for all of the government's AI programs to leverage and should include all relevant government data. This would allow for the data to be easily shared between agencies and be leveraged for widespread AI adoption. The Department of Defense is currently working towards its own version of this, but if the United States wants to lead, this must be government-wide.

- ***Make all government data AI-ready:*** AI is only as good as the data that it is trained on, and without AI-ready data, no use case will be successful and we will never be able to truly leverage the technology.

- ***Stand up government-wide AI data infrastructure:*** Once the data is made AI-ready, this commercial best practice makes it so that each Agency can

tap into the Data Reserve and efficiently scale AI programs in the most cost effective manner.

- ***Invest in AI ready data as a national priority:*** The government must invest both in continued investment to keep feeding data into that National AI Data Reserve and to incentivize our private sector to create an asymmetric data advantage. The CCP has recognized this, and Congress should look at all tools at their disposal, whether that is tax credits or stronger private-public partnerships, to incentivize Data Dominance.

Pillar Two: Unleash - In order to win, the US needs to unleash our technology. In Scale's direct work with other Governments, such as Qatar[23] and our observations of developments in Singapore, the United Kingdom[24] and elsewhere, other governments around the world are actively implementing AI across their public sectors much faster than governments at all levels in the United States.

To date, no Federal Agency has truly made progress implementing AI in any meaningful way, despite identifying over 1,700 use cases[25], and developing many research reports and pilots. Fortunately, we still have time to catch up, but the window is closing. This starts with the National AI Data Reserve laying the foundation for applications like AI agents and agentic capabilities.

For private enterprises, AI Agents have already proven to provide strong results for things like coding and customer service applications. Identifying and implementing agentic applications for the government should be no different. If

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[23] See, https://scale.com/blog/mcit-scale
[24] See, https://committees.parliament.uk/work/8367/use-of-artificial-intelligence-in-government/
[25] See, https://fedscoop.com/federal-government-discloses-more-than-1700-ai-use-cases/

done correctly, it could revolutionize government efficiency, allowing humans to shift from manual decision making to a role focused on providing oversight of AI systems. This will free up public employees to think more strategically and ensure our democratic values are reflected in the systems our governments develop. Agentic Government will speed efforts to reduce the regulatory backlog, streamline permitting processes, and provide the Department of Defense asymmetric advantages over adversaries on topics like planning and OSINT collection.

All of this is possible today, but in order to implement it, Congress and the Administration must establish an ambitious, coherent, and integrated AI strategy. To do this, Washington should:

- **Require each Agency to stand up at least one flagship Agentic Government program**: Due to the over 1,700 identified use cases, agencies clearly understand where AI can be most effective, but are still stuck in a research and pilot mindset. This must change and Congress should require that every agency stand up an agency-wide agentic program no later than one year from now.

Pillar Three: Innovate – Scale has long supported the position that the right regulatory framework is one that maximizes innovation, but still creates proper guardrails. For the United States to continue to be the most attractive place for leading tech companies to develop the next generation of cutting edge AI systems, our government must create the best environment for them to do so.

To ensure that the United States is set up to be just that, Congress and the Administration should:

- ***Confirm a sector-specific and use-case based regulatory framework:*** This approach rightly governs the outputs and mirrors how we have always governed technology. For example, a laptop can be used for a number of different purposes including enabling research and connectivity, but it can also be used for hacking. However, the government does not regulate the laptop, it regulates the malicious use of the laptop. This is the same approach the US should adopt for AI.

- ***Ask agencies to identify regulatory gaps and fill them:*** To adequately implement this approach the United States must confirm that our regulatory system is sufficient for AI. To do this, a thorough understanding of where gaps may be in the regulatory system is critical and Scale strongly supports Congress working with the Administration to conduct a comprehensive regulatory gap analysis which would highlight if one exists. If shown to exist, actions must be taken to provide regulatory consistency.

- ***Clarify one single federal AI governance standard:*** In 2024, there were more than 700 different AI bills introduced across nearly every state[26] and it is anticipated that this number will grow in 2025. Beyond the contents of the bills themselves, we have seen inconsistent definitions of key aspects of the AI ecosystem used by each state as well as mechanisms to prove regulatory compliance.

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[26] See, https://www.bsa.org/news-events/news/2025-state-ai-wave-building-after-700-bills-in-2024

- ***Put policies in place to let the AI workforce thrive in America:*** Innovation is enabled by people, and much like coding in the 1990s, acquiring the skills necessary to train, fine tune, and evaluate AI systems will be vital to future innovation. These skill sets did not exist a decade ago, but are already proving to be important drivers of economic activity. If our nation wants to build the highest quality AI systems in the United States, they must be trained by people in the United States. Congress and the Administration should confirm that all relevant policies are flexible enough to enable this new kind of work to thrive right here at home.

Pillar Four: Promote - Effective tech diplomacy relies heavily on the access and adoption of US technology by our allies. Over the past few years, the United States has simply not prioritized the tech promotion aspect nearly enough. In the coming year, countries around the world, which we refer to as "AI geopolitical swing states", will be forced to effectively choose between whether they want to deploy Western or Chinese technology.[27]

This is not new and the global roll out of 5G technology offers a stark reminder of what happens if the United States does not step up to lead on new technologies. In the early days of 5G, governments around the world had to choose whether to harness U.S. technology or Chinese technology. This happened because the United States did not actively promote our technology aggressively enough. Now, China's global influence on 5G is much stronger than the United States'.

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[27] See,
https://www.csis.org/analysis/ai-diffusion-framework-securing-us-ai-leadership-while-preempting-strategic-drift

But tech diplomacy is not a level playing field due to the CCP's willingness to heavily subsidize their technology exports, so the United States needs to look at creative ways that we can win. To do this, Congress and the Administration should:

- ***Resource and empower the National Institute of Standards and Technology (NIST):*** NIST is the world's most well respected science organization. It needs more resources and leverage to be able to complete all relevant measurement science, such as standards and frameworks for AI.

- ***Export NIST's measurement science to the world:*** The Global Network of AI Safety Institutes is made up of 10 countries[28] with the United States currently serving as Chair. This is a ready-made entity to export our measurement science and position it as the global standard. To date, China has not been allowed entry into the body and the United States needs to make sure that remains the case.

Conclusion

America led in the Industrial Revolution, the Space Race, and the Internet Age. AI is the next frontier, and I'm confident that we will lead again. Thank you again for the opportunity to be here today to discuss with you the ways in which the entirety of the AI ecosystem must work together to win. I look forward to your questions.

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[28] See, https://time.com/7178133/international-network-ai-safety-institutes-convening-gina-raimondo-national-security/

Mr. GUTHRIE. Thank you. Thank you for your testimony, as well. We will now begin questioning, and I will recognize myself for 5 minutes for questions.

So Mr.—Dr. Schmidt, you talked about we need all available sources of energy, and I think you said in the Library of Congress we can use AI to solve climate change. If we are going to try to build a broad coalition, we can't just go for energy without dealing with climate. And we can't just do climate and not have energy, because though wind, solar, and batteries are important, they won't supply the energy that we need. So what do you mean by all sources of energy, and how do you think that we could solve climate through AI?

Dr. SCHMIDT. Thank you, Mr. Chairman.

As we discussed, the needs of our industry are so great that we cannot cut down any of the sources of energy right now. Why does this make sense, knowing that climate change is real, and knowing that it is a problem, is that the intelligence revolution, the ability to do planning and discovery, will allow us as Americans to develop new materials, new energy sources, and so forth because of the AI data centers.

So our core argument is invest in the way we can now, because the future will be so much cleaner and so much more efficient as a result of these algorithms.

Mr. GUTHRIE. Thank you for that. And also, you said in the Library of Congress that Europe has chosen not to grow. As we look to our competitor across the Pacific—I mentioned we look over to the Atlantic—what lessons learned do you think we need to look— as we say, a lot of times people look at Europe and want to see what they are doing and copy it. What should we not do that Europe has done?

Dr. SCHMIDT. Europe is a wonderful place to visit, but it is not growing. It has great human values, but it is not growing. As a result, everyone is unhappy. The standard of living between the United States and Europe has now diverged. The U.S. lives much better than Europeans, which is annoying to my European friends.

There are so many reasons why economic growth is important. Growth solves every problem in a democracy.

Mr. GUTHRIE. Well, thanks. So you were talking about better— so what kind of things have Europe—decisions European leaders have made that we need to avoid?

Dr. SCHMIDT. Well, the primary issue is overregulation. We have a similar problem in America in that the overlapping set of local-Federal-State rules, which were done with good intentions, have the property that they are slowing things down. Our competitor, China, is not a democracy, it is an autocracy, whatever you want to call it, and they just decide.

In this fight, as I said before, if they get there first we will be very upset. All of us will be alive when this occurs. Every one of you will see it. Imagine a situation where attacks that we cannot even imagine are unleashed by China in an adversarial thing. We have no concept of having a superintelligent opponent where we are not as intelligent as they are.

Mr. GUTHRIE. Thanks. So in your article I have here on The Atlantic—or the Foreign Affairs, I am sorry, the Foreign Affairs, you

wrote, essentially, technological advances in the next 5 to 10 years will determine the country that gains the upper hand. I have a couple of minutes. Could you kind of explain militarily what this means?

And then, what—because you wrote about what they can do militarily. And then this is—we need to act now.

Dr. SCHMIDT. So in the framing in China and Taiwan, which is discussed a great deal, everyone assumes that it is a battle of missiles and aircraft carriers. That is not correct. It will be a battle of swarms of drones. Those drones will be highly intelligent, highly planned, and they will do maneuvers that no one can anticipate. We collectively are not ready for that.

Imagine a situation where China has invented new algorithms for military attacks and defense that we cannot even conceive of. Remember, I am discussing a world where humans have a partner that is smarter than the collection of those people. As I said, this will happen in our lifetimes, and it is important that we get there first. If you take a look at Ukraine and Russia right now, you see the future of war.

I am assuming, by the way, that China would start by cyber attacks and so forth. There is evidence that these new systems will be able to come up with zero-day exploits that we cannot foresee. A zero-day exploit is something we have never seen before and we can't anticipate. There's lots of people who were worried that biological attacks can be done, and there is a lot—there is a report from the Emerging Biothreats Commission this week with the great details, and there is a classified version that all of you should take a look at. There is plenty of evidence that these things are possible.

Mr. GUTHRIE. So Mr. Wang, I see you are shaking your head. I only have about 30 seconds, but if you would like to make a comment on what he was—that comment.

Mr. WANG. I agree with Dr. Schmidt that the potential implications on national security are incredible. As he mentioned, I think the place we are going to see this first is in cyber. I think we are going to see agentic cyber warfare in which we will see incredibly powerful AI and large-scale data centers being utilized to hack into our systems.

One of the things that we were discussing previously is how vulnerable our energy——

Mr. GUTHRIE. Thanks. I am at zero on my time, and we are going to try to stick to it, so I have to hold myself to that. So I appreciate that, and we will get more answers.

I will yield back and recognize the ranking member for 5 minutes.

Mr. PALLONE. Thank you, Mr. Chairman. My questions are of Mr. Turk.

You laid out how important it is that we keep our investment environment stable and attractive so AI data infrastructure and energy companies can make the large investments and America needed to build AI tools in the U.S. But unfortunately, the Trump administration is doing the opposite. Trump has frozen investments in energy infrastructure, is attacking tax credits for energy genera-

tion, and put in place tariffs that are destroying our economy. And don't just take my word for it, others are saying it too.

So I would ask unanimous consent, Mr. Chairman, to insert into the record an article from Politico entitled, "Why Trump's tariff and tax policies could derail efforts to boost US power supply," if I can.

Mr. GUTHRIE. Without objection, so ordered.

[The information appears at the conclusion of the hearing.]

Mr. PALLONE. Thank you.

So Mr. Turk, can you talk about the harm that some of the Trump administration policies will have on our AI competitiveness?

I have to tell you, I would also like to talk about the harm that he is doing to our major universities like Columbia, but that is for another committee, so I can't ask you that today. But tell us about the harm that he is doing to our AI competitiveness, if you will.

Mr. TURK. Well, thanks, Ranking Member Pallone. Let me start with the tariffs, just because that is the news of the day and the week.

I can't think, honestly, of a worse policy right now if you want to bring on AI power quickly in our country, power for AI in our country. Not only is it increasing costs across the board for the AI and the data centers itself, but for the power that goes into the data centers.

But it is also injecting an immense amount of uncertainty. Folks who are planning data centers don't want uncertainty, they want stability of policy so they can plan going forward. So I think tariffs is absolutely the worst if you want to bring on additional data and additional energy for data centers.

Secondly, the uncertainty of the incentives, the tax incentives, the grants and the loans, all that Congress has worked on in recent years, repealing that and even the uncertainty of whether provisions are going to be repealed or not is also going to have a chilling effect on the investment for this power that I think all of our panel here agrees that we need to have.

Mr. PALLONE. All right.

Mr. TURK. We also need to be honest with ourselves. Right now, the quickest power, the most affordable power to bring onto our grids, including for data centers, is renewables and storage: 93 percent in 2025 will be renewables and storage. So we need to focus on a wide variety of energy sources.

I completely agree with folks, but if we want to put urgency to it the last thing we need to do is repeal these tax credits, grants, loans.

Mr. PALLONE. And then what about—I am going to ask you to be quick, if you will, but—because I have a couple of questions—what about the repeal of these programs like the Inflation Reduction Act that you mentioned that was put in place by Democrats, and the tax credits? How is that going to make energy more expensive for American families in an era of increased energy demand, if you would?

Mr. TURK. Well, we not only have additional energy demand, electricity demand for data centers, we have it for additional manufacturing, electrification of buildings. So the demand for electricity is going up now when it has been flat for about 15, 20 years. That

puts upward pressure on prices, unless we have more supply coming on.

And so to increase the cost of more supply, more of those electrons coming on makes it more expensive for AI data centers, but it makes it more expensive for households. I mentioned $220 per household, on average, being increased with just a couple of those tax provisions being revoked. If you get rid of more tax provisions, more grants, more loans, it is just going to increase that cost for everybody.

Mr. PALLONE. And what are—lastly, do you agree that we need sensible guardrails to ensure that the privacy and security of Americans' personal information is not a casualty of the rapid development of these AI algorithms and leaky AI tools, if you will?

Mr. TURK. Well, I absolutely agree, and certainly private companies, including those represented here, are going to be the ones who do this cutting-edge AI and bringing all these tools to help humanity.

But they have a profit motive. They are companies. They are trying to make a profit. They don't have expertise. They don't have nuclear weapons experts. They don't have biological weapons experts.

We need democracy to step up. That is why I am so happy to be in front of you all, a committee that is taking this seriously to have a hearing after hearing and really looking to have that kind of sensible, thoughtful regulation, that balance that the chairman talks about.

Mr. PALLONE. Well, thank you. And I have to say again—I don't want to talk about Columbia and universities today because it is not in our jurisdiction, but I have to say that, you know, cutting all these research money for major universities, trying to get rid of—you know, today he announced—or yesterday—that he was denying all the visas for foreign students at Rutgers University in my district.

I mean, I see that—we are not going to have—you know, our universities aren't going to be able to do the work that is necessary to actually keep up competitively with China, and it is just really sad. But thank you.

I yield back, Mr. Chairman.

Mr. GUTHRIE. I thank—the gentleman yields back, and the Chair recognizes Mr. Latta for 5 minutes for questions.

Mr. LATTA. Well, thanks very much, Mr. Chairman, and thanks for witnesses for being here. This is extremely important.

And just a few weeks ago, the head of Nvidia said—and I will paraphrase—in order for us to keep the model responsive, we have—we now have to compute 10 times faster. The amount of computation we have to do is 100 times more, easily. Another report had come out saying that in 2024—that said that China is looking at about a 94.5 percent—or 94.5 percent gigawatts new—of power coming from cogeneration.

And so what we are seeing is, across everything we have been talking about in this committee for quite a while, is that we are going to have to have more power.

And Mr.—Dr. Schmidt, if I could start with you, you said something very interesting, something that has been brought up in this

committee for a good number of years about light-touch regulation. And I have heard it from the Internet of Things, you name it, that—what we touch in this committee. But could you just talk a little bit about, when you talk about the light touch, what we have to be doing to make sure we stay competitive?

Dr. SCHMIDT. The first thing the Government needs to do is to make sure the Government understands at the secret and top secret level what China is actually doing. So some variation of these safety institutes that is at the classified domain that allows our Government to understand the details of what our opponents are doing is important.

With respect to the current U.S. companies, all of them are very well aware of these issues and are working very hard to mitigate them. I am part of a group that actually talks about this informally every week, to give you a sense of it. And the companies are trying very hard to keep the models safe. Having an agreement, for example, where the Government is aware of what the companies are doing is probably a good thing. That is what I mean by a light touch.

This innovation, this arrival of this new, alien, incredible intelligence will be done by the private sector. I want our U.S. Government to understand in detail its consequences and help it—and help us be successful as a nation.

Mr. LATTA. Let me follow up, because also you talked about, you know, we need energy in all forms. A couple of weeks ago in our Subcommittee on Energy, we had the RTOs and the ISOs here in this country, about seven different ones. They all said this exact same thing: We have to have more power, and we shouldn't be taking generation offline. Do you agree with that statement from all those companies?

Dr. SCHMIDT. Well——

Mr. LATTA. Or all the ISOs and RTOs?

Dr. SCHMIDT. I don't understand the structure of that part of the industry as well as you do, sir. From my perspective, the single most important thing to do is to have an all-energy strategy. It—as Honorable Turk said, it makes no sense to shut down the renewable stuff. We need more renewables. We also need more natural gas. We need more of everything. We are not going to be able to get the targets of gigawatts that we need without doing everything more, right? That includes permitting, as I think we have all talked about.

Mr. LATTA. Thank you.

Mr. Bhatia, you mentioned that we need reliable power, and, really, we can't have disruptions out there in it. And, you know, one of the issues, again, is we have got to make sure, again, with—what the RTOs and the ISOs are all saying is we have got to have this power. Do you see us meeting that power's need in the very near future?

Because again, when you are talking about, you know, we have to have permitting reform, what is going on in this country.

Mr. BHATIA. You know, I think that we are behind. I think that we need to think long term but act now.

For semiconductor manufacturing, power is essential. It is one of the highest input values, and it has incredible impact on the sta-

bility of the power. The reliability of the power has incredible impact on the—our ability to run efficient operations and to not have disturbances.

I mentioned in my prepared testimony that even a fraction of a second of power droop—not even loss, not even a second, a fraction of a second of power droop—can have tens of millions to hundreds of millions of dollars of impact in our fabs. So we absolutely need to make sure that we have more power, that power—transmission lines are, you know, built for the 21st century. And in fact, everywhere where we operate our fabs, power reliability is absolutely, you know, at the very top of our list when we do site selection.

Mr. LATTA. Well, in my last 37 seconds—because you also mentioned we need to cut through that red tape—how would you recommend to this committee that we cut through that red tape?

Mr. BHATIA. Well, I think one of the ways is being sure that we reduce the duplicative regulations that are in place between Federal and State.

In, you know, one of our projects in New York right now we have to do similar filings in both the Federal and State level, even though the State-level regulatory requirements match the Federal ones. And so that just, you know, extends the timeline, creates more effort, and, you know, creates delays. And I think the same thing can be true for many, many different energy projects and transmission projects around the country.

Mr. LATTA. Well, thank you, Mr. Chairman. My time has expired right on the button.

Mr. GUTHRIE. Thank you.

Mr. LATTA. And I will also submit my questions, other questions, to the witnesses.

Mr. GUTHRIE. Thank you. The gentleman yields back, and the Chair recognizes the gentlelady from Colorado, Ms. DeGette, for 5 minutes.

Ms. DEGETTE. Thank you so much, Mr. Chairman, and my questions follow very closely on what Mr. Latta was just talking about. I want to thank you for having this hearing. We had a hearing in the Energy Subcommittee in 2023 about AI and energy, and many people hadn't even been thinking about the tremendous use of energy by AI up until that time.

I think that this issue is a really ripe issue for bipartisan solutions. However, I am concerned sometimes when we talk about cutting red tape or eliminating these proposals, sometimes that is a code word for partisanship. But we have had—as several people have pointed out, we have had bipartisan suggestions. Mr. Peters from this committee has worked on some with people from your side of the aisle. They have had them in the Senate. So, you know, if we try to—well, if the Republicans on this committee try to go this alone, then I think this is going to run into trouble, but I think there is tremendous potential for us to work on this in a bipartisan way.

I want to talk about an issue, though, that Mr. Pallone raised, which is—and also Mr. Turk raised—which is really a concerning issue of today, and that is these tariffs. All of the witnesses here today can stipulate that we are going to need a large increase in

all types of energy to not just deal with current demands of consumers, but AI. Does anybody disagree with that?

No, no one disagrees with it.

So Mr. Turk, so if we are going to build more transmission infrastructure, we are going to have to have raw materials like steel and aluminum. Is that correct?

Mr. TURK. Yes.

Ms. DEGETTE. And if these tariffs actually go into effect, which it seems like it might, won't those raw materials needed to add transmission capacity be more expensive?

Mr. TURK. Yes.

Ms. DEGETTE. And Mr. Bhatia, just yesterday, in fact, Micron announced that they are going to have price increases on some products today, starting today doing—due to President Trump's tariffs. Isn't that correct?

Mr. BHATIA. We did—we—you know, memory market is——

Ms. DEGETTE. No——

Mr. BHATIA [continuing]. By many different factors——

Ms. DEGETTE. I mean, didn't you announce yesterday that Micron is going to impose tariff-related surcharges on some products from April 9?

Mr. BHATIA. The tariffs are an evolving situation, and we are communicating with our——

Ms. DEGETTE. OK. Well, Mr. Chairman, I ask unanimous consent to put into the record a Reuters article which says, "Micron to impose tariff-related surcharge on some products from April 9."

Mr. GUTHRIE. And without objection, so ordered.

[The information appears at the conclusion of the hearing.]

Ms. DEGETTE. Thank you.

Now, Mr.—Dr. Schmidt, you just talked about—and I agree with you—that we need more energy in all forms, and that is—and also, that is likely the way that this market is going to develop. Is that right?

Dr. SCHMIDT. Yes, correct.

Ms. DEGETTE. So when people say, "Oh, we need to drill, baby, drill," that—we do need natural gas, but we also need to make sure that we can upgrade our grid to deal with the renewable energy that is inevitably going to be a part of this process. Is that right?

Dr. SCHMIDT. Yes. Yes, ma'am.

Ms. DEGETTE. Now, so Mr. Turk, I want to ask you: Without guardrails, how is it that we are going to be able—without guardrails that protect consumers, how is it we are going to be able to develop centers, data centers for AI, at the same time we can ensure average Americans can get the electricity that they need at decent prices?

Mr. TURK. Well, I think we need to do two things at the same time. We need to bring on those electrons as quickly as we can, including to streamline permitting but to do it on a bipartisan basis. Bipartisan means durable. It means making sure things work, actually, in the real world.

And then secondly, we do need to have the guardrails. With all due respect to the other witnesses, we got phenomenal talent in the U.S. We are lucky to have that talent working on AI. But we also need to have the Government step up. We need to have sensible,

thoughtful guardrails to protect everyone's privacy. That is your jobs.

Ms. DEGETTE. And if we don't have those guardrails, what is going to go—what is going to happen for energy prices for consumers?

Mr. TURK. Well, energy prices will go through the roof and we will lose trust for AI by the American people as well, which isn't going to help our competition with China either.

Ms. DEGETTE. Thank you.

I yield back.

Mr. GUTHRIE. The gentlelady yields back. The Chair recognizes Mr. Hudson for 5 minutes for questions.

Mr. HUDSON. Thank you very much, Mr. Chairman, and thank you for holding this very important hearing today. This topic is crucial to future generations in ensuring the resources for healthcare facilities, banks, universities, our national security, including our warfighters.

I thank the witnesses for your very important testimony, it is very informative. The bottom line is we must maintain our place as a global leader on AI, and I think we can all agree on that.

North Carolina, where I live, is a State that leads in innovation, and that includes in AI. There is no doubt we will continue to incorporate AI in many of our industries, but we must ensure we have the resources necessary to advance and sustain AI. I represent Fort Bragg. We call it the epicenter of the universe, home of the Airborne and Special Forces. At Fort Bragg we use AI. AI benefits the warfighter by anticipating what is next, adjusting to situations, and connecting our soldiers.

It is absolutely critical to our national security that we stay ahead of our near-peer adversaries, particularly China, so that we maintain our superior advantage. I never want my guys and gals in a fair fight, I want us to be the leader. And I certainly don't want us to face a near-peer adversary that has a superior AI technology.

I have also seen threats to our energy sources, whether it is the rolling brownouts we saw in California but also including when two substations in my district were attacked in my home county, causing a multiday power loss. Nearly 4,000 people were without power for almost a week. Hospitals faced blackouts, schools and businesses closed, restaurants and grocery stores lost their inventory, stop lights were dark, cell signals went down. Even gas stations had to close. One of my constituents lost her life.

Disruptions to our energy supply are dangerous, and an attack like this has big implications on our future AI capabilities. The threat only grows as AI is further incorporated in our everyday lives. I would ask—I will start with Mr. Wang, but if anyone else wants to, jump in—can you please share, from your opinion, how an unreliable or a nonresilient grid would impact investing—investment planning and existing commercial activities?

Mr. WANG. First of all, I want to just echo many of your statements. They are spot on. First of all, we need advanced AI for our national security. We need our Department of Defense, our warfighter, to have advanced AI capabilities. That is absolutely

critical for this next phase. And that is dependent on energy, as we have discussed here in the—over the course of today.

One of the greatest risks—if you think about the training of these large-scale AI systems, it requires a continuous source of power to be able to both train advanced AI systems and keep them running. If we have an unreliable energy grid in any sort of, you know, competitive or conflict scenario, if the adversaries have the ability to take down our grid through cyber attacks or other forms of attacks, then that greatly impacts our ability to be competitive or to be able to fight in that battle. So it is absolutely critical we have a reliable energy grid. It is important that we secure this energy grid. It is important that we are able to protect against cyber attacks and other forms of attacks and we have consistent power.

Mr. HUDSON. Does anybody else want to weigh in?

Mr. Bhatia?

Mr. BHATIA. I think that, you know, the President, as well as Congress, is behind the strong growth in manufacturing across many different sectors, including semiconductors. And energy has always been an advantage for this country, due to, you know, abundant natural resources. And we have invested in all different technologies over time, and that has just stalled over the last 10, 15 years, as some of the other panelists noted.

And so I absolutely believe that investing in energy is going to help to fuel this manufacturing renaissance, and in particular the semiconductor renaissance that, you know, we all know is so important to winning in AI.

AI, you know, just to co-opt some of the words of Mr. Wang on the panel here, you know, it is about data. And data needs memory chips, and it needs the most advanced memory chips in order to be able to create all of the insights that are valuable in whatever circumstance or application that we see.

Mr. HUDSON. Well, thank you for your answers.

Mr. Turk?

Mr. TURK. Just—Congressman, if I could just say a word on grid, and I am just so pleased you mentioned the grid, it is just such a fundamental backbone of our infrastructure—for military bases, but for everybody else in industry.

This is where I think it is so important to have all the tools in the tool belt. You all provided through the bipartisan infrastructure legislation $10.5 billion to improve our grid through a program called the GRIP program. We have $23 billion in our loan program right now, with a whole bunch more in the pipeline to help utilities to strengthen the grid going forward. That is what I am talking about of keeping all these tools in the tool belt.

Mr. HUDSON. Thanks, I appreciate that.

Mr. Chairman, my time has expired, so I will yield back, but thank you to the witnesses for those answers.

Mr. GUTHRIE. Thank you. The Chair will—the gentleman yields back, the Chair recognizes Ms. Schakowsky for 5 minutes for questions.

Ms. SCHAKOWSKY. Thank you so much.

Mr. Turk, I want to—did I do that wrong?

No? OK.

I have questions for you. Some go way back. We are talking about AI today, but I have to tell you that I and Gus Bilirakis on the Republican side have been working on the issue of privacy for a very, very long time, and even more before that with—in all kinds of tech interests. But we have never done anything to rein in Big Tech, nothing whatsoever. So we see families that have to give all kinds of information, which they do, all kinds of, I think, risks that go on.

So, of course, we are talking about AI. But in the meantime, we have seen tech leaders apologize to consumers: "Oh, we didn't mean to put children at risk, we didn't mean to do this or that, and yet we have done nothing at all." So what it seems to me is now we are talking about AI, and you talk about risk. You used that word, "risk." So do we have to go back further, or let's—we—if you want to just talk about risk with AI, what exactly are we talking about?

You mentioned that in your written statement, but I would like to know who—and we can start with how do we address the issue of risk? But who should be addressing the issue of risk?

Mr. TURK. Well, thank you, Congresswoman, for that question, and thank you for your focus on these issues for years and years. Your leadership has just been tremendous.

I completely agree with something Dr. Schmidt said at the beginning in his opening statement about AI being underhyped, if anything. This is an incredibly powerful technology. What that means to me is—and I have had the chance to work with a lot of our experts in the Government, and we need to make sure that we keep those experts in the Government, we need more AI experts in the Government, not letting AI experts leave, which gives me concern with some of the firings and some of the other things that this administration, the Trump administration, is doing—but powerful technologies can not only be used for good. Powerful technologies, especially in terrorist hands, in rogue states' hands and other hands, once you get these models out there, it is incredibly difficult to bring them back in.

So I will give you a specific example of a risk. And I know this is an unclassified setting, so I will just talk a bit in generalities. As smart as the folks are who work in Scale AI and OpenAI and Google and Meta and these other big tech companies, they are not nuclear weapons experts, nor should they be. I am not sure why you would be a nuclear weapons expert—and Mr. Wang mentioned his parents working at Los Alamos, which is just a phenomenal lab for us in our country.

We need to make sure that, before a model goes out there in the public, that there is some red teaming, there is some vetting by nuclear weapons experts to know what to look for, to make sure that terrorists can't take these models and help them develop nuclear weapons or biological weapons or chemical weapons. That is where I think they are—just as you suggest, it is who and how.

The private sector will need to lead. They have an incentive to make sure that their models are safe, but they don't have all the expertise they need to red team and make sure that those models are safe.

I would prefer that not to just be a voluntary kind of understanding. I think it should be a requirement that, before models come out, there needs to be some vetting. Now, that has to be done efficiently. It has to have the right balance that the chairman is talking about to make sure that the broad expertise that we have—the nuclear weapons experts, the chem weapons experts—are poking and prodding and making sure that these models aren't going to cause us harm. So that is one particular example.

The other one that you mentioned, which I think is incredibly important as well, is privacy and making sure that information is not sucked up inappropriately to go into these AI models in the first place, and that these models aren't going to infringe on the privacy. I absolutely think consumers, citizens, Americans should control their information, and we should have guardrails. We should have regulations in place to ensure that that is the case. Again, this should be thoughtful, this should be efficient, this should be in a way that allows our companies to push the boundaries.

I completely agree with everyone who has spoken that we need to win this AI race, but we need to do this thoughtfully and make sure that the democracy, the people's representatives, have some say here too.

Ms. SCHAKOWSKY. So as part of the who, you are saying that the Congress of the United States should play a role?

Mr. TURK. Absolutely. That is why I am so pleased that this committee is having multiple hearings, not just one-offs.

Mr. GUTHRIE. Thank you.

Ms. SCHAKOWSKY. Well, thank you so much, I appreciate it.

I yield back.

Mr. GUTHRIE. Thank you. The gentlelady yields back. The Chair recognizes Mr. Bilirakis for 5 minutes.

Mr. BILIRAKIS. Thank you, Mr. Chairman, I appreciate it. Thanks for holding the hearing. I thank the presenters.

Mr. Wang, to win the race against China, American AI companies need to succeed at home and abroad. However, we have seen our largest foreign trade partners, especially the EU, enact sweeping new AI data regulations that could be used to target U.S. companies. How can we address new and emerging digital trade barriers to ensure American AI companies can outcompete their Chinese competitors, again, on an even playing field?

Mr. WANG. Thank you for the question.

You know, it is certainly true that China, in particular, and the Chinese Communist Party has a strategy to win on data. This includes some of the things that you mentioned around, you know, being more loose around data privacy both domestically and internationally, as well as explicit programs that they have within their country to create tax incentives, you know, vouchers and other forms of large-scale government programs to win on data. That is why I actually think it is critical in the United States that we focus on exporting our technology globally, as well as exporting our standards globally.

So one of the avenues that we have as a country to be able to do this is through NIST. You know, as the United States we have an opportunity to really define what are the standards for AI that

will be adopted globally. And other countries are listening, and they—you know, through the global network of AI safety institutes, there is a global coalition of countries who are looking to us to help define what are the standards for safety and other provisions that they will—that we will all collectively utilize to define how we govern AI in the future. So we have a golden opportunity as a country to help set the global AI standards, and we need to take that and be very thoughtful about what we present.

Mr. BILIRAKIS. Thank you.

Mr. Schmidt—Dr. Schmidt, we have seen Chinese AI companies, DeepSeek, Alibaba, and now Manus AI debut powerful AI models in the past 2 months. Many are rightfully focused on these models' capabilities. But I am also concerned about how they were trained, potentially on Americans' personal data and by misusing access to American AI services.

We should also be cautious about how Chinese AI will be used by American consumers and in potentially sensitive areas of the U.S. economy, such as healthcare. And I am very interested in that. We should act now, before China has a foothold on these emerging markets and controls AI data outputs to Americans' queries.

What steps can we take to address these risks to American consumers and businesses?

And first I want to talk to Dr.—if Dr. Schmidt can answer, and then if anyone else wants to chime in and I have some time, please don't hesitate.

Dr. SCHMIDT. Not only is your question great, it is worse than you said. Sorry.

The Chinese models are released in open source, which means that you can see how they work, and they are easily spread, and they are free. It is highly likely that the U.S. companies will be, by the time we are done, pretty well regulated by you all because of the importance of what they are doing. This is my personal opinion. I am not calling for it, but I think that is what is going to happen. It is very hard to regulate the open source movement coming out of China. We need to make sure we deal with that.

The industry is struggling with your question because we have not figured out a way to deal with what is called distillation, where—and distillation is where you take one model and you ask it questions, and you get the answers. And the—there's lots of evidence that the Chinese did exactly what you said in your question using this distillation mechanism, so we don't really know.

My own view is that the best answer is more offense, not more defense. And simply invest, invest, invest to stay ahead. In order to invest, as I mentioned in my opening statement, we need high skills immigration of key people because these things are essentially math problems. We need all the energy that we discussed.

I think the American innovation system, which is the combination of the government, the venture capital industry, the private sector, and universities is phenomenal. It is important we not in any way slow down the universities in AI research.

We can win this. It has to be an all-country effort. I am—my personal view is it is a national security issue for America against China.

Mr. BILIRAKIS. Agreed, agreed. Yes, I don't have any more time left, so I will yield back.

Thank you, Mr. Chairman.

Mr. GUTHRIE. Thank you. The gentleman yields back. The Chair recognizes Ms. Matsui for 5 minutes for questions.

Ms. MATSUI. Thank you very much, Mr. Chairman. I want to thank all the witnesses for being here today. This is a critically important issue for the future of America and, really, for the future of humanity at large.

Now, as coauthor of the original CHIPS Act, I know how critical this policy is to strengthen our national security and technological leadership. The CHIPS and Science Act is working as intended, leveraging its $50 billion of Government funding to spur a ninefold investment of $450 billion from the semiconductor industry. Yet President Trump threatened to abandon this once-in-a-generation effort to bring advanced semiconductor manufacturing back to America, and his tariffs are driving up costs to what we need to be competitive in AI, including aluminum, steel, semiconductors, and electronics. This administration's chaos and uncertainty will harm our AI leadership.

Dr. Schmidt and Dr. Bhatia, how would dismantling or delaying the CHIPS and Science Act programs impact America's global competitiveness, especially in AI innovation?

Mr. BHATIA. Thank you, Congresswoman Matsui, for your support of the CHIPS Act and our industry over your entire career.

We are the only U.S. memory company, and our investments are—you know, bring tremendous value across leading-edge memory solutions, as well as across other industry—other segments like the automotive industry, aerospace, defense. So we believe our investments and our more than $100 billion plan over the next 20 years will bring tremendous value, and we are actually encouraged by the Executive order to create an accelerator program for large-scale projects through the CHIPS office, through the Department of Commerce to be able to ensure that our projects——

Ms. MATSUI. So you don't want any slowing down, right, no pausing.

Mr. BHATIA. That is right, that is right. I think the accelerator's goal is to be able to make sure that the projects can be successful.

Ms. MATSUI. Dr. Schmidt?

Dr. SCHMIDT. A number of us were very strong supporters of your legislation for the following reason. Twenty-five years ago we made a mistake, as a country, and we got out of this business. It costs money to get back into it. It costs money to build the factories, to train the people, and so forth. Ten billion of the 50 billion is in new R&D for new kinds of packaging, which will give America a possibility of leading globally in semiconductors. The other 40 is to allow us to have domestic production.

Why do we need domestic production? Think national security. Just think about it. It is worth it to our Nation to have a supply chain of critical intelligence materials. That is literally the things that do the thinking under your control, Congresswoman.

Ms. MATSUI. OK.

Dr. SCHMIDT. Thank you.

Ms. MATSUI. And Dr. Schmidt, I read your testimony. I was very impressed with it, particularly the part about our innovation power, the potent collaboration between government, private industry, and academia. The Government, you know, really provides the strategic direction, and the private sector driving innovation, and academia, which fuels a pipeline of foundational research and talent.

I was wondering. You know, I think it is great to have this collaboration, but I am wondering because the Trump administration claims they are committed to American dominance, yet time and again their actions show the opposite. We should be training and recruiting talent to shape our AI leadership. Instead, more than 75 percent of U.S. researchers surveyed are considering leaving our country because of the chaos of the Trump administration. President Trump is firing experts in our agency, waging a war against science, and destroying our public research funding system.

Mr. Turk, this dismantling of public research and reductions in the Federal workforce consistent with—is it consistent with strengthening U.S. leadership on AI and other emerging technologies?

Mr. TURK. I think it is absolutely inconsistent. I think this is a huge threat going on right now, hollowing out the expertise in our national government, and I certainly got a chance to work with phenomenal experts, civil servants in our Department of Energy. We built that institution up for years and years, that kind of talent at our national labs. And to be haphazardly and chaotically firing people, losing that talent at the exact time that we need it, given the global competition we have got in AI and all these other critical technology areas—so I think it is exactly the wrong approach.

Ms. MATSUI. OK. There are other energy technologies the Republicans have historically supported. The Bipartisan Infrastructure Law—we created the Office of Clean Energy Demonstrations to help develop advanced nuclear, hydrogen, carbon capture, and long-duration energy storage. Mr. Turk, what is happening to the Office of Clean Energy Demonstrations under President Trump?

Mr. TURK. So it is one of the offices that has been decimated the worst. And you just mentioned——

Mr. GUTHRIE. I am sorry——

Mr. TURK [continuing]. The incredibly important areas that they are working on. Funding that has been provided——

Mr. GUTHRIE. We need——

Mr. TURK [continuing]. On a bipartisan basis from Congress.

Mr. GUTHRIE. The time——

Mr. TURK. And to see that being dismantled is just a travesty.

Mr. GUTHRIE. We have to move on.

Ms. MATSUI. My time has—I have other questions I will submit for the record.

Mr. GUTHRIE. Thank you. I thank—the gentlelady yields back. The Chair recognizes Mr. Palmer for 5 minutes for questions.

Mr. PALMER. Thank you, Mr. Chairman.

Dr. Schmidt, I read your book, and I have—one of my favorite quotes is from Henry Kissinger. He said the absence of alternatives clears the mind marvelously. I say it another way: Nothing brings clarity and focus quite so well as the absence of alternatives.

My concern is that we are in an arms race with China for artificial intelligence and quantum computing, and that if China wins that race they will not be *a* superpower, they will be *the* superpower.

I also continue to point out in this committee that there is not a single major refinery for rare earth elements in the Western Hemisphere. There's only nine in the world; eight are in China, the other one is in Malaysia. And I just want to ask you, Do you think this ought to be one of those moments of clarity that focuses Congress on meeting these demands, these needs?

Dr. SCHMIDT. Thank you, and I do.

If I told you with certainty that in 5 years China will be able to mount cyber attacks against American infrastructure that we have no defense of, would you act now? Yes.

Mr. PALMER. Absolutely.

Dr. SCHMIDT. If I told you that China was building an architecture for national security that was autonomous, robotic, attritable, et cetera, would you act now? Yes, you would.

I am telling you those now.

Mr. PALMER. So if we don't act on the mining, processing, and refining of rare earth elements immediately, we could find ourselves in the very position you just described.

Dr. SCHMIDT. That is correct. We want full control of our own supply chain.

Mr. PALMER. Absolutely.

Dr. SCHMIDT. Energy, chips, the infrastructure that we need. It is an issue of national security for America.

Mr. PALMER. Mr. Wang, in order to meet the demands that we have for power generation, what—how—what power generation capacity do we need to have to achieve dominance in AI and quantum computing? Do you have any idea of what that would be?

Mr. WANG. Well, as was mentioned earlier, the scale of data centers that are being built require similar amounts of power as entire cities——

Mr. PALMER. OK.

Mr. WANG [continuing]. In the United States.

Mr. PALMER. Well, Dr. Schmidt, I don't—you probably don't remember this. At the dinner at the Library of Congress, you and I had a brief discussion. One of the things that I continue to point out in this committee and other places is that there's 100, 200 hydrocarbon power generation facilities that have been shuttered and dismantled.

We know that we have these enormous power demands. I know there is a move now to go back to opening these back up on natural gas and coal. But what do you think about using small modular reactors to locate them on these facilities to meet—it is the quickest way, I think, to meet these power demands.

And the good part of this is, with all due respect to my Democratic colleagues, we are not going to do it with renewables because we just don't have the time to build out everything you have to build out, including the transmission lines. Those transmission lines still exist at these shuttered power plants. We could literally—we could open them with coal or natural gas, but I think we ought to be thinking about small modular reactors that can

plug into the existing transmission lines. How would you respond to that?

Dr. SCHMIDT. One of my personal frustrations is the regulatory structure around nuclear NSMRs. SMRs are the right answer, so your instincts are exactly correct. Furthermore, they can be built in volume. How many SMRs are in use in America today? Zero.

Mr. PALMER. Zero.

Dr. SCHMIDT. How many—what is the most promising one? An initiative in Canada. Why——

Mr. PALMER. And I am glad you brought that up, because they just licensed it, what, 2 days ago, or a week ago.

Dr. SCHMIDT. And the typical supply—the "fast" approval time is considered to be 12 years. That defies logic. We need a new program around much faster permitting for safer and safer fission and fusion nuclear. SMRs are the correct path.

One of the issues that is—sorry for the details—is 30 years ago or 40 years ago, when—the standard for permitting in nuclear was set at a threshold below natural radiation. Alex can talk about this with great detail more than I can. At the end of the day, it was set too hard. It was a mistake. It needs to be fixed.

Mr. PALMER. Well, the GE Hitachi—and I am not taking sides for any brand—it could be built in about 3 years.

But you made another point there that I think is very important for this committee, and that is the economy of scale. If we were committed to building these out in scale, so much of it can be done in factories, so much of the testing can be done in a factory and then on site.

I think it is extremely important that this Government move toward small modular reactors to meet the power demands that we have to have to even be competitive with China in the AI space.

Thank you, Mr. Chairman, I yield back.

Mr. GUTHRIE. The gentleman yields back. The Chair recognizes Mr. Castor for 5 minutes for questions.

Ms. CASTOR. Well, thank you, Mr. Chairman. This is a very important topic, and we should be focused on bipartisan solutions to advance American innovation.

The problem is there are so many new roadblocks right now, and President Trump has turned himself into the anti-innovation president. He is—has outright killed large new energy resources that were in line to come onto the grid. He has imposed these new import taxes and tariffs on everything we need to compete on AI: aluminum, steel, semiconductors, electronics. He is threatening to halt our investment in semiconductors in America. He is—has taken a hatchet to the academic and scientific workforce. This is all a gift to China at exactly the wrong time.

But let's focus in on the challenges and the opportunities for energy and AI. Secretary Turk, it is good to see you. One of the challenges is the enormous need for new energy capacity, but I am very concerned for what this means for everyday Americans and their electric bills there.

Mr. Chairman, I am going to offer—ask unanimous consent to submit for the record a new study from the Environmental and Energy Law Program out of Harvard Law School, where they highlight—they say they are skeptical of utility claims that data center

energy costs are isolated from other consumers' bills. Rate structures, as well as secret contracts could be transferring Big Tech's energy costs to the public. How do we balance——

Mr. GUTHRIE. Without objection, so ordered.[1]

Ms. CASTOR. Thank you.

How do we balance these needs?

Mr. TURK. So I think we have to, as I said in my opening statement, bring power on the grid—it could be behind the meter, as well—to power data centers, to power AI cutting-edge models.

We also need to make sure we have downward pressure on prices. I don't know of any elected official anywhere in our country who shouldn't have affordability and the cost to consumers as job one, and everything seen through that lens. As you suggest, it doesn't seem like that is what the President—our President right now—has in mind.

So even contemplating repealing the tax credits that puts downward pressure on prices across the board—technology neutral, right? Any technology can qualify for those tax credits if it meets certain thresholds. Getting rid of those is exactly the wrong thing to do right now.

And I mentioned the analysis that has been done, a number of groups have done really good, cutting-edge analysis: $220 more annually each and every year for an average household. Now, that goes up in some States to $400 more a year. If you happen to represent Missouri, Arkansas, Texas, New York, Iowa, and Kansas, watch out, it is $400 more per year just to repeal two of the tax credits, let alone the full panoply of what has been done.

Ms. CASTOR. Yes, thanks.

So one of the opportunities, however, is to work together on a much more efficient and modern electric grid across the country. It is kind of outdated, the way everything is structured and—right now. That is why yesterday I introduced my Advancing Grid Enhancing Technologies Act with Senators Welch and King that will implement shared savings incentives that promote the deployment of grid-enhancing technologies. That is the cheapest way to supercharge our grid. We have got to optimize the existing grid infrastructure to bring energy projects online more quickly and save consumers billions of dollars.

Do you see hope here with our—with modernization of the grid and GETs?

Mr. TURK. Well, thank you for your leadership, and thank you for focusing on GETs, grid-enhancing technologies.

We have got such a range of technologies. Some we still need to reduce costs, but some, like GETs and reconductoring, make sense. We just don't have a utility industry now and the incentives for those technologies to be utilized at scale, to allow us to get more out of our existing grid.

We of course need to build new transmission, as well, in our country to make sure that we are prepared for what we need in the future. So I am really pleased and thankful for your leadership in that area.

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[1] The report has been retained in committee files and is included in the Documents for the Record at https://docs.house.gov/meetings/IF/IF00/20250409/118133/HHRG-119-IF00-20250409-SD095.pdf.

I am also firmly one—and I agree with Dr. Schmidt and others—that Congressman Palmer was just talking about, small modular reactors. I think small modular reactors—I think we should be investing now in fusion so we have that as a solution.

Enhanced geothermal is such a phenomenal resource in our country, taking advantage of the drilling expertise in the workers to drill 24/7 clean power, including for data centers. We should be investing even more now to try to bring that technology online very quickly.

Ms. CASTOR. Thank you.

I yield back my time.

Mr. GUTHRIE. Thank you. The gentlelady yields back. The Chair recognizes Dr. Dunn from Florida for 5 minutes.

Mr. DUNN. Thank you very much, Mr. Chairman. So exciting topics, from tech startups to energy, grid operators, internet service providers. Everybody is working to develop these new AI technologies, and America has always been at the forefront of technological innovation.

But with AI, we are just not. We are not untouchable. We have competition. We are in a race with China to lead in this field.

And it is promising to have two major American companies sitting before us today, Scale AI and Micron, who are leading the way. This global AI boom has prompted widespread industry adoption across all kinds of sectors. Healthcare is one of keen interest to me, but also finance, telecom, weather. This morning I met with NOAA. They are excited.

However, this exponential growth of demand brings it with some substantial energy requirements. And as AI models grow in size and complexity, so does the infrastructure required to train and operate them. For instance, training large language models can take weeks of processing and high-powered GPUs, and the energy consumption can be staggering. At the same time, our telecoms infrastructure has to keep up with AI's growing demands. High-capacity networks are essential to ensure fast data transfers in these real-time AI applications such as autonomous driving, telemedicine, and smart cities and whatnot.

As AI use grows, both the energy consumption and telecom's capacity required will grow commensurately with it. At the same time, the Chinese Communist Party is moving fast and hard with zero regulations and zero ethical restraints, so we have our work cut out for us.

I also sit on the China—Select China Committee and the NATO Parliament, and I had a chance to discuss these issues with our European counterparts. And I met with the member of the European Parliament who led the current EU privacy bill. And she cautioned me, "Whatever you do in Congress, don't do that. Don't do what we did. Don't do what we did." That was her words kind of from a—right from the horse's mouth, if you will. The expert witnesses here, I think, understand today that the EU bill has indeed restricted artificial intelligence development in Europe.

With that, Mr. Schmidt, as these AI tools develop, their utility to each of us will be proportionate to their—our ability to access them. With that in mind, are we moving quickly enough to enable

the deployment of broadband connectivity and commercial access to spectrum, Mr. Schmidt?

Dr. SCHMIDT. On the spectrum side we need another round of a spectrum analysis and a new way in which the unused spectrum is allocated. I happen to believe in a situation where companies are able to buy the spectrum but they have to build it out, or they are given the spectrum and they have to build it out. I don't want people sitting on spectrum and not making it use. We need that bandwidth. However you all arrange that, it will be fine with us, I think.

Mr. DUNN. Well, it is trickier than you think, but thank you for that. I am pleased that this—our members of that committee are sitting here with us today.

Mr. Wang, it is good to see you again here in Washington. You are becoming a regular up here. I fear for your soul.

[Laughter.]

Mr. WANG. Today cutting-edge AI research is dominated by industry, partially due to the very high costs of computing needed to train these advanced models. Given the fast pace of the progress, how can we ensure our government or our pilot programs keep up with the rapidly evolving industry needs and standards?

Mr. WANG. I think that the most useful framework here is to just think about what are the raw ingredients for these AI models. So it boils down to three major elements: computational power, which requires a lot of energy, as we have discussed a lot today; algorithms, the sort of instructions for the models, and that requires incredible talent to devise new algorithms; and then data.

And oftentimes we really—and really, these AI models and progress in AI models boils down to progress in every one of these three underlying components. Oftentimes we don't consider enough our relative position on data with respect to the Chinese Communist Party. They have had a decadelong strategy to be dominant in data, to win on data. They have large-scale government programs. They have built their entire system and their entire country, their sort of civil-military fusion system, to be dominant on data.

And we need to begin thinking as strategically on this front as well. We need a program, and we need thought around how we achieve data dominance as a country, how we utilize all of the incredible data that we have as a country to get out ahead. And our Government is one of the largest producers of data, and we need to leverage this advantage.

Mr. DUNN. And do you think having a privacy law would help that? I mean a standardized privacy rule for the country.

Mr. WANG. I definitely want to prevent this—the case where we have a patchwork of privacy laws—

Mr. GUTHRIE. The gentleman——

Mr. WANG [continuing]. Across every State in the——

Mr. GUTHRIE. The gentleman is out of time. I am sorry.

Mr. DUNN. OK. Just on that, sort of on the——

Mr. GUTHRIE. The gentleman is out of time.

Mr. DUNN. Mr. Bhatia, a similar question.

Mr. GUTHRIE. The gentleman yields——

Mr. DUNN. Coincidentally, the European——

Mr. GUTHRIE. The gentleman is out of time, I am sorry, I am sorry.

Mr. DUNN [continuing]. Announced yesterday——

Mr. GUTHRIE. I am sorry, you are out of time.

Mr. DUNN. I am out of time.

Mr. GUTHRIE. I am sorry.

Mr. DUNN. God, that one flew fast.

Mr. GUTHRIE. The gentleman yields back.

Mr. DUNN. I was having fun.

[Laughter.]

Mr. GUTHRIE. It does go fast, doesn't it?

Mr. DUNN. All right.

Mr. GUTHRIE. And Mr. Tonko——

Mr. DUNN. Thank you very much, Mr. Chairman—

Mr. GUTHRIE [continuing]. Is recognized for 5 minutes. Mr.——

Mr. TONKO. Thank you, Mr. Chair. Let me begin by acknowledging that just about every witness who has testified at the Energy Subcommittee this year, whether by invitation of Republican or Democrat, has agreed that we must make it easier to build transmission infrastructure to meet our Nation's growing energy demands and to be the global leader in AI. Today's witnesses are no exception, so I really hope this is an issue that the committee can get serious about.

Dr. Schmidt, your testimony mentioned building more transmission, but you also called out the need to embrace small grid capabilities and grid-enhancing technologies. Why is it important to maximize our existing electricity system's efficiency and performance while we also work to build new infrastructure?

Dr. SCHMIDT. One of the ways to think about the energy problem is that you are building things that last 40 years and that you are in a constant process of renewing things that were built 40 years ago. And in that sense we need an integrated plan to upgrade everything.

I like what the Honorable Turk said, that you need all of it. My list was fusion, fission, especially SMRs, and enhanced geothermal, natural gas, renewable wind, and solar. We need all of it. In order to do that, the grid has to be more dynamic.

You want to have the source of power be as close as possible to the consumer. The ideal scenario is you put your power plant next to your data center. The data centers need 5 gigawatts. They are huge, right? You need 5 gigawatts of power, which is also huge. We can't do that. Therefore, we need to have the transmission to get them from one to the other.

Mr. TONKO. Thank you. I appreciate that.

And, Mr. Turk, your thoughts on this. If we can make some existing loads more flexible through demand response programs or deploy grid-enhancing technologies to get more out of our existing infrastructure, are these important tools to create the energy system conditions needed to win the race for global AI leadership?

Mr. TURK. Well, I think they are absolutely indispensable, and there are no regrets, as well. Just as Dr. Schmidt was talking about, why wouldn't we take advantage? And I know you have been a leader on this for years in the Congress. Why wouldn't we take advantage of that infrastructure that we have built? Infra-

structure is one of those things that is going to be around 40 years or even more. Let's get the most out of it.

And we do have technologies these days, GETs technologies, reconductoring, using AI, using machine learning to help the grids balance loads a lot quicker. We started a program at the Department of Energy to use AI for permitting to make sure that we could do more permitting, including on transmission, to build out our transmission system even more quickly than we have been doing. It is a big challenge, but we have got to use all the tools.

Mr. TONKO. Thank you, both of you gentlemen.

And Mr. Bhatia, I want to first and foremost welcome you to upstate New York. I also want to thank you and recognize the important commitments that Micron has made to upstate New York. Today we are talking a lot about how we can build and operate our energy system to meet AI's needs, but we rarely talk about how AI and its enabling technologies can be developed to better fit within the reasonably foreseeable constraints of our system. And that is why it is critically important that we continue to invest in research.

So Mr. Bhatia, your testimony mentioned that Micron is developing chips with much more improved energy efficiency. Can you discuss why this is a priority for Micron, and how important is a chip's energy efficiency to reduce the overall energy demands of these data centers?

Mr. BHATIA. Certainly. Thank you for your comments, Congressman.

And, you know, I really believe the semiconductor industry and memory chips are part of the solution. You know, the brilliance of Moore's Law, which is the governing law for the industry over the last—well, since its, you know, inception 50-plus years ago, is that with every generation of technology that we introduce, 18—every 18 to 24 months, we are taking the same operation and doing it with higher performance, lower power, and less resources utilized to build that device, whether—in our case memory, cells. And so that scaling path by itself is part of the solution to being able to make all these tremendous AI innovations, these data-driven AI innovations come to life using lower and lower power as we progress through time.

And Micron has actually been very focused on leadership in that way. For the last four DRAM generations, Micron has been first to market by several quarters, ahead of our Asian competitors. And that allows us to build chips that are lower-powered than those competitors. So for example, I mentioned in my prepared remarks that every one Nvidia GPU has 96 high bandwidth memory chips integrated with it. Our high bandwidth memory chips are 30 percent lower power, 30 percent lower power than our competitor's chips that go into those similar systems.

So absolutely critical for us, and we look for all avenues to be able to continue to reduce power as we scale down the trajectory and improve the efficiency of our chips, including—

Mr. GUTHRIE. Thank you.

Mr. BHATIA [continuing]. Partnering with national labs——

Mr. GUTHRIE. Thank you, the time——

Mr. BHATIA [continuing]. To do research with——

Mr. GUTHRIE. The time is expired, thank you.

Mr. TONKO. Well, thank you very much, Mr. Chair, and thank you for the comments from——

Mr. GUTHRIE. I appreciate——

Mr. TONKO [continuing]. The witnesses.

Mr. GUTHRIE. The gentleman yields——

Mr. TONKO. I yield back.

Mr. GUTHRIE [continuing]. Back, thank you, and the Chair recognizes Dr. Joyce for 5 minutes.

Mr. JOYCE. First I want to thank Chairman Guthrie for holding this critical hearing on the future of artificial intelligence.

AI is the defining technology of the next several decades. It will have a revolutionary effect on all aspects of our lives. It will be integral in everything, from the high-level data analysis to the use of a search engine. In industries as diverse as energy production and healthcare, AI is already making significant inroads.

As a doctor, we see AI integrated into innovative medical devices, helping to translate the information collected by the device into clinical guidance. In medical practices, AI can help streamline the administrative tasks, allowing doctors to ultimately spend more time with their patients. This is just the beginning of the capabilities that AI will give us, and it is why it is critical that the U.S. leads the way in the development and the deployment of this technology, just like the Space Race during the Cold War.

However, our geopolitical rival is striving to catch up and overtake America so that they can dominate this new sector. Make no mistake, China is desperate to beat us in the field of AI. It is a national imperative that we do not allow this to happen. America and the free world can't afford to let the Chinese Communist Party win the race with AI.

Fortunately, we have an advantage, and that advantage is the vast energy resources, the resources that are under the feet of my constituents in Pennsylvania. Energy is now the limiting factor for building the data centers that AI uses, which is why, to win the race for AI, we need to unleash American energy.

We have already begun to see the new project development with data center agreements between AWS and Talen Energy at the Susquehanna Nuclear Generation Facility, and the reopening of Three Mile Island, thanks to the power purchase agreement between Constellation Energy and Microsoft.

Another project in Indiana, Pennsylvania, was the announcement to repurpose the retired coal-powered Homer City Generating Station. This new facility, powered by Pennsylvania's abundant natural gas reserves, will be one of the largest power-generating sites in the entire country, capable of generating up to a staggering 4.5 gigawatts of electricity to power data centers and AI facilities on the site, attracting billions of dollars in investment to our region.

These projects show that America's ability to lead the world in AI is directly tied to our Nation's energy production. We must continue to use our energy advantage in this global competition.

Dr. Schmidt, in earlier public statements you had supported moving away from fossil fuel baseload power. Today it seems that you have a different view on the energy industry. Can you please

explain why your views have evolved, and what that connects with your views on AI development?

Dr. SCHMIDT. Let me also mention that 35 to 40 years ago, Carnegie Mellon in Pittsburgh invented a great deal of the world that we are talking about, so thank you to your State and to what they were able to do.

We need all sources of power to accelerate because we don't have a choice. If you just assume that you can get there with baseload power, with renewables, you can get there—maybe 25, 30 percent, we can debate it—you can't solve the whole power—the whole problem as we are laying out without an all-power solution. And that is why I am taking the position that I have today.

Mr. JOYCE. You mentioned renewables, but renewables do not provide that baseload power that is so necessary in the data centers. Correct?

Dr. SCHMIDT. Not correct. I am sorry, sir. Renewables plus batteries are now roughly competitive with the price of new—natural gas, partly because the natural gas demand has gone so much.

And so, again, from my perspective, the answer is yes to all. Let the market sort it out. Let everybody build everything. We need it all now.

Mr. JOYCE. And I think, ultimately, we need the nuclear and the natural gas to be able to allow those data centers to continue to develop and continue to grow.

Dr. SCHMIDT. Yes, and let me—sir, may I just emphasize the importance of baseload power, which I think is what you are getting at?

We need continuous—if you listen to Micron, these guys are superhuman. What they have done in America against the Chinese and the other Asian manufacturers is enormous. They need that baseload power. That is why your premise is correct.

Mr. JOYCE. Thank you very much. I think we can all agree that the baseload power is truly the key to moving forward with the development of AI in the United States.

Mr. Wang, as I mentioned earlier, there are two data center projects in Pennsylvania that are colocating with nuclear power stations——

Mr. GUTHRIE. I am sorry, we are beyond time. Sorry.

Mr. JOYCE. Thank you. I will——

Mr. GUTHRIE. Do that for the record—

Mr. JOYCE [continuing]. Issue my questions for followup.

I thank you again, Chairman Guthrie, for holding this important hearing today.

Mr. GUTHRIE. Thank you. The vice chair of the committee—I appreciate—yields back, and the Chair recognizes Ms. Kelly for 5 minutes for questions.

Ms. KELLY. Thank you, Mr. Chair.

As my colleagues have noted, this hearing comes at a pivotal time. The Trump administration, led by Elon Musk and DOGE, are working to rescind key investments made under the Inflation Reduction Act, which you have heard, that have spurred unprecedented growth in clean energy generation while expanding domestic manufacturing opportunities. These investments have made a major difference in my district, which is urban, suburban, and

rural. I go from the City of Chicago downstate, where I have 4,500 farms.

Mr. Turk, given the expected growth in demand and significant investments that will be made to our grid's infrastructure, can you discuss the difference—the different responsibilities between States and Federal governments in regulating how these improvements will be paid for?

Mr. TURK. Yes, absolutely. Luckily, we have got policies in place, tax incentives in place, grants in place, loans in place to make it more affordable to—for us in our country to build the kind of power that we need not just for data centers but for the rest of our economy as well. Repealing those tax credits—I hope I have been incredibly clear here at this hearing—repealing those tax credits, those grants, those loans will raise the price, will raise the costs, and will delay how quickly we can bring electrons onto our grid.

So I think it is incredibly important for the Federal Government to play a strong role. Luckily, we have got those incentives in place, it is just a question of whether we take those off the table, take those tools off the table. And I just couldn't agree with you more strongly we need those tools on the table.

Ms. KELLY. Well, thank you. I hope everyone is listening.

Alongside the provisions in the IRA, it is imperative we continue working to invest in our Nation's critical supply chains. Supporting our capacity to develop and produce a high-tech revolution is essential for prosperity in this modern economy, which is why I was proud to join my colleague, Representative Dingell, in leading the Democratic Supply Chains Act last Congress. Vital provisions from this package were included in the Promoting Resilient Supply Chains Act, which was passed by this committee yesterday. Efforts like these—not unpredictable, unlawful funding cuts and across-the-board tariffs on our allies—will help the U.S. lead the way on AI while ensuring innovation continues to thrive in communities like mine.

Mr. Turk, during your time as Deputy Secretary, how has the rapid growth of AI transformed future planning and considerations around grid reliability and resilience?

Mr. TURK. So AI is an incredibly powerful technology. It can help on the grids. The grids are becoming increasingly complicated. We have got a complicated patchwork in our country. We need to not only have the local grids and the regions work, but we need inter-regional communication, interregional flows if we are going to be effective in terms of dealing with the challenges that we have got in front of us. So AI can be an incredibly powerful tool there.

We also need an independent FERC to make sure that we have got good regulation, predictable regulation, regulation that has the certainty that folks can plan for going forward. So we need to have that regulatory environment in place too.

Ms. KELLY. Thank you for your response.

My district is poised to lead the charge by building an innovative quantum computing campus right in Chicago's southeast side. I am encouraged by the promise of world-class collaborations, exciting new technological advancements, and ensuring economic development returns to this community. With major projects like the Illinois Quantum and Microelectronics Park and other large-scale data

centers coming to the area, we must also work to bring new, clean energy generation online to help meet the projected load growth in the coming years. We could not simultaneously pull back from these critical investments while trying to lead on AI and critical manufacturing here in the U.S.

Last question, Mr. Turk: What critical supply chain investments need to be made to ensure that we meet projected demand while ensuring reliability and affordability?

Mr. TURK. So, again, we have got a whole panoply of tax incentives, grants, and loans. Let me give two specific examples.

We talked about critical minerals earlier in this hearing. Because of those tax incentives, because of the grant money that we have been given—thank you for giving us that from the Congress, from the Department of Energy perspective—we have now made a real dent. We are on a pathway to diversifying supply chains.

China holds 80 percent of the processing for critical minerals in our world right now. Because of the grants, because of the loans, because of the tax incentives, we are on a pathway to increase in the U.S. alone—of course, working with allies—2,100 percent lithium increase. I could give you a statistic for cobalt and other kinds of things.

So we are on a pathway, but this is not the time to lean back——

Ms. KELLY. Right.

Mr. TURK [continuing]. To take these tools off the tool belt. We need to lean in on that front.

Ms. KELLY. I am going to have to cut you off, out of respect for my time.

So I yield back, Mr. Chair.

Mr. GUTHRIE. The gentlelady yields back. The Chair will now recognize Mr. Weber from Texas for 5 minutes.

Mr. WEBER. Thank you, Mr. Chairman.

Mr. Schmidt, I am going to come to you and then, Mr. Wang, you are next.

When discussing the power needs of the AI industry, it is important to look at the recent track record of investment decisions in generating facilities. Constellation Energy is investing 1.6 billion—with a B—dollars to restart Three Mile Island nuclear plant. Amazon Web Services paid $650 million to house a data center facility next to a nuclear plant. The Homer City Generating Station in Pennsylvania is investing 10 billion—with a B—dollars to convert a natural gas plant.

Billions of dollars of investment have gone into AI, and barely any is going to wind, solar, or battery storage. So I have got kind of a two-pronged question here.

First of all—we will start this way—can you discuss—oh, well, let me—I—let me make this statement. Is it possible that those investment companies used AI in their decision on how to invest in energy? Let that sink in for just a little bit, OK?

Can you discuss why AI—Mr.—I am coming to you—companies are investing billions of dollars into dispatchable and reliable generating resources. I know you had the conversation with Dr. Dunn, but we are talking about real companies, real businesses making real investment decisions based on risk. Your thoughts?

Dr. SCHMIDT. So all of the data I have seen indicates that it is a fair choice now between renewables and batteries, and essentially natural gas and so forth. In other words, the answer is you want both. How they make those decisions are highly local, involving funding, permitting processes, and so forth.

Texas—and what you are doing is phenomenal—if you look at—many of the new data centers are being built in Texas because of the environment that you all have created, and some of the largest ones are being created there.

Mr. PALLONE. Bigger than the country.

Mr. WEBER. I am sorry, I am getting invaded over here.

[Laughter.]

Mr. WEBER. By a friendly fire.

[Laughter.]

Mr. WEBER. Keep going.

Dr. SCHMIDT. So Texas is a really good model of—as you know, you have your own electric grid, and it is highly unregulated. What I like about the Texas grid is that you see real power, real pricing power on a—essentially, a microsecond level.

With respect to how people make these decisions, I hope that every company in America uses AI tools to make important, strategic decisions. They are natural allies in the business decision process.

Mr. WEBER. OK, I am going to actually jump off the questioning line I had.

So AI—so what happens if China, who is so far ahead of us because we don't have our permitting process lined up right, we are so stupid that it takes so long to permit stuff that China doesn't have that problem, what happens if they intercept and take over our AI? What happens then?

Dr. SCHMIDT. Well, I am not suggesting they will take over our AI. Our analysis is that China has very large power supplies compared to the United States. They do not have the power problem that we see—

Mr. WEBER. So they can't hold our AI hostage?

Dr. SCHMIDT. As a technical matter, no. What they can do is they can—there are what are called adversarial attacks, where they can essentially go in and screw with the model, excuse the term, and basically screw it up.

Mr. WEBER. What if they have better AI than we do?

Dr. SCHMIDT. That is a competitive issue. And the issue—one way to think about it is—and I will make an argument—if you and I are competitors, you are the good guy, I am the bad guy, and I am ahead of you, and I am 6 months ahead of you, you say, "Oh, it is only 6 months." But if the slope of innovation is near vertical, it is almost impossible for you to catch me up.

Mr. WEBER. Right.

Dr. SCHMIDT. It is a dynamically unstable——

Mr. WEBER. And that doesn't work when you are talking about America's security at risk.

Dr. SCHMIDT. It puts——

Mr. WEBER. That analogy doesn't work——

Dr. SCHMIDT [continuing]. Our core national security——

Mr. WEBER. I got you.

Dr. SCHMIDT [continuing]. At risk.

Mr. WEBER. Let me move on.

Mr. Wang, the Energy Subcommittee held a hearing on the role of AI and powering the American energy future October 19, 2023. AI—during the hearing we discussed how AI can be used to improve the performance of the grid used in oil and gas production, and also some of the vulnerabilities of AI—like kind of you are alluding to, Mr. Schmidt. I have no doubt that there have been major advances in AI since that hearing, so I have got a couple of questions from you.

What benefits would there be from integrating AI into our Nation's energy sector?

And would you want that sooner rather than later, and all the permitting to be reasonably quick?

Mr. WANG. I think what you have been alluding to through all of your questions is a very important point, which we, I think, have been grappling with in the AI industry, which is that AI has the ability to transform nearly every industry. What—we refer to this in the industry is how do you move towards more agentic systems, how do you move towards systems where AI are able to make more decisions more quickly, and result in an overall dramatically more efficient, more effective system? This will tackle every industry over time, but particularly in the energy sector it is critical.

And the last answer is sooner rather than later.

Mr. WEBER. Got you.

Mr. Chairman, I yield back.

Mr. GUTHRIE. The gentleman yields back. The Chair recognizes Dr. Ruiz for 5 minutes.

Mr. RUIZ. Thank you, Mr. Chairman.

Consumer protection, data privacy, and artificial intelligence impact every American. But for me, I feel a deep responsibility to ensure that our Nation gets this right, not just as a lawmaker but as a father of two young daughters. I see how kids today are shaped by AI-powered platforms and digital relationships like never before.

While tech can inspire creativity, it also poses real risks. Studies link heavy social media use, especially for young girls, to anxiety, depression, and low self-esteem. Too often, AI algorithms promote harmful content over healthy self-worth content.

Dr. Schmidt, you have often cited the example of an AI-enabled teddy bear that learns and evolves with a child, highlighting the potential risks of such intimate AI relationships. As this scenario becomes increasingly plausible, what steps are companies taking to design systems that protect rather than exploit young users?

Dr. SCHMIDT. So thank you. Every company is very concerned about the point you are making, and every company is trying to address this question of, let's call it, a rogue AI that comes out of themselves partly for moral reasons, but also it is just bad for business.

As to whether the government will ultimately regulate that area, it is not clear to me. You do have some things that you could do right now. There is a law called COPPA, which has a 13-year—you have to be 13 to be online. I have strongly recommend it to be raised to 16 for that reason. You can also look at section 230 and

try to reduce some of the most egregious harms, and that has been discussed for some time in Congress. Those small changes would take the most extreme examples of harm and take them out of the market, which is probably a good thing.

Mr. RUIZ. Thank you. You know, too often systems are designed to keep kids online longer to collect their data and serve them ads for profit. They are not designed to keep them safe, respect their privacy, or ensure age-appropriate content. That is why we need action, we need enforceable privacy safeguards and clear rules on how AI interacts with minors, because no algorithm should decide what is best for our kids without oversight.

But we must also be honest about what could stand in the way. The sweeping tariffs proposed last week by the Trump administration risks slowing innovation, raising costs on the very tools needed to build safer online spaces and delaying efforts to hold tech companies accountable. They risk putting petty politics ahead of public good, and in doing so they leave our most vulnerable, our kids, exposed.

Dr. Schmidt, as efforts to strengthen data privacy and AI safeguards move forward, how do you anticipate the 2025 Trump administration's tariffs will affect our ability to develop and deploy privacy-first technologies designed to better protect young users online?

Dr. SCHMIDT. I don't know that I can make the combination in the question. I will have to think about it.

I will tell you that tariffs are tax increases. Tax increases slow down progress, increase costs, lead to inflation, are generally bad.

Mr. RUIZ. Deputy Secretary Turk, the Department of Energy, particularly through its national labs, has been deeply engaged in advancing AI safety and red teaming efforts. Can you speak to the importance of DOE's role in this space, and what the implications might be if that role were diminished or reassigned by the administration?

Mr. TURK. Absolutely. We have got world-class experts at our national labs, nuclear experts, bioweapons experts. We need to make sure that that expertise is tapped into, those individuals are utilized for this red teaming, right?

So before a model comes out, have those folks with their expertise working with the companies to make sure that those models—not purposefully, I don't think any company, certainly here, would purposefully put out a model that allows a terrorist to build a nuclear weapon, but they don't have the nuclear expertise to ensure that that is the case. That is why having these experts, these Government experts, these independent experts, are so important as part of that red teaming.

Getting rid of those folks is absolutely a national security concern, would have serious national security implications not just for AI, but for everything that we need those experts for.

Mr. RUIZ. Thank you. You know, we have the opportunity and the responsibility to get this right. We cannot afford to wait until we see another crisis in youth mental health, another generation struggling with digital addiction, or another data breach exposing millions of children's personal information. So I urge my colleagues, let's put families first.

Thank you, and I yield back.

Mr. GUTHRIE. Thank you. Dr. Ruiz yields back. Mr. Allen is recognized for 5 minutes.

Mr. ALLEN. Thank you, Chair Guthrie, for hosting this full committee hearing examining AI and impacts—how it impacts development——

Mr. RUIZ. They gave it——

Mr. ALLEN [continuing]. With an all-out energy approach and the technology. And certainly, we have got to be competitive globally.

In fact, you know, we wouldn't be hiring this—we wouldn't be having this hearing if President Trump were not in office, because he has said that his—part of his agenda is an all-out energy program. We need to dominate energy in the world. And of course, AI, we understand that race. And so—and everything that we are doing, our conference is doing, is to provide every opportunity for us to be the energy-dominant country that we were just 6 years ago. And so that is what is so critical, and that is why we are having this hearing today to find out, OK, what do we need to do to make that happen?

I would like to thank you for being here, our witnesses.

You know, with the emergence of AI, the U.S. has to be a global leader. To be a leader in AI, it is critical that our energy sector is equipped to meet the demands of—that AI poses.

Dr. Schmidt, in about 2030, data centers can consume upwards of 9 percent of total U.S. electricity at the same time as we are seeing historic projections of electricity demand because of AI developments, and the Nation's bulk power system is already under incredible strains. In fact, the North American Electrical—Electric Reliable Corporation, or NERC, found in their last long-term reliability assessment that half the Nation is at risk of resource adequacy. We know in some States we are having brownouts. That is, half the Nation is at risk to blackouts during times of extreme weather.

In my opinion, our Nation will need significantly more power to meet these demands, and fast. How can we balance the needs of everyday Americans to keep the lights on while simultaneously powering developments in AI models?

Dr. SCHMIDT. The answer, of course, starts with our overall premise, which is more of everything. It also includes a more intelligent grid that is more flexible when bad things happen. That is now possible with AI and with grid modernization. You need both.

Mr. ALLEN. Mr. Bhatia, last month we heard directly from the grid operators talking about grid who are charged with overseeing the reliability of our electric grid. And they highlighted one of the biggest issues facing the bulk power system is the premature retirement of baseload power plants, which has been mentioned quite often in this hearing.

We also heard that places like New England, who do not have sufficient natural gas capability and longstanding opposition to nuclear energy, are not seeing the same uptick in new investments or data centers and manufacturing facilities.

My home State of Georgia, which has been the best State to do business in 12 years in a row, has been a leader in investment in job-creating industries, largely because of our probusiness environ-

ment and diverse slate of baseload-generating resources. In fact, now we have just added to Plant Vogtle two more units, and it is the largest clean energy facility in the United States built in the last 30 years.

Given your company's energy-intensive nature, how important is access to reliable, affordable electricity when deciding where to invest in U.S. manufacturing facilities?

Mr. BHATIA. Thank you, Congressman, and I would like to just start by giving a call out to our research and development center that we have in your home State. And we have certainly found that, over time, that that has been a wonderful place for us to attract talent and grow our engineering capabilities there.

Mr. ALLEN. Yes.

Mr. BHATIA. In terms of your question on baseload, absolutely. I think many of the questions today have been focused on that.

And for, you know, semiconductor operations, we have very, very consistent loads. We have, of course, high loads. And the reliability of the power is incredibly important, as I have mentioned earlier. So nuclear power, hydroelectric power, these are excellent fits for us. But we also agree with the other panelists an all-of-the-above approach is what is required.

Mr. ALLEN. Good. I have a few—Mr. Bhatia, I have a few yes-or-no questions I am going to ask you.

Do you agree that permitting reform is needed to meet, as you discuss in your testimony, our rising energy demand?

Mr. BHATIA. Yes.

Mr. ALLEN. Do you agree that it includes air permitting?

Mr. BHATIA. Yes.

Mr. ALLEN. The National Ambient Air Quality standards implemented by the Biden-Harris administration's EPA, for example, have proven to be a significant burden on the U.S. manufacturing base. These stringent regulations have made it difficult to permit and develop many of the facilities needed to support our next generation of industrial base. Whether it be PM 2.5 or ozone, EPA needs to be more flexible. No question about it.

Mr. GUTHRIE. Your time is——

Mr. ALLEN. My time has expired. I have an additional question for you. If you would answer that for the record, I would appreciate it.

And I yield back.

Mr. BHATIA. I would be——

Mr. GUTHRIE. Thank you. The gentleman yields back. The Chair recognizes Ms. Clarke for 5 minutes for questions.

Ms. CLARKE. Thank you very much, Chairman Guthrie, Ranking Member Pallone. And to our panelists for today's hearing, thank you to our witnesses for being here to testify.

And let me just say that it is a pleasure to see Micron presented—represented on this panel, as Micron is making historic investments in New York that will transform our State and the semiconductor industry more broadly.

Members of this committee are well aware that generative artificial intelligence has proven to be one of the most impressive technological advancements of this generation. But with a tool so ex-

pansive, it is up to us to ensure that AI systems are developed and deployed responsibly and with consumers in mind.

Last Congress I had the honor of being appointed to the Bipartisan Task Force on Artificial Intelligence, which was established to ensure that the United States continues to lead in AI innovation, as well as examine appropriate guardrails to protect against emerging threats like those outlined in the 2023 GAO Report on the Rapid Use and Growth of AI. I have been sounding the alarm on issues related to AI and algorithms for years, namely the potential for algorithmic bias.

AI has only gotten smarter. And with its rapid development, consumers are faced with the increasingly acute potential for harm caused by algorithmic discrimination. For example, facial recognition technology, a tool used by both retail stores and law enforcement, has repeatedly shown an inability to accurately identify people of color, which has led to multiple instances of false identification and unwarranted harassment. And when it comes to home ownership, Black applicants are denied mortgages at higher rates, a decision that is increasingly made based on algorithms. In healthcare, algorithmic bias can lead to misdiagnosis, as the people of color are historically underrepresented in existing data sets, and algorithms are improperly tested for accuracy.

My top priority with respect to the growing use of AI is simple. We need to make it abundantly clear to developers and deployers of algorithmic systems that Americans do not forfeit their civil liberties when they go online. That is why I have prioritized algorithmic accountability and have fought to codify and make explicitly clear that civil rights protections still apply in the digital realm, especially when AI is used in critical decision making.

Lines of code remain exempt from our antidiscrimination laws and too often go unchecked. Every algorithm has an author. Every bias has an origin. Through proper regulation we must ensure safety, inclusion, and equity are top of mind in the deployment of automated, critical decision-making systems that affect Americans' lives.

And while I am pleased with the final report of the bipartisan Task Force on AI and find that it serves as a productive framework to set guardrails on AI that includes civil rights and liberties, the conversation does not end there. It is up to this committee, my Republican colleagues, who seemingly have an aversion to the words "civil rights," to properly protect all Americans when they either electively or unknowingly use AI to make critical life decisions.

I have one question, Mr. Turk: Do you agree that it is important to ensure that AI systems are rigorously tested for bias before they are deployed and on a regular basis thereafter?

Mr. TURK. Well, let me first thank you for your leadership on the bipartisan task force and more generally, and I completely agree we need to have those kinds of protections in place. This is a powerful technology, an incredibly powerful technology, and we need to get this right.

Ms. CLARKE. Yes, I am just concerned that, you know, some biases get baked into our systems and that inaccuracy can be detrimental not only to communities but to our ability as a nation to

be as strong as possible, particularly when guarding against adversaries that seek to do us harm.

So thank you for your work, gentlemen. I appreciate all that you are doing.

Young man, Mr. Wang, you are making it happen.

[Laughter.]

Ms. CLARKE. We are proud of you. Much continued success.

And I yield back the balance of my time.

Mr. GUTHRIE. Thank you. The gentlelady yields back, and the Chair recognizes Mr. Balderson for 5 minutes.

Mr. BALDERSON. Thank you, Mr. Chairman, and thank you for holding this hearing today, and I would like to thank all the witnesses for being here also today.

Let me start with you, Dr. Schmidt.

I represent Ohio's 12th Congressional District, which covers central and southeastern Ohio. Licking County, which I am proud to represent, has one of the largest clusters of data centers in the country. Google, Amazon Web Services, Meta, QTS, Vantage, and more all have data centers in central Ohio and my district. In total, power demand from data centers will reach 5,000 megawatts in central Ohio by 2030, based on signed power agreements. Just last month, Williams announced a $1.6 billion investment to build new—two new natural gas-fired plants in Licking County with a combined capacity of 400 megawatts. This reliable baseload power generation is critical to meet growing demand in central Ohio.

Dr. Schmidt, in order to alleviate strain on the electric grid, I am curious what role or involvement you think these tech companies should have in helping to bring in new generation to secure the massive amounts of power needed for their facilities.

And how should these companies partner with grid operators or power providers to ensure we can properly account for tracking—growing tracking demand?

Dr. SCHMIDT. So when I was at Google, we made a bet on Ohio and we built the largest data center at the time in the world, which was massive. And I used to go visit it. And so, oh my God, the data centers you are describing are 10 times larger than anything I ever built way back when I was doing this only 7 years ago. So it gives you a sense of the scale of the investment in what you are doing.

The best thing to do is to have a strategy within your State where everybody agrees to solve the energy power problem. We found in—working in Ohio that we were able to get access to the high-voltage lines that we could not get access elsewhere. We built our own substations, which are also massive. That is what it takes. That is what every one of you is going to have to do to have your States be a center for AI—the AI revolution.

Mr. BALDERSON. Thank you.

Mr. Bhatia, I will switch to you. I would also like to hear your thoughts on this. What is Micron doing to be proactive in securing the power needed for these chip fabs?

Mr. BHATIA. So as part of our selection of the locations where we will be expanding, the power availability and the agreements that we could reach with local power companies was a key part of that criteria. As I mentioned before, nuclear power, hydroelectric power, both very good fits for us, and those are in strong availability in

the areas where we selected, and we continue to work with the providers in those areas to be able to ensure that we can have more investments to be able to have long-term access to that affordable and reliable power.

Mr. BALDERSON. Thank you. I will continue with you, sir. You note that one of America's strongest competitive advantages compared to markets in Asia is our reliable and affordable energy supply. I strongly agree with you, with this assessment that we must maintain this key competitive advantage by building out generating capacity to meet the expected short-term surge in energy demand after years of flat growth.

However, right now we are seeing massive backlogs of generation project and grid operators, interconnection queues. Depending upon the region, power projects are sitting and waiting in interconnection queues for 5 years before they can even get studied and then ultimately built and connected to the grid. The build-out of AI and data centers isn't happening in 5 years. It isn't happening now, and these facilities need power. Do you have concerns that the current process can take years and years just for new power generation projects to get through the queue?

Mr. BHATIA. Yes.

Mr. BALDERSON. Thank you. Do you think Congress can play a role in ensuring new generation is getting online and connected faster, given the historic increase in power demand?

Mr. BHATIA. Yes.

Mr. BALDERSON. Thank you very much.

Dr. Schmidt, would you like to add anything to that?

Dr. SCHMIDT. The interconnection queues are a very good example of something which is something that you all need to work on: basically, getting the system to be more flexible when the industry shows the demand.

I mean, the delays are crazy, right? People—they have the money, they have the ability to get the power built, and they can't interconnect it. That is a good example of grid modernization. It applies to everybody.

Mr. BALDERSON. So I encourage you—we have introduced some legislation called the GRID Act, and it is all about the interconnection queue.

So with that, Mr. Chairman, I yield back. Thank you.

Mr. JOYCE [presiding]. The gentleman yields. The Chair recognizes the gentleman from California, Mr. Peters, for his 5 minutes.

Mr. PETERS. Thank you, Mr. Chairman. I do think it is great that the whole committee is hearing this.

And I thought particularly, Dr. Schmidt, I want to compliment you on setting the table on this because we are caught up in a lot of little things, and you really gave us a very big perspective on how important and daunting this is.

I had a bunch of questions from before. I am only going to ask one, which is about the Energy Permitting Reform Act, or EPRA, which was the Senate permitting deal at the end.

Mr. Turk, can you talk a little bit about the importance of transmission and the importance of interregional planning and interregional transmission as a way to help deal with our energy needs?

Mr. TURK. Well, put simply, we just need to make improvements. We need to get the most out of our existing transmission: grid-enhancing technologies, reconductoring, bringing AI and other tools to make sure that we are smart about these assets and they are flexible and they are smart.

And then secondly, we do need new transmission, and it does take too long in our country to build transmission. We underwent a whole series of reforms in the Biden administration to try to improve that, and I think we made some significant progress, but we need to do more. And certainly, Congress has an incredibly important role here.

Mr. PETERS. Well, I am an advocate on this committee and the Energy Subcommittee for permit reform. We did a lot of work to get EPRA to the point it was. I think we should start with that and adopt it.

I will say that this concept of all-of-the-above energy, I understand—I think sometimes it is all of the above as long as it is natural gas. The thing I would say is we—I was recently at a meeting with the energy company and some of my Republican colleagues, where they said now it takes 5 years to get a national—natural gas plant online, largely because of the supply chain constraints and getting turbines. But you can get solar within a year. And the company was begging us not to repeal the incentives for solar power and probably wind that are in the IRA. And I hope, when we talk about all of the above, we are really committed to all of the above and that we don't do something to shoot ourselves in the foot.

With respect to natural gas, I am more than willing to work on natural gas. I have been saying like a broken record what I want out of that, from an environmental perspective, is some agreement on the regulation of fugitive emissions, methane emissions. It is an easy thing to do. It is something the industry is open to. If we did that here, it would solve a lot of—it would answer a lot of the questions we have about the use of methane or use of natural gas as a bridge fuel. I think that is an easy thing to follow.

I would reiterate what some other people see, the need to invest in basic science is really critical here. China is more than keeping pace with us. They are outinvesting us by quite a bit. In my district a lot of that is in biotechnology, but a lot of it is in fusion. And I think that is something that we have to continue to invest in. It is—it would really solve a lot of problems, but it takes investment. And I think investment in energy in our universities, the best university system in the world, the best set of universities in the world, is really critical to this—for this country.

I agree that our data is ridiculously unmanaged and uncoordinated. We saw this in COVID. I tried to deal with it in COVID. You can't draw conclusions from a data set that is so disparate and unorganized. I think that your comments were really wise about that, sir, and I think that Congress has a role in making sure that we get on top of that.

I would—do not want to overlook the role of imports in this. I mean, we do not make solar panels here. We import a lot of things. We are making it more expensive. It is craziness. It is a craziness. And I think, for the Republicans who used to be such staunch supporters of free trade, and Democrats like me who supported both

the Trans-Pacific partnership and the USMCA negotiated by Donald Trump, we can't forget the benefits of that international trading system and that the cost of inputs that we need to solve this problem are really being heightened by this trade war and this self-harm.

I do want to say, too, that I think we should think hard about whether some of the calculations can be decentralized. We have taken for granted, we have taken as a given that there is a certain amount of energy we need. I have no doubt that it is a lot. I had actually heard 5 gigawatts for a data center, now I hear 10. That is a massive challenge. We ought to think about whether, as a—systemically, some of those calculations could be done on these handheld devices. It would take some of the power requirements away from those big facilities.

And finally, I would—the other thing I would observe as a Californian is we can't let ourselves get into the situation we are in with privacy, where we have 38 different standards across the country. This committee has got to come to grips with the notion we have to do preemption. There is a Federal supremacy clause for that reason. This has got to be a national policy. We have got to set national standards. We have got to do it on privacy, we have got to do it on AI, and we can't be scared of using our power here.

Thank you very much. We have a lot of work to do. Again, thanks so much for the witnesses. And I yield back.

Mr. JOYCE. The gentleman yields. The Chair recognizes the gentleman from Texas, Mr. Pfluger, for 5 minutes.

Mr. PFLUGER. Thank you, Mr. Chairman.

Dr. Schmidt, Mr. Bhatia, what role will LNG play in providing the power that is necessary for AI and data centers?

Dr. SCHMIDT. I am sorry, LNG?

Mr. PFLUGER. Natural gas.

Dr. SCHMIDT. So natural gas? It sure looks like natural gas is needed in most renewables scenarios because of, essentially, a peaker plant. It also looks like we just need more natural gas, more natural gas generation kind of everywhere.

Mr. PFLUGER. Mr. Bhatia, you mentioned that in your testimony——

Mr. BHATIA. Yes.

Mr. PFLUGER [continuing]. Earlier today about concerns with intermittent power. So when we are looking at sourcing, what do you need, intermittent? Or do you need a reliable baseload?

Mr. BHATIA. Well, so we have—obviously, we need reliable baseload power. Natural gas has the ability to be able to be a really good smoothing capability for the—and buffer, basically—for the ups and downs of the overall grid. And that is why I would agree with Dr. Schmidt that it is an important area, and it is an element—it is an area that the United States has, you know, a tremendous amount of capability in.

Mr. PFLUGER. The power providers were here. ERCOT testified last week, and they said that Texas alone is at a peak demand of about 80 to 85 gigs right now, and that is going to increase in the next 4 to 5 years to 150. So Mr. Turk, are you familiar with the study that DOE did last year—it actually started in 2023—on LNG?

Mr. TURK. I am.

Mr. PFLUGER. What was your role in the——

Mr. TURK. So I was the——

Mr. PFLUGER [continuing]. Department of Energy?

Mr. TURK. I was at that time the Deputy Secretary, the number 2 official.

Mr. PFLUGER. OK, did you——

Mr. TURK. And I was very involved.

Mr. PFLUGER. You were involved with that report?

Mr. TURK. I was.

Mr. PFLUGER. What was the title of that report?

Mr. TURK. I don't remember what the title of the report was. What we did is we asked a number of our national labs to give——

Mr. PFLUGER. Let me——

Mr. TURK [continuing]. Us an independent assessment.

Mr. PFLUGER. OK. When was that report released?

Mr. TURK. We pushed our national labs to do it as quickly as possible, and——

Mr. PFLUGER. When did the Department of Energy release the report?

Mr. TURK. I think we ended up releasing it late last year or early this year.

Mr. PFLUGER. OK. So you actually did release it?

Mr. TURK. We did release it.

Mr. PFLUGER. Were there sections that were redacted?

Mr. TURK. Not to my knowledge.

Mr. PFLUGER. That is——

Mr. TURK. We believe very strongly——

Mr. PFLUGER. That is what was reported.

Mr. TURK. We wanted an independent analysis to look at the cost implications, the environmental implications, and we did not suppress any information whatsoever.

Mr. PFLUGER. Were you aware of the 2023 study's findings prior to the January 26 decision to indefinitely ban new export authorizations under section 3 of the Natural Gas Act?

Mr. TURK. So we didn't ban any—we did the study in order to take a step back because we have authorized so much. Up to half of our natural gas production right now is authorized to actually go abroad and to be sold, including to China.

Mr. PFLUGER. Why was——

Mr. TURK. So what we did was take a pause——

Mr. PFLUGER. I will reclaim my——

Mr. TURK [continuing]. Did the study, and then——

Mr. PFLUGER. I will reclaim my—Mr. Turk, thank you. Thank you. Pause, ban, we can debate this all day long, but why was the study not released immediately after it was done?

Mr. TURK. So it was.

Mr. PFLUGER. So——

Mr. TURK. We released the study—

Mr. PFLUGER. So do you——

Mr. TURK [continuing]. Once the experts finished the study.

Mr. PFLUGER. Do you disagree that the study was more favorable to LNG than the Biden administration would have liked, and that is why there was a pause put on LNG exports?

Mr. TURK. The study—the pause was so that we could do the study before making decisions.

Mr. PFLUGER. So—

Mr. TURK. And to actually have our independent experts, and the independent experts in our national labs were the one who did the study.

Mr. PFLUGER. OK. So the study actually came out, was released by Secretary Wright, and——

Mr. TURK. We released the study.

Mr. PFLUGER [continuing]. There was——

Mr. TURK. The Biden administration released the study.

Mr. PFLUGER. In December of 2026—or December of 2024, excuse me. And it came out as a—pretty favorable with regards to emissions, but it was delayed by the Biden administration for months——

Mr. TURK. It wasn't.

Mr. PFLUGER [continuing]. On being released. Well, that is——

Mr. TURK. It wasn't. I was there. It wasn't delayed.

Mr. PFLUGER. It——

Mr. TURK. That is how long it took because we wanted a thorough, independent analysis by several of our national labs.

Mr. PFLUGER. So do you agree that the emissions of natural gas were better and more consistent and actually more favorable than what you claimed and what Secretary Granholm claimed in the attempt to ban natural gas exports?

Mr. TURK. So LNG exports have a very, very significant—a very significant greenhouse gas footprint. So just one project, we are talking 4 BCF per day. That project itself has more emissions throughout the life cycle—methane emissions, but CO_2 combustion—when that gas is burned than 141——

Mr. PFLUGER. You haven't——

Mr. TURK [continuing]. Countries in our world.

Mr. PFLUGER. You haven't answered my question, so——

Mr. TURK. That is one facility, 141 countries in our world.

Mr. PFLUGER. So——

Mr. TURK. That is a pretty significant footprint.

Mr. PFLUGER. So you stand by your decision to ban LNG exports.

Mr. TURK. Again, we did a pause so we could do the study.

Mr. PFLUGER. And you stand by that.

Mr. TURK. And so that any Secretary of State could have good, independent analysis——

Mr. PFLUGER. Your decision to do that is going to impact these guys right here. It is going to impact our ability to provide power for the AI data center—

Mr. TURK. So again, that is LNG that is being exported.

Mr. PFLUGER. OK.

Mr. TURK. This had nothing to do with domestic use of gas here.

Mr. PFLUGER. I yield back, Mr. Chairman.

Mr. TURK. In fact——

Mr. PFLUGER. Thank you.

Mr. TURK. In fact——

Mr. JOYCE. The gentleman——

Mr. TURK [continuing]. The more we export, the more price pressure for our——

Mr. JOYCE. The gentleman yields.

Mr. TURK [continuing]. Domestic.

Mr. JOYCE. The Chair now recognizes Mr. Soto from Florida for his 5 minutes.

Mr. SOTO. Thank you, Mr. Chairman.

You know, listening to this hearing, I feel like we are in a time warp back to 2024. Biden was president, we had the strongest economy in the world, and we were free to debate the finer points of AI regulation, the IRA, and data centers. But it is April 9, 80 days into the Trump administration, and Trump's tariffs, chaos, and deportations have sent our economy into a freefall while our friends across the aisle just bury their heads in the sand and pretend this isn't happening. Or will you join us to help fix it?

Speaker Johnson just today blocked any consideration of tariffs until September 30. He put a straitjacket on the U.S. House of Representatives to even try to address this issue. Meanwhile, AI data centers could see an estimated 30 percent increase in expenses to build, according to Fortune magazine this week. Air conditioning, liquid cooling systems, transformers, circuit breakers, cabling, routers, switches, construction materials, battery systems will all go up because of Trump's tariffs.

So is the biggest threat to AI overregulation, or is it the tariffs? Duh.

Mr. Turk, what do you think is the biggest threat right now to AI development, is it the overregulation, allegedly, or is it tariffs?

Mr. TURK. I think tariffs increase costs, and they increase uncertainty, and that is damaging for AI being built in our country, but it is damaging across our economy.

Mr. SOTO. And then we—I am worried about demand and access to capital. I heard it in both Newsweek and in Fortune magazine this week: access to capital is in real jeopardy because major tech companies, the biggest investors in AI, see a potential recession on the way and their core businesses are threatened. Ad spending drops, the capital drops during a recession.

Dr. Schmidt, we saw that the Google shares were at $200 a share when Trump took office, and now they are at $146, a 27 percent drop in 3 months. No one celebrates that, that is awful. That would have a negative effect on future AI investments for Google right now. Isn't that true?

Dr. SCHMIDT. Don't remind me of the stock price.

Mr. SOTO. Yes, I didn't mean that—I am not here to attack anybody, I was—but that—but how does that affect Google's investment in future AI?

Dr. SCHMIDT. I can't speak for Google, but I can say in general the genius of the American financial system, aside from the fact that we are a reserve currency, is that crazy entrepreneurs can raise billions of dollars on a whim, on a risk. That is why we are leading. If that system breaks, the system that is the unification of the government, the private sector, and academics, and that money is not available, we are toast.

Mr. SOTO. Yes, we are the world's currency right now. But, you know, that is in jeopardy as we speak.

Mr. Bhatia, we saw Micron take a thump too, from 109 per share when Trump took office to 65 today, a 41 percent drop. Again, no one likes this or celebrates this, but how does that affect your access to capital and the ability for you to continue to develop AI chips—AI microchips and technology?

Mr. BHATIA. So, you know, we have—we take a long-term view, and the demand for growing, for memory—the demand for data, and therefore the demand for memory—continues to grow. It is a secular trend. And so we intend our investments to be for the long term, but we have to bring them online—in line with the demand trends that we see. And so we continue to expand in that way.

But that shows the importance of—and these kind of volatile events will happen from time to time in our industry, and that shows the importance of us having a durable, predictable investment tax credit to be able to support our continued expansion here in the United States, where we are committed to building.

Mr. SOTO. We all want to make sure these stocks go back up and people's retirements are protected, and that is why this Congress needs to work together. We did work together on the bipartisan ADVANCE Act, which boosted nuclear, signed by President Biden, a bipartisan product from this committee.

Mr. Turk, how does the speeding up of deployment and licensing of new reactors and fuels help, through nuclear, the future of AI?

Mr. TURK. So I think it is a big deal, and thank you for the leadership on the ADVANCE Act. We need to not only get the most out of the resources that we have got, including those resources that can be brought on quickly to our grid—right now that is solar and storage and wind, those are the resources that allow us to bring electrons on quickly to power these AI data centers—but we absolutely have to work on clean baseload power. Nuclear is an incredibly important part of that equation. Enhanced geothermal is another incredibly important part. And so we need to have the research, we need to have the investment, and we need to have those tools as quickly as we can.

Mr. SOTO. Thanks.

I yield back.

Mr. JOYCE. The gentleman yields. The Chair now recognizes the gentleman from Idaho, Mr. Fulcher, for 5 minutes.

Mr. FULCHER. Thank you, Mr. Chairman.

Mr. Bhatia, in a different era back years ago, I was privileged to work for Micron Technology. Technically, I began with the startup phase. It was still in startup phase. I spent 15 years there. I cannot tell you how proud I am of that and the education that I received personally, and the experience, life experience, that was truly unique. And I could not have higher regard for your company. And so please know that.

At that time, as I say, things were different. But we sold ourselves, we positioned ourselves with customers and potential customers that most of our costs were fixed. And whether we produced one die or a million die, the costs were largely the same, and that gave us the ability to sell ourselves as an American supplier.

Now, today you discussed how energy is one of the factors that has changed that business model. In those days it was all about die size, and could we stack the capacitors and make it efficient, and that was the secret sauce. And if we got that, we won.

What has changed in today's business model, other than the energy that you correctly spoke about to change that strategy and business model in the framework that you are operating in today?

Mr. BHATIA. Thank you. Thank you, Congressman, and thank you for your time in the early days of Micron and helping put the company on the track to where it is today.

I think the biggest thing that has changed is the cost competitiveness of building and operating fabs in the United States over this last 25 to 30 years has become a widening gap between doing that in the United States versus Asian countries where we operate.

Mr. FULCHER. Construction cost, just to be clear——

Mr. BHATIA. Construction cost is one of the biggest gaps. It is probably the biggest gap between the Asian countries and where our competitors are versus the United States.

In fact, the energy is an area that has been a bright spot for the United States, and it is an area that, you know, the focus of this hearing is to make sure that it continues to be an area of advantage for semiconductor industry, for Micron, but also for many other industries so that we are able to be able to make sure that all of these projects can come to fruition. And——

Mr. FULCHER. Workforce?

Mr. BHATIA. And the investments we are making in workforce, you know, we certainly believe that, in partnership with the many different universities that we are working with across the country, that we are going to be able to redevelop a pipeline of skills and capabilities that have been lost over the years as manufacturing left the country.

We are also working with various different military exit organizations to be able to train veterans to come and work, because we think there is a really good overlap between the skills that they have from the military and the skills that they have to be able to operate and maintain fabs.

And I think, you know, as I have mentioned before, expanding and extending the currently expiring investment tax credit for semiconductor projects is really, really very critical.

Mr. FULCHER. Got it, and I am going to come back to you if I have time.

Mr. Wang, I want to ask you a question. In your testimony you said there's three things Congress should do in order to move forward regarding AI. The second point you made was one Federal AI standard. We have had discussions about that on the committee. Dig that a little deeper. Peel that onion back.

Specifically, what should those standards be, to the best of your advice?

Mr. WANG. Yes. So first of all, just speaking as an AI company and being able to operate and innovate effectively, we need one Federal standard. We cannot afford a patchwork of 50 different State standards——

Mr. FULCHER. I understand.

Mr. WANG [continuing]. That we have to execute against.

Then peeling the onion back, we believe that we need to create a regulatory framework that enables innovation while still adding some level of guardrails. So our view is we need a use case, sector-specific regulatory framework, where in certain industries like medicine or financial services or insurance or others, where there should be heightened levels of scrutiny or heightened levels of controls for what AI systems can and should do, we should put those in place. But in other industries where we want the core technology to advance more rapidly and more effectively, we need to allow that to happen.

Mr. FULCHER. OK. And I am about out of time, and I am going to submit some questions for the record, Mr. Chairman.

But Mr. Wang, I do think you are a wealth of knowledge, and I would just say to you and the rest of the committee, as we go about—forward in setting or trying to set some Federal standards, please be careful what you ask for, because you just might get it. And we can be a friend, or we can be a very ugly big brother. And I say that because it is very difficult to identify the proper role of the Federal Government with these things.

So thank you to all those who testified.

Mr. Chairman, I yield back.

Mr. JOYCE. The gentleman yields. The Chair recognizes the gentlelady from Michigan, Mrs. Dingell, for her 5 minutes.

Mrs. DINGELL. Thank you, Mr. Chairman, and thanks to Chair Guthrie and Ranking Member Pallone for convening this hearing.

AI, as has been discussed today, is transforming every sector, from healthcare and transportation to manufacturing. But with rapid advancements come serious challenges such as data privacy risks, algorithmic bias, and the growing threat of foreign adversaries exploiting our vulnerabilities. And we cannot afford to let America's data and personal information be weaponized by China or other adversaries, or allow AI to spread unchecked through deep fakes, robocalls, and deceptive ads. That is why I was proud to help lead the TAKE IT DOWN Act, which passed out of the committee yesterday, to hold bad actors accountable for sharing nonconsensual deepfake content online and to protect survivors.

AI, when paired with 5G and emerging technologies, is already transforming lives, streamlining public services, modernizing transportation, and improving healthcare outcomes. But to lead, we have to invest. That is what we were doing during the Biden administration. And quite frankly, I am very worried that we are now witnessing efforts to undo that progress.

Programs that were signed into law through the Bipartisan Infrastructure Law, the CHIPS and Science Act, the Inflation Reduction Act, all of which provided funding that is crucial for the AI ecosystem, are being dismantled. And these investments aren't just about clean energy. That is what people don't understand. They are about global competitiveness, job creation, and securing the future of the American industry. The IRA has been critical to accelerating domestic manufacturing, especially in the auto sector—I admit that is one I care about deeply—which remains the backbone of the American economy.

My Republican colleagues say we must outcompete China in AI. They are right. We must. I agree. But you don't win it by slashing

your own tires. You can't lead by cutting funding, firing experts, and abandoning the public-private partnerships that fuel innovation.

Secretary Turk, does cutting funding from agencies like the Commerce Department's Bureau of Industry and Security, holding up CHIPS investments, threatening that they may not happen, firing technical experts at NIST keep the U.S. competitive in the global AI race, especially as China ramps up its investments?

And what happens if we walk away from CHIPS and the IRA incentives?

Mr. TURK. I think this is exactly the wrong time to walk away for those—from those incentives.

Mrs. DINGELL. OK, short.

[Laughter.]

Mrs. DINGELL. Mr. Bhatia, what are the —I like it. It is wrong.

What are the consequences of repealing the tax credits and public investments that are driving domestic industry growth and clean energy and advanced manufacturing?

Mr. BHATIA. Well, Congresswoman, first I would like to just comment that I am proud to have been born and raised in Michigan. My first job in manufacturing was more than 30 years ago in the body shop, and that created my love of manufacturing.

And, you know, a thriving automotive industry, as you said in your comments, is, I think, critical for the country's, you know, economic health, as well as for national security.

I absolutely agree that we need to have continued support for investment tax credits for areas that are critical to AI, including, of course, semiconductor manufacturing. The tax credit that was passed is expiring, and this will create a challenge for continued investment, especially long-term investment, because this is not just a 5-year race. This is a 15-, 20-year race that we are getting into, and we want to make sure we have leadership in technology and capacity together to be able to lead in creating the—in enabling the AI revolution.

Mrs. DINGELL. Thank you.

Dr. Schmidt, do companies operating in the U.S. currently have meaningful incentives to protect consumer data and privacy?

Are the current patchwork of State laws and voluntary standards sufficient, or would a comprehensive Federal privacy law with strong data minimization provide greater clarity and consistency for both consumers and the industry?

Dr. SCHMIDT. I think there is a general view in the industry that a single privacy law would be a good outcome. I think it will be very hard to achieve. My own opinion is, given that it is hard to achieve, you are better off working on the most extreme cases, such as I fully support the bill you did yesterday. That is a good example of an extreme case. Maybe there's some other extreme cases that we could also handle through your good work.

Mrs. DINGELL. Well, more questions, and I want to dig into that too, Mr. Chairman, because I am out—I am going to have questions for the record, as some of my other colleagues do.

But this is a very important issue, all of them are. Thank you, Mr. Chair, and I yield back.

Mr. JOYCE. The gentlelady yields. The Chair recognizes the gentlewoman from Tennessee, Dr. Harshbarger, for her 5 minutes.

Mrs. HARSHBARGER. Thank you, Mr. Chairman. Thank you to the witnesses for being here today.

I will start with you, Dr. Schmidt. When tech companies are building the future of AI in the United States, we know these data centers use massive sums of energy. And for the most part, they are going to be running at maximum capacity 24/7. And this technology requires more baseload power—production, rather than renewables like wind and energy, where that production fluctuates.

And my question is, How would it strengthen America's bid to lead the AI economy if we adopted a more friendly environment for natural gas and build out additional pipeline infrastructure?

Dr. SCHMIDT. I agree with the need for more natural gas in the United States, more pipelines. I would also point out that you can achieve the same baseload goal with a combination of batteries and renewable. I think that the industry and the energy suppliers should make those on an economic basis, and I think the collective panel here is telling all of you——

Mrs. HARSHBARGER. Yes.

Dr. SCHMIDT [continuing]. All of more is better.

Mrs. HARSHBARGER. Yes, all of the above.

Dr. SCHMIDT. Yes.

Mrs. HARSHBARGER. Mr. Bhatia, your testimony goes into great detail about the difficulties of navigating U.S. permitting law. Does the challenge Micron faces when building a facility like the one you are working on in New York—chip makers—would it make the chip makers reconsider the United States?

And if so, how could the U.S. be—could it be leaving opportunities on the table by failing to update NEPA?

Mr. BHATIA. So certainly we have, you know, experienced delays, and the duplicative nature of the process has——

Mrs. HARSHBARGER. Yes.

Mr. BHATIA [continuing]. Been challenged. And it is a challenge for, I think, any company who has to go through the NEPA process, whether in semiconductors or in other areas, and there will be other NEPA projects, including in—potentially in energy and other sectors where, you know, I think that there is a potential for some streamlining to have Federal and State processes to be harmonized so that we don't have to go through the extended time.

Mrs. HARSHBARGER. Yes, it is duplicative. I mean, very much so. Thank you, sir.

Mr. Wang, one thing I really love is government efficiency. And I was inspired by your testimony—by your recommendation of implementing AI applications for the Government. It could free up public employees to think more strategically and could reduce regulatory backlogs.

So how could the administration use AI to lower taxpayer burdens and increase government efficiency?

Mr. WANG. The opportunities for AI to aid in government efficiency are immense, and this is one of the areas where I think AI can have tremendous impact very, very quickly, actually.

You know, this goes to one of the things that we are talking a lot about in the industry, which is moving towards an agentic gov-

ernment. So how can we enable AI agents to start speeding up and streamlining a lot of the processes that we have within the Government so that they go from years to weeks, or potentially even days?

So a few examples of that. You know, I think about how we can use AI to cut down the time it takes to handle veteran healthcare paperwork, or an AI system that could vastly improve fraud detection at the IRS. And then, you know, I think the combination—you know, if you look at every single agency, there is immense opportunity.

Mrs. HARSHBARGER. Yes.

Mr. WANG. And you can go across—you know, we see this in the DoD, who we work very closely with. We were working with them recently, we have been deploying a system called Thunder Forge, which is a system to using—for using AI for military planning and wargaming, a process that currently is extremely manually intensive. And we all know that, to be competitive in the future, we need to be more efficient.

So there is just a wealth of opportunity, which is one of the reasons why we recommend that, ideally, every Federal agency should have some flagship AI programs to start implementing and getting into the process of utilizing AI and AI agents to streamline more of their processes. And ultimately, if we do that today, we will reap the benefits in the years to come.

Mrs. HARSHBARGER. You are right. I see that already in some of the things we have already found with fraud, waste, and abuse, and some other—we don't even communicate within an agency, for heaven's sakes. So AI would absolutely benefit.

You keep doing your work, young man, OK?

All right. With that, Mr. Chairman, I yield back.

Mr. JOYCE. The gentlelady yields. The Chair recognizes Mr. Veasey from Texas for his 5 minutes of questioning.

Mr. VEASEY. Thank you, sir, and I think this is amazing that we are here having this conversation today.

Right now in the Dallas-Fort Worth region, we are literally becoming a hub for advanced manufacturing and AI innovation, and you can see it in all the new facilities that are opening up. You know, we have had the Facebook data center for a long time now, but we just—we have groundbreaking on several other new centers in the Alliance Corridor near Crowley and near Benbrook in Fort Worth. And this is really amazing, because you can see the new facilities going up and the jobs that they are bringing along with them, which is very, very important. It is generational, and it is really helping the DFW area lead the charge in this area.

But as we lean into the future, we have to be clear-eyed about what comes with it, because AI just doesn't run on code, and it runs on power, something that we talk a lot about on this committee. And with a massive growth of data centers and AI infrastructure that is happening right now, it is putting a tremendous strain on the grid. And we have to get ahead of this, or consumers could end up footing the bill on this through higher prices and tighter capacity and more volatility.

And so we can't treat energy demand from AI like an afterthought. We have got to be smart. We have got to keep the lights on. We have got to keep the bills affordable, and we have got to

keep the grid resilient, especially in places like Texas that's a huge part of our country's economy, but also because we have already seen by what not investing in the grid can look like in 2021 during Winter Storm Uri. Because if AI moves forward without guardrails for jobs, for privacy, and for families, we really risk turning a lot of this promise into disruption.

And I had a question for Mr. Turk: Do you believe the Department of Energy or Congress needs to take more aggressive steps to plan for and manage the energy load coming from AI infrastructure?

And are there policies that you would recommend to ensure grid reliability and, again, affordability?

Mr. TURK. Absolutely is the short answer. And fortunately, Congress provided a whole range of tax incentives, grants, and loans that are having a real impact right now on making prices more affordable not only for AI companies but also for consumers across the country. And it is helping to improve our grid reliability also.

I know there is an active discussion going on right now in Congress: Do you all repeal those tax incentives that are lowering costs and allowing us to bring electrons on more quickly? And we look at what type of electrons are going to be brought on more—most quickly in our country. It is solar, it is wind, it is storage. That is what the experts, that is what the utility CEOs are saying.

Unfortunately, right now we have a backlog on natural gas turbines right now. That is making it very challenging to bring natural gas on as quickly as some AI companies might want it to. So if you want to bring on electrons quickly, keep those tax incentives, keep those grants, keep those loans in place so that we can do it quickly, we can do it affordably, and that reduces costs for everybody, including for consumers.

Mr. VEASEY. Yes, absolutely, and it keeps America ahead by us investing in those things.

You were at DOE when the CHIPS and Science Act passed, a law that is helping bring semiconductors and AI-related manufacturing back to U.S. soil. If those incentives are rolled back, do you think companies would continue to invest in domestic manufacturing, or would they move those operations overseas?

Mr. TURK. I think Dr. Schmidt described what happened, unfortunately, a decade, two decades ago, when we let those manufacturing facilities slip out of our hands and go to other countries. And the CHIPS and Science Act was Congress working with the administration to step up and say we need to bring that back, and it is going to take some upfront capital. It is a perfectly appropriate role for the Government to say this is a critical technology, we are going to invest, we are going to encourage, and sent a bunch of private-sector investment to have those chips manufactured here in the U.S.

So the short answer to your question is, if we were to some reason slow down the CHIPS Act or rescind that funding, we are going to be right back where we were, which is not where we need to be.

Mr. VEASEY. Yes. If for some reason we didn't fully implement CHIPS Act in this area, what would that mean for America competitively, particularly when we start talking about what countries like China are doing?

Mr. TURK. So it is not only the economic opportunities that producing the chips here have for communities across the country. There is a real national security implication.

Mr. VEASEY. Yes.

Mr. TURK. Chips, along with data and power and human intelligence, fuels this AI revolution we are in the midst of. If you don't have those chips and you are beholden to other countries and other supply chains, that is a real vulnerability.

Mr. VEASEY. Yes, which means China rules the world. Very scary.

Mr. Chairman.

Mr. JOYCE. The gentleman yields. The Chair recognizes Mr. Bentz from Oregon for his 5 minutes of questioning.

Mr. BENTZ. Thank you, Mr. Chair, and thanks to all of you for being here.

Is there a reason that we should have a more organized approach, Mr. Wang, to the approach that we are using to try to achieve this win in artificial intelligence?

And before you answer that, tell me what a win is in artificial intelligence. I know, when I was reading the Oppenheimer book, and "Turing's Cathedral," and other such literature—well, more Oppenheimer—the goal was a bomb. What is our goal in AI?

Mr. WANG. AI is, as has been mentioned, a unique technology because it has such broad-reaching implications. It can be utilized to empower our economy and enable our industries to grow. It can be used for science in accelerating scientific discovery, helping us do things such as, you know, solving fusion or finding a cure to cancer. And it can also be used for—as a weapon, and used in military contexts.

Mr. BENTZ. And I know I asked you to tell me if our approach is the proper approach, and we will get back to that in a second. But as Lincoln said, the way you get things done is to change public opinion. And the great thing about this hearing today is what we are trying to say is this is an existential issue. This is so important we need to waive environmental rules, we need to push things aside, we need to create exemptions. We need to get past this haystack of obstacles that we have created for ourselves to protect things. But it takes forever now to do anything here, and we don't have forever.

So what I am really asking is, make the best argument you can to America right this minute about why this is an existential, truly absolutely necessary thing for us to set these other important things aside. And it has to be more—and maybe it can't be. But your best argument. I am going to ask everybody else the same question, but go ahead.

Mr. WANG. If we fall behind the Chinese Communist Party, this technology will enable the CCP, as well as other authoritarian regimes, to utilize the technology to, over time, effectively take over the world. You know, they will be able to export their ideologies, they will be able to utilize it as a military technology to invade other countries, and they will be able to use it for effectively spreading their regime in a more broad way across the world.

Mr. BENTZ. And so what is missing, of course, is—you say, "use it." The definition of "it" is going to become more and more impor-

tant. So people actually can grasp—this broad phrase of AI as so general.

Your turn.

Mr. BHATIA. Well, I think it is really critical that we not only maintain our leadership in terms of the algorithms and the data structure approach to being able to enable the AI applications, but absolutely the hardware, semiconductors, logic, memory. These are—it is absolutely critical that we are able to maintain our advantage——

Mr. BENTZ. They are critical. But what I am trying to get at here is public opinion has to understand why they are critical——

Mr. BHATIA. Yes.

Mr. BENTZ [continuing]. Why it is absolutely essential that we win this race to a goal that is not as clear as I would like.

Dr. Schmidt.

Dr. SCHMIDT. In 5 to 10 years, every American citizen will have the equivalent of an Einstein on their phone or in their pocket. This is an enormous increase in power for humans. What if that Einstein is a Chinese one?

Mr. BENTZ. And I am going to shift back to Mr. Wang for just a minute because of, frankly, your age as compared to those others on the panel. So if everybody is going to have Einstein available, how would you suggest to teachers that they address this in the classroom?

Mr. WANG. I think it is important. Frankly, I think AI will be an immense opportunity for humans and for industries to be able to leverage as a core technology. Our view is that, you know, in many ways our role—you know, humans' role will go towards supervising and managing these AI systems, these AI agents, if you will, in a—and give ourselves, frankly, more leverage.

So I think the key for teachers and for education systems is to teach people how to leverage AI systems, how to use them. You know, how do you embrace the technology as a tool, as something that enables you to do more things, better things, you know, more ambitious things?

Mr. BENTZ. And that would mean that all of our teachers have to understand how to use this new tool.

And I am going to be out of time, but I was interested, Mr. Turk, in the remarks you made about trying to recover and bring back to the United States manufacturing capability. I know that Micron is the only memory chip maker we have left here, and so I think the tariff concept is exactly that, to try to, in some fashion, get us back to where we need to be as we watched all those different, important jobs flee, now doing our best to get them back. And the real question is how to do it.

And I am out of time, but it is certainly incredibly important. Thank you. Thank you all.

I yield back.

Mr. EVANS [presiding]. The gentleman yields. The Chair now recognizes the gentlelady from Massachusetts, Mrs. Trahan.

Mrs. TRAHAN. Thank you, Mr. Chairman.

Congress must lead in advancing a proconsumer, pro-innovation AI agenda. Clear guardrails and regulatory certainty will fuel, not hinder, that innovation. So to understand what that looks like for

everyday Americans, let's just start at the beginning of the AI pipeline with research and what we need to be doing to set the conditions for AI capacity.

Foundational research drove breakthroughs like transistors, the internet, and large language models. Our adversaries get this. While Federal R&D funding is being cut, the Chinese Government is scaling its investments. For example, China is outspending us by more than double in fusion energy research and commercialization.

Dr. Schmidt, in your testimony you noted the importance of ramping up fusion energy research. Commonwealth Fusion is in the district that I get to represent. The fusion and AI leaders that I regularly speak with tell me how important public-private partnerships are for advancing new technology and moving towards commercialization.

How important is a strong Federal research enterprise for domestic innovation, including infusion and in AI?

Dr. SCHMIDT. Commonwealth is an example of American exceptionalism. As you know, their development of these incredibly powerful batteries—or, sorry—magnets, excuse me—that was done in research at MIT shows you the path. You do it at MIT, you do a spinout. It was done collaboratively with MIT, with other investors. People have put billions of dollars into Commonwealth, including myself. I am also the chairman of a competitor company on the West Coast. That is how the American system works.

Mrs. TRAHAN. Yes.

Dr. SCHMIDT. The current 15 percent indirect cost issue is hurting American science, and it needs to be addressed. If there are issues in specific programs, do it surgically. The damage that is being done to American research, broadly speaking, will harm the country for the next 50 years.

Mrs. TRAHAN. Thank——

Dr. SCHMIDT. This is the time to reverse this.

Mrs. TRAHAN. Your answer is exactly why the Federal Government must bolster and not squander its research capacity. Whether it is pushing away international researchers or gutting science agencies like NIH or the National Science Foundation, undermining research, the first step in the AI pipeline, threatens our ability to win, which I believe we all want to do.

I would like to turn to AI development, which depends on computer chips. In 2022 Congress passed the CHIPS and Science Act to bring chip production back home. China sees the same strategic value and is implementing a massive state-sponsored campaign to strengthen its semiconductor supply chain. Mr. Bhatia, companies like Micron have received billions through the CHIPS Act to expand chip factories in the United States. How important is it that the Federal Government fully implement the CHIPS Act to ensure that Micron and other firms are able to bolster their domestic manufacturing capabilities?

Mr. BHATIA. Thank you, Congresswoman, and you are right that, you know, our Asian competitors do have, you know, large cost gaps, cost deltas versus our operations here in the United States— 35 to 45 percent range, depending on where in Asia—and those countries are also incentivizing their domestic companies, which creates competitive disadvantages for the U.S. companies.

And it is absolutely essential that we are able to extend and expand the investment tax credits that were passed as part of that legislation so that the spring of new facilities that have started can continue and bloom over the next decade.

Mrs. TRAHAN. Yes, thank you. You know, President Trump says he wants to revive American manufacturing, but he is gutting the CHIPS program office and floating repeal of the CHIPS Act altogether, and that just doesn't add up.

Finally, on AI deployment, to benefit from AI people need protection. AI isn't flawless. It can mislead, it can make false predictions, it can expose personal data. Yes, we must beat China, but we don't need to become China. America must lead with its values, especially privacy. Our tech laws should reflect that.

Mr. Wang, in your testimony you affirm the need for effective AI guardrails. This committee has repeatedly come close to passing a Federal privacy standard based on data minimization and transparency. How important are privacy protections as a guardrail for AI?

Mr. WANG. You know, we strongly support Congress's desire to get data privacy legislation done. Ultimately, what we find critically important is that—again, I have mentioned this a few times—that we have one Federal framework so that we don't have a patchwork of various frameworks throughout the country.

Mrs. TRAHAN. Yes, this committee has a lot of work to do. Thank you so much for your testimony.

Mr. EVANS. The gentlelady yields. The Chair now recognizes the gentlelady from Iowa, Mrs. Miller-Meeks.

Mrs. MILLER-MEEKS. Thank you very much to the Chair and ranking member for holding this extremely important hearing on AI, energy, and global competitiveness.

Iowa's 1st District has become an important contributor to our Nation's AI infrastructure. In February, Cedar Rapids announced its largest economic development investment in the city's history, a $750 million partnership between the city, Alliant Energy, and QTS to build a major data center campus. The project will bring hundreds of construction jobs and high-tech positions, while featuring innovative, water-free cooling systems that address resource concerns.

It is also home to Azure's largest supercomputers, which Microsoft built for OpenAI to train breakthrough AI models. This cutting-edge infrastructure in our State's heartland demonstrates how communities beyond traditional tech hubs can play vital roles in advancing AI innovation.

As we examine these technologies, I am particularly interested in how we ensure reliable power generation for these high-demand facilities. Iowa's diverse energy portfolio positions us well, but we need significant additional generation capacity nationwide to meet growing electricity demands for AI, domestic manufacturing, and residential demand. I am eager to explore how we maintain America's energy competitive edge, and especially against China's targeted effort to become the global AI leader by 2030. The decisions that we make today about regulation infrastructure will determine whether the United States maintains its leadership position and how critical this is, as has been mentioned earlier.

Mr. Wang, I was impressed by MIT's AI innovation when I visited there a few years ago, but concerned to learn about the CCP's whole-of-government approach to accelerating Chinese AI capabilities. With the recent emergence of models like DeepSeek, how would you characterize our current competitive position against China, specifically in the areas of data and—I think you have answered this partly—computing algorithms and workforce development?

Mr. WANG. It is an important question. And, you know, I always—you know, AI really does boil down to its ingredients, and these ingredients are the ones that you referenced: computational power, data, algorithms, and ultimately the workforce that we have to support it.

When it comes to computational power, we are still ahead as a country, but we have to be very diligent to ensure that we stay ahead. We are lucky that the leading chips in the world are Nvidia chips, some of the chips from Micron and others, which are the forefront of the industry and the envy of the world. But we need to maintain those leads, and we need to think deeply about how we do that.

When it comes to algorithmic—the algorithms, you know, I would actually say we are probably on par at this point with China. You know, we used to have a meaningful lead. Most of the most innovative algorithms are American innovations, but they have been very quickly replicated. And at this point it is not clear that we have a lead.

When it comes to data, this is where China has an immeasurable lead. They have invested in it for years, you know, nearly a decade of investment into data sets to fuel their AI development. This started with their global surveillance programs and when they, you know, instituted large-scale AI for facial recognition and other technologies throughout the country. And it has continued to today.

We need to figure out, as a country, how we achieve data dominance and how we can do that both in the public sector as well as across the private sector.

And then lastly, on the workforce, this is an important point. We, as a country—again, the workforce is what fuels every component of this—of these sets of innovations, so we need to ensure that we, as a country, are setting up the right programs to empower the AI workforce of tomorrow. Thank you.

Mrs. MILLER-MEEKS. Mr. Bhatia, in your testimony you stated that the U.S. is not on track to keep pace with projected energy demand and that, unless the U.S. makes substantial policy shifts, access to affordable and reliable power will begin constraining America's manufacturing renaissance.

During our hearing with the Nation's grid operators last month, they expressed similar concerns. Your testimony specifically highlighted the Boardman to Hemingway transmission line project that has faced nearly 20 years of permitting delays.

Can you elaborate on how these permitting challenges directly impact Micron's expansion plans and competitiveness, compared to China's ability to rapidly deploy energy infrastructure?

Mr. BHATIA. Thank you, Congresswoman.

The Boardman to Hemingway line is just an example. It is a project that is, I think, 300 miles long and has been on the drawing board for almost 20 years now, and it is—we were joking earlier that it is approaching its 21st birthday almost, in terms of how—when it was proposed until today, and still hundreds of millions of dollars spent on permitting.

It is a project that does span three different States to be able to connect transmission in the Pacific Northwest. And because of those kinds of regulations between the different States as well as Federal oversight issues and regulations, we have not been able to see it even get started. And that is just one example of, I am sure, many, many other examples of projects which really are needed to be able to bring the grid resiliency that others on the panel have talked about and that I have called for as well.

Mrs. MILLER-MEEKS. Thank you. I have a question for Dr. Schmidt on fusion, but I am out of time so I will submit it for the record, if you could please answer it. But I hadn't heard fusion mentioned, so I wanted to get that in.

Thank you, I yield back.

Mr. EVANS. The gentlelady yields. The Chair now recognizes the gentlelady from New York, Ms. Ocasio-Cortez.

Ms. OCASIO-CORTEZ. Thank you, Mr. Chair, and thank you to our witnesses for joining us today and offering your testimony.

You know, this—the crux of what we are here to discuss today is where a lot of where the rubber meets the road when it comes to AI and how this actually manifests in the world, and the real problems that we are going to have to square and solve, particularly as it comes to energy and energy consumption.

Mr. Schmidt—Dr. Schmidt, you have written in the past about the energy consumption of AI. You mentioned in this article here on Project Syndicate that "AI guzzles electricity. A single ChatGPT query requires 10 times as much as a conventional web search." And in your opening statement today you said something very fascinating and compelling, I think, about the actual scale of the energy consumption that we are confronting here when you talked about gigawatts and nuclear facilities.

Could you repeat that for me very quickly?

Dr. SCHMIDT. So some math here is—and thank you, Congresswoman—the typical data center—sorry, the typical nuclear power plant is 1 gigawatt. We have roughly 90 of them. We are talking about 90 gigawatts in the next 3 to 5 years needed in America to maintain this leadership. And you put the——

Ms. OCASIO-CORTEZ. Ninety gigawatts for the AI data centers?

Dr. SCHMIDT. For the United States. And the reason I want to emphasize this is (1) this is insane, in terms of a build. Why do we need it? Because we are going from the ChatGPT that you know, which is language-to-language——

Ms. OCASIO-CORTEZ. Right.

Dr. SCHMIDT [continuing]. To reasoning systems that do thousands and thousands——

Ms. OCASIO-CORTEZ. Yes.

Dr. SCHMIDT [continuing]. What they do is called reinforcement learning. They go back and forth and back and forth.

Ms. OCASIO-CORTEZ. Correct.

Dr. SCHMIDT. They are not as efficient as our brains, and they discover new things.

Ms. OCASIO-CORTEZ. And so we are—and I completely hear you on the scale of the technology that we are dealing with here. And going back to that 90 gigawatt number, that is the equivalent of— to what you mentioned here, 90 nuclear power plants, just that we would be developing—or the equivalent of that just for AI data centers alone.

And of course, we are not talking about building 90 nuclear power plants. We are talking about building that capacity, which, before us here today, to be frank, and with the current administration, is fossil fuel infrastructure. Of course, we have talked about mixed energy loads, but with the investments and what we are seeing in terms of what is getting defunded and what is getting funded and what is being advocated for, this is largely fossil fuel infrastructure, and particularly methane—methane being 28 times more potent in contributing to the climate crisis than even traditional CO_2.

But what we are also seeing is that in the administration's moves to massively invest in AI, we have also seen the fossil fuel market be tightly associated with this. In fact, the day after Trump announced his $500 billion AI Stargate initiative, gas prices in the market went up 5.3 percent. And after the DeepSeek announcement from China, which announced that they used—consumed 50 to 75 percent less energy, gas prices fell 8 percent.

And so, increasingly we are seeing fossil fuel market speculation seeming to start to intertwine with the development of the AI industry. And this is a problem for working people, and this is the part that we need to square. In New York, Con Edison bills—that is our kind of local energy provider—are up for—some families are paying $1,200 a month to pay their energy bill. And we are here talking about massive energy investments not to lower their bills, but for, ultimately, infrastructure that is privately owned.

Mr. Turk, if a utility invests in a new substation so that gas generation for an AI data center can connect to the grid, will that utility typically pass those costs on via its electrical rates?

Mr. TURK. Well, I think you have hit the nail on the head here, right? We don't just need new electrons for AI. We need them for consumers, right? And we need to have downward pressure on prices, not the opposite.

And so that is why we need to keep our eye on the ball, including and especially with the IRA tax credits. What we are talking about is average households paying $200 more per year if those tax credits are repealed. For citizens in New York it is $400 per year more.

Ms. OCASIO-CORTEZ. And so I think—so—but at—the core of the question—without—you know, if we currently go on this path, the increases in that energy consumption from AI get passed on through the bills.

Mr. TURK. That is exactly right. It is a competitive environment. We have increasing demand. If we don't have a range of resources, especially solar and storage, which are the cheapest resources to bring on quickly right now in our country, if we increase the prices of that, everyone is going to feel it——

Ms. OCASIO-CORTEZ. And——

Mr. TURK [continuing]. And consumers in particular.

Ms. OCASIO-CORTEZ. And fossil fuel prices are certainly more volatile than renewables.

Mr. TURK. That is right. That is right.

Ms. OCASIO-CORTEZ. Thank you very much.

Mr. EVANS. The gentlelady yields. The Chair now recognizes the gentlelady from Florida, Ms. Lee.

Ms. LEE. Thank you, Mr. Chairman.

Mr. Wang, I would like to go back to your testimony of earlier today, specifically toward the end, where one of the things that you touched on was how we, as Congress, might empower and utilize NIST to help us in our promotion of artificial intelligence.

One of the things that you mention is that NIST needs more resources to be able to complete relevant measurement science, such as standards and frameworks. Would you tell us a little bit more about—elaborate on those standards and frameworks, and what you think NIST could be doing that would be constructive?

Mr. WANG. Ultimately, as AI develops as a technology, it is very important that we have what we call test and evaluation regimes, that we are able to both test and evaluate the performance of these AI systems, understand their limitations, as well as do—as other of the panelists have mentioned, do extensive red teaming on these AI systems, understand how an adversary would be able to utilize AI or hack into our AI systems to harm us.

You know, this work is incredibly important and serves as a foundation that we can use to export American AI standards globally. And this is—you know, this is really the strategic move for America, which is how do we ensure that the way that we think about AI—both embedded with our values and our democratic values, as well as how we think AI should be developed globally—is exported as broadly as possible throughout the world.

You know, we saw, I think, in the last few generations of technology the Chinese Communist Party actually be quite strategic on this, the Belt and Road initiatives, their use of Huawei technology for 5G. You know, they have in many recent developments, major developments in advanced technology, they focus on exporting their technology and making sure that Chinese technology is the global standard.

We need to do the opposite with AI. And the beauty of the situation that we are currently in is that many, many countries—you know, Japan, France, the UK, India—have all established AI safety institutes that are all looking towards the testing that we are doing in the United States and the standards that we are enforcing in the United States for them to institute their own standards.

Ms. LEE. If we are able to develop and then effectively export that measurement science, would you elaborate on how it is that you think that will help promote democratic values?

And similarly, if we fail to do so, what do you anticipate that we will see if we do not create those standards and share them globally?

Mr. WANG. Ultimately, you know, just as a simple example, let's say that we institute as part of our test and evaluation systems certain guardrails around factuality, so the AI systems, you know—or certain guardrails around, you know, whether or not the AI

could be used to create bioweapons or whatnot. That would totally eliminate certain classes of risks of a CCP model being used globally to, you know, perpetuate their ideologies or perpetuate, you know, perpetuate instability globally.

You know, there is—we have an immense ability to ensure that the United—that the American view of AI, which is a democratic technology that can be utilized by the people, for the people to ultimately empower industries, that that is how the entire world views the technology. And it is a fixed window of opportunity. We will not have this opportunity forever. At some point, all of the other countries will start instituting their own AI standards, and so we need to act quickly.

Ms. LEE. One of the things that you mentioned is your assessment that NIST would benefit from having additional resources from Congress in order to be able to undertake this activity. Do you have a perspective on how that looks, whether it is dollars, whether it is people, if there is a certain type of workforce they require? Do you have any perspective on how we could better equip NIST to be ready to do this?

Mr. WANG. Yes. I think all of the above are important. I think ensuring that they have the dollars, ensuring that they have the headcount. And one of the things that I think is very critical is that they are able to bring in and leverage cutting-edge AI talent as a part of NIST to help define these standards globally, because these are very advanced technical questions that need to be answered, but ones that will have immense benefit to America and our economy long into the future if we succeed.

Ms. LEE. Thank you.

Mr. Chairman, I yield back.

Mr. EVANS. The gentlelady yields. The Chair now recognizes the gentleman from Massachusetts, Mr. Auchincloss.

Mr. AUCHINCLOSS. Thank you, Chairman.

Dr. Schmidt, it is good to see you again. You had come and spoken to the Select Committee on China, and you were elucidating then, and I have enjoyed hearing your testimony today as well. I was hoping you could tell the committee a little bit about a famous Google paper in 2017 called, "Attention is All You Need."

Now, you were no longer executive chairman at that point, but you had been stewarding the company for the 15 years before that, and I am sure is well aware of how that publication came to be. Can you give us, like, a minute backstory?

Dr. SCHMIDT. I was, in fact, still executive chairman. And the interesting thing about that paper is when it came out I didn't even notice it. That shows you—asleep at the wheel, or something.

The six authors all became hugely famous because they came up with a way of building scalable intelligence. Before that, the RNN and CNN—not media CNN, the convolutional neural network—architectures were slow, and the "Attention is All You Need" allowed you to essentially devolve the computation into subdividable things which could scale infinitely. The transformer paper—and the "T" in GPT is transformer—is the underlying architecture——

Mr. AUCHINCLOSS. Right.

Dr. SCHMIDT [continuing]. That has enabled this explosion.

Mr. AUCHINCLOSS. Am I right, that that transformer architecture in the 2010s was—really came—became coherent around the problem of natural language translation?

Dr. SCHMIDT. Not really. The transformer architecture was essentially a refactoring of the technologies of the time into a more scalable architecture, specifically that you could have federated computing—you would have lots of different computers doing things at the same time is the easiest way to explain it. And it was a real breakthrough. They will ultimately win the equivalent of Nobel Prizes for it.

Mr. AUCHINCLOSS. Well, I was looking, I was doing some research about the—what has been called the Transformer Eight, the eight——

Dr. SCHMIDT. Yes.

Mr. AUCHINCLOSS [continuing]. The authors of that publication. And they are almost like the PayPal Mafia of AI. I mean, what they have gone on to do is remarkable.

Here is what else is remarkable. Of those eight, seven are immigrants.

Dr. SCHMIDT. Yes.

Mr. AUCHINCLOSS. And the eighth is the grandson of refugees who came to the United States fleeing persecution. In fact, two-thirds of top AI startups are founded by immigrants, and most Ph.D.-level AI talent in the United States is foreign-born.

Dr. Schmidt, can you describe the impact of immigration on AI's—America's AI competitiveness?

Dr. SCHMIDT. I was in a conversation last week in London, where people were talking about people leaving the United States AI companies to move to London because they couldn't work here anymore. That is insane. It is so counter to American national security. It is, like, crazy.

From my perspective, the most important thing America can do is look for high skills immigration. These—to describe how hard this stuff is, these are Ph.D.s in math. I have no idea what they are doing, and they are inventing these incredible algorithms.

Mr. AUCHINCLOSS. Yes.

Dr. SCHMIDT. We need all of them in America, every single one of them. Physics, chemistry, you name it, we need them all.

Mr. AUCHINCLOSS. And yet the Trump administration is currently eroding due process for immigrants in this country, whether they have green cards or student visas. They are deporting students, they are creating a climate of fear and anxiety on some of our best campuses.

Go ahead, sir.

Dr. SCHMIDT. It is actually worse—we agree. It is actually worse. People are being thrown out of the universities that are doing AI research. Universities have shut down their hiring pipeline. And they need AI professors, and the people will otherwise go to industry. So the damage being done to the universities is really, really profound.

It is very, very important that we understand that American leadership in the—in research, which you understand very well from where you are, is the cornerstone of our future. We will not

get there. Meanwhile, China is pouring an enormous amount of money into the same groups.

Mr. AUCHINCLOSS. Do you think, if the Trump posture towards immigrants—student immigrants in particular, universities more broadly—if that persists, can America beat China in AI?

Dr. SCHMIDT. No. In fact, when I was—you all appointed me to be the chairman of the National Security Committee on—Commission on AI, and we looked at this very carefully. What was interesting is that Chinese-born contributors were often part of the key papers. They were not the lead author, but they were part of it. If you would get rid of those people—and in particular they go to China, right?—the leadership literally moves. I would much rather have them be here.

And people say, well, you know, they are criminals. They are not criminals. They want to be in the United States.

Mr. AUCHINCLOSS. Right.

Dr. SCHMIDT. If they are criminals, arrest them.

Mr. AUCHINCLOSS. They are Americans by choice.

Not only is Donald Trump providing a massive opening for China with his xenophobic immigration policy, he is also providing a massive opening for China with his trade wars that's bringing Europe and China closer together.

With that I yield back, Mr. Chairman.

Mr. EVANS. The gentleman yields. The Chair now recognizes the gentleman from California, Mr. Obernolte.

Mr. OBERNOLTE. Thank you very much, Mr. Chairman, and I would like to thank Chairman Guthrie and the Energy and Commerce Committee for having this hearing on a topic that is very close to my heart, and something I think is of immense national consequence to our economy and our country.

Mr. Wang, it is great to see you again. In your testimony, you were talking about the steps that must be taken to ensure U.S. continued leadership in AI. And I was very thankful that you had some very specific asks of Congress and the administration. And one of those was that we adopt a regulatory framework that is sector-specific and use case based.

And I wanted to ask you, could you elaborate a little bit on what you mean by that and how we would go about enacting it?

Mr. WANG. Yes. So ultimately, what we need as a country is to ensure that—from a technology development standpoint, that we do not slow down. We need to ensure that AI as a technology moves forward as quickly as possible. And that includes embracing the technology and ensuring that we have the—we have room to innovate.

But the application of that technology towards certain sectors or certain specific use cases in the economy are areas where I think, you know, there probably needs to be some level of regulation, or at least some level of guardrails in place. You know, these could be industries like the medical industry, the pharmaceutical industry, the financial services industry, and others—you know, industries that already have some degree of regulation to protect consumers and protect Americans.

You know, we can—in many cases, we can utilize those same provisions or those same regulations, and then there might be some cases where there are some gaps.

Mr. OBERNOLTE. All right. The Artificial Intelligence Task Force in the House issued a report in December that made exactly that same recommendation, and I think the exact finding was that we regulate tools, not—outcomes, not tools. And AI is a very powerful tool, but it is a tool. If we focus our regulation on outcomes, then we can capture all the different uses of the tool.

You also talked about the need for a single Federal standard for regulation, and Congressman Dunn was on the way to asking you about that and unfortunately ran out of time. So I wanted to give you a little bit of space to explain what you meant by that.

Mr. WANG. Yes. So, you know, as an AI company—and I think what we ultimately want as a country is to ensure that our industry can continue developing advanced AI systems and continue driving American leadership. You know, the worst-case scenario for us is actually that there are 50 different—that every State adopts a different regulatory standard, and we have to, you know, operationally comply with 50 different regulatory standards.

I mean, it quickly becomes impossible, especially as you consider, you know, in a lot of cases the way that we develop AI is we develop, you know, one large model, and then we start applying that model in all sorts of different industries and use cases and jurisdictions. And so we need, as an industry and as a country, one clear Federal standard, whatever it may be. But we need one—we need clarity as to one Federal standard and have preemption to prevent this outcome where you have 50 different standards.

Just to put a finer point on this, you know, we do not want our American companies spending all their time figuring out how to comply with every State's standards, whereas the Chinese models and the Chinese companies will just race ahead on innovation.

Mr. OBERNOLTE. Right. That is another conclusion that we completely agree with you. In the task force report we had a whole chapter on this issue.

And let me just point out the fact that, since then, just in the last couple of months, we have at last count 958 bills pending in State legislatures across the country on the topic of AI regulation, and I am sure it is going to grow to be several thousand just in this year. If we allow this regulatory landscape that complicated to exist, I actually think that Scale is probably well suited to that because you have got the legal sophistication to deal with that.

But who does not have that sophistication are two people at Caltech—see what I did there; not MIT, Caltech—trying to start the next Scale. So I think we definitely—we have a limited amount of legislative runway to be able to get that problem solved before the States get too far ahead.

And one last question for you, Mr. Wang. You had mentioned the need to establish a national AI data reserve. Could you talk a little bit about why that is so important?

Mr. WANG. If we—you know, ultimately, national security is the responsibility of the Government. And our Government's data, particularly our DoD's data and our data relating to national security, is so vital and valuable to ensuring that our AI systems are able

to defend our country, defend our men and women, and ultimately ensure national security, broadly speaking.

So the necessity of the national AI data reserve is so that, you know, in 10 years, 5 to 10 years, we are not sitting here seeing how advanced the Chinese systems for defense and intelligence and, you know, cyber warfare and other systems are because they have an integrated data approach versus our systems, which would be dramatically behind.

Mr. OBERNOLTE. Well, thank you very much for your testimony. Sorry I didn't get to the other witnesses. I have a million questions. We will submit that for the record.

I yield back.

Mr. EVANS. The gentleman yields. The Chair now recognizes the gentleman from Louisiana, Mr. Carter.

Mr. CARTER OF LOUISIANA. Thank you, Mr. Chairman, and thank you to our witnesses for joining us today. I am glad we are discussing the need to upgrade our infrastructure for the 21st century economy and provide for all Americans' access to cutting-edge technologies championed by our witnesses here.

In January, Louisiana became the first State to secure Federal approval for deploying $1.3 billion in broadband equity access and deployment, otherwise known as BEAD, funding. This achievement highlights the bipartisan nature of Louisiana's commitment to universal connectivity and to set standards for States regarding broadband access.

The State's BEAD rollout plan began under the Democratic Governor John Bel Edwards and was completed under Republican Governor Jeff Landry, who called it a generational investment that will create thousands of jobs, drive billions of dollars in economic growth, and transform Louisiana's communities in all 64 parishes. The State's plan will connect approximately 140,000 locations to high-speed Internet through funding awarded to 20 internet service providers, with nearly 70 percent of the funds awarded to Louisiana companies.

More than 90,000 of these locations were set to transition from zero connectivity to futureproof broadband fiber, although these broadband investments will drive significant economic growth for the State, creating approximately 10,000 new jobs and generating an estimated 2 to 3 billion dollars in new revenue for Louisiana companies.

However, since the Trump administration took office, just a week after Louisiana received approval—its final approval to move forward on its proposal—the Commerce Department has withheld final funding to the approval that would have otherwise had shovels in the ground installing high-speed broadband infrastructure today—not aspirational, but now. The unexpected delay has stalled progress, frozen investments made by small internet service providers and contractors, and left rural communities still waiting on the promise of broadband access.

Just recently, Meta announced that they were building a roughly $10 billion data center in rural Richland Parish in Louisiana, an area that would have benefited from the State's broadband rollout. In fact, over 600 households within a 10-mile circumference of the new Meta facility would be connected via BEAD. We also expect

that—around the data center to grow as the facility brings in hundreds of workers, including skilled technical specialists.

The delays around BEAD rollout mean that these workers for— the $10 billion advanced data center may lack high-speed broadband at home, threatening yet another huge investment in my home State. The freeze in BEAD funds is yet another example of how the Trump administration has shown chaos and uncertainty for businesses trying to make major investments in technology and energy, on top of the past week of economic turmoil and worldwide market crashes. This is unacceptable.

Mr.—is it "Ba-ye-ta"? It is close enough?

Mr. BHATIA. Close enough.

Mr. CARTER OF LOUISIANA. How important is quality of life for your workers when you are looking to grow your operations in new areas?

Would considering making major investments in the area where your workers are, and their families lack access to the internet be a major factor?

Mr. BHATIA. Absolutely. We would like to ensure that we have a workforce that is highly skilled, highly trained, and can—and, you know, all the jobs that we are creating with our projects—you know, 11,000 direct jobs at Micron, 80,000 direct and indirect jobs—those all should be high-paying jobs which will allow people to have a high standard of living. And we think that is an important element to ensure our technology leadership as well as our manufacturing efficiency.

Mr. CARTER OF LOUISIANA. Thank you.

Mr. Wang, in your testimony you recommended that the Federal Government put policies in place to let the AI workforce thrive in America. Would you agree that we are holding back our future workforce by allowing children to grow up in an America without access to high-speed broadband Internet?

Mr. WANG. I certainly think that the ability for our future—for our children and future workforce to embrace AI technologies and other technology is going to be absolutely critical to, you know, the future development of our country. So ultimately, yes, I think we need to ensure that——

Mr. CARTER OF LOUISIANA. Thank you. I have got 4 seconds.

Real quickly, Mr. Turk, our American grid is now facing an unprecedented surge in electrical—electricity demand. How has the Trump administration's blanket refusal to permit large-scale offshore wind projects impacted our country's ability to meet this new demand?

Mr. TURK. So it is another tool in the tool belt. Why take it off? It is incredibly important, along with other sources of power.

And I think your point more broadly about infrastructure funding, you need predictability and you need certainty. You don't need chaos. And that is what——

Mr. CARTER OF LOUISIANA. Thank you very much.

Mr. TURK [continuing]. We are seeing.

Mr. CARTER OF LOUISIANA. My time has ended.

I yield back. Thank you.

Mr. EVANS. The gentleman yields. The Chair now recognizes the gentlelady from North Dakota, Mrs. Fedorchak.

Mrs. FEDORCHAK. Good afternoon, everyone. Thank you for being here. It has been an interesting hearing.

Dr. Schmidt, you said you think the AI—the importance of AI and the challenges we face has been underhyped. I agree with you. I also think that the challenges that our electric grid in this country face have also been underhyped. The truth of the matter is we are underpowered today, and that doesn't even take into consideration the demands that the AI industry brings, or the need and the urgency for us to meet that demand.

So knowing that, would you all agree that one of the first things we should be doing is stopping retiring of existing resources that are connected to the grid?

And I will just go down the line. Mr. Turk? Real quickly. I don't need a 1-minute answer. Yes or no, we should stop retiring existing resources if they are still somewhat economic.

Mr. TURK. Yes, but we do need to keep an eye on other goals, including climate, and we need to make sure we——

Mrs. FEDORCHAK. OK, thank you.

Dr. Schmidt?

Dr. SCHMIDT. Yes.

Mrs. FEDORCHAK. OK. Mr. Wang?

Mr. WANG. Yes.

Mrs. FEDORCHAK. Mr.——

Mr. BHATIA. All of the above.

Mrs. FEDORCHAK. Excellent, thank you. I think it is not a yes/ but, it is yes, we need to stop retiring. This is an urgent need. Everyone has said it is a national security issue.

All resources take time to get on the grid. And so when we don't even have enough to meet demand today, then we most certainly— and we have growing demand, we most certainly should all be able to agree in a bipartisan manner that we should keep whatever we can right now, and then go from there, because technologies evolve and they will continue to evolve.

Mr. Turk, you had said earlier that you think that you had said that solar and wind are the cheapest resources to bring on to the grid. Can you elaborate? What do you include in that calculation?

Mr. TURK. Yes. So I look not only at the levelized cost, but I look at what is actually being brought into our grid right now, driven by economics.

Mrs. FEDORCHAK. Does that include——

Mr. TURK. And so 93 percent—our independent Energy Information Administration is saying 93 percent of the new power brought on this year will be solar and storage and wind.

Mrs. FEDORCHAK. OK, but that doesn't necessarily mean it is coming on because it is the cheapest. Does your calculation include the cost of transmission to bring that online?

Mr. TURK. Well, this is why we need to have—and I know you are an expert in this, and thank you for your leadership in NARUC, in particular, with your previous job—we need to have the whole grid. We need to be thinking about reconductoring. We need to be thinking about grid-enhancing technologies. We need to be thinking about transmission too. We need to think about it holistically——

Mrs. FEDORCHAK. Right.

Mr. TURK [continuing]. And systemically.

Mrs. FEDORCHAK. Exactly. And I support GETs 100 percent. It is not the 100 percent solution, though. And it is not——

Mr. TURK. It is not, that is right.

Mrs. FEDORCHAK. It should not be overstated, because I think a lot of people who don't understand this hear things like that and think there are simple solutions, when really they are far more complicated.

And the truth of the matter is, when you consider solar and wind as being the cheapest, the cost of the transmission is not included in that calculation, nor is the cost of all the backup generation that is needed to provide power when solar and wind aren't available. Those have to be included in our calculations when we are talking about costs, because the people who pay for that, they notice that those aren't the cheapest things because it is all included in their bill. Nobody else soaks up those costs but the final customers who pay the bill.

I would like to ask one more question of all of you. So I think that in an urgent time like this, it is more important than ever that the signals that this Federal Government sends through its policies provide clear messages and clear instruction about what we need the most.

We had all the grid operators here a week ago. To the person, they all said what they need now is dispatchable power. Knowing that, is it reasonable for the Federal Government to continue to incentivize resources that are not dispatchable?

And I will start down here at the end. Should we be sending that signal? If what we need is dispatchable, why are we sending strong signals that you should bring on things that aren't dispatchable through tax policy?

Mr. BHATIA. I think that, you know, I mentioned all of the above earlier. I think that we need to think about technologies that can—and investing in technologies that will be able to contribute longer term. We shouldn't take away from that.

I mentioned in my prepared remarks, you know, some nuclear technology that we have stopped investing in that, you know, probably looks today to be short-sighted. But at the same time, we need to be focusing on the technologies—on the sources of energy that can support the demand today.

Mrs. FEDORCHAK. Thank you.

Mr. Wang?

Mr. WANG. I am not an energy expert, I am an AI expert, so I am probably not the best to answer to this.

Mrs. FEDORCHAK. OK, Dr. Schmidt?

Dr. SCHMIDT. If you take all of the subsidies away of oil and gas and all the ones around renewables, you get a different calculation. Given we have the oil and gas subsidies, it is—I think it is fine to have the renewable subsidies.

Mr. GUTHRIE [presiding]. Yes, our——

Dr. SCHMIDT. The key thing is solve the storage problem, which I think has largely been solved. That creates dispatchability.

Mr. GUTHRIE. Thanks.

Mrs. FEDORCHAK. Thank you, I yield back.

Mr. GUTHRIE. The gentlelady yields back. The Chair recognizes the gentleman from New Jersey, Mr. Menendez, for 5 minutes.

Mr. MENENDEZ. Thank you, Chairman Guthrie, for holding this hearing this morning—afternoon, I guess, now.

Dr. Schmidt, in your testimony you state that securing America's energy future requires bold, strategic Federal action and investment. One example highlighted by both you and Mr. Turk is the potential for fusion energy, which is generally supported by both Democrats and Republicans.

Dr. Schmidt, can you briefly describe the potential fusion has for the future of our domestic energy production?

Dr. SCHMIDT. Fusion is different from fission. It is a very different process. It is the technology that is inside our sun.

There are two main approaches. One is essentially—it is called a tokamak. You essentially create a plasma that floats. The plasma is so hot you have to control it using magnets and AI to hold it, otherwise the walls would melt. There are a number of companies in America that are using that approach.

There is an alternative approach, which is a pulsed fusion. This was funded initially through something called NIF in Livermore way back when. And it looks like the pulse—and what you do is you create a magnetic field which causes a collapse that causes electricity, and the electricity generated is greater than the electricity to cause the pulse. It is called $Q > 1$. The timeline of these things is demonstration for a number of these companies by roughly 2030.

If you make some assumptions about the number of electricians and the scale of the problem—and the devices are typically 400 megawatts. So think of the number of 400-megawatt sort of power sources, and you sort of take the current power source—coal power, nuclear, basically, natural gas, whatever—and you put this fusion thing in it, that is the model.

The problem is, when I look at the timeframe, you are not until 2040 to 2045 when you have abundant fusion.

Mr. MENENDEZ. Right, to get onto the grid and make it part of our daily life.

Dr. SCHMIDT. Now, having said that, this is an area where America will lead. It should be a source of great pride for America to lead in this for the world.

Mr. MENENDEZ. I agree with you. And how important is Federal funding specifically for the U.S. National Laboratories program to advancing new technologies like fision?

Dr. SCHMIDT. The DOE work in this is fundamental, and such is true of the labs and all of the stuff I am talking about. The people that I have hired in my company are all coming out of the labs, thank God.

Mr. MENENDEZ. And thank you for that. And so just yes or no: If this program were to see its funding cut or significantly reduced, would that hinder our ability to harness this new technology?

Dr. SCHMIDT. It would be horrific. We need much more funding in these areas.

Mr. MENENDEZ. See, I agree with you, but last month at a Space, Science, and Technology Committee hearing, leaders from the Department of Energy sounded the alarms about tens of millions of

dollars that are crucial to research development being put on hold because of President Trump's funding freezes across the Federal Government.

Dr. Schmidt, in your testimony you mentioned the need to dramatically increase funding for energy sector cybersecurity.

Dr. Schmidt, again, just yes or no: Should the Federal Government take the lead on having a strategy to combat cyber attacks to our critical infrastructure?

Dr. SCHMIDT. It has to.

Mr. MENENDEZ. Yes, I agree, but President Trump recently signed an Executive order that puts States and municipalities at the forefront of our Nation's cyber attack response process, instead of the Federal Government, weakening Federal investment in disaster preparedness and creating a patchwork plan for attacks to our critical infrastructure across the country.

Dr. Schmidt, yes or no, does that seem like a wise strategy?

Dr. SCHMIDT. It is not a good idea. Remember that we have an incredible cyber force in America under the Pentagon and the National Security Agency. I do a lot of military work. They are phenomenal.

Mr. MENENDEZ. I agree with you, and their work should be celebrated, and it should sit at the Federal Government, not States and municipalities. I am in complete agreement with you.

Mr. Wang, in your testimony you called for the establishment of a national AI data reserve. Your testimony also notes that the right regulatory framework maximizes innovation while still creating proper guardrails.

Mr. Wang, yes or no: Should guardrails be placed on the government's collection of sensitive data?

Mr. WANG. Yes.

Mr. MENENDEZ. Yes, I agree. But here is the thing, right? So the Trump administration is currently weaponizing data that they have within their control—including families' sensitive personal information that is collected by HUD and IRS—to target immigrants, mixed-status families, right?

So I agree that having the data is the power, right, that we will be able to use in terms of AI, right? And the Federal Government having a reserve or a collection of data is how we fully harness AI, right? But this administration is undermining our belief and trust in the Federal Government's ability to properly hold data and not use it and weaponize it, which this administration is.

This is my challenge with Republicans right now, is that they are seeing all this stuff happen in real time, right?

Dr. Schmidt, you have talked about an all-of-the-above approach to energy production, but they want to roll back investments in renewable energy. And they sit here every week and make it seem like it is business as usual. You are their witnesses, and you are telling them we need to reverse course in what this administration is doing, and they remain silent week after week.

Mr. GUTHRIE. I am sorry, the——

Mr. MENENDEZ. And that is the challenge.

And by the way, people have gone over on the other side.

Mr. GUTHRIE. The time has expired.

Mr. MENENDEZ. I am 3 seconds over, Mr. Carter. Three seconds, OK?

But this is something you all need to be accountable to the American people——

Mr. GUTHRIE. The gentleman's time has expired.

Mr. MENENDEZ. It is like this administration——

Mr. GUTHRIE. And the gentleman from Georgia is recognized.

Mr. MENENDEZ. Thank you, Chairman Guthrie.

Mr. GUTHRIE. Yes, thanks.

Mr. CARTER OF GEORGIA. Thank you, Mr. Chairman. Thank you all for being here. And thank you, Mr. Chairman, for holding this very important meeting.

Artificial intelligence is transforming every aspect of our economy and our society, as we well know. From energy and communications to national security and healthcare, AI is both—presents extraordinary opportunities.

I am very interested in healthcare, and chair of the Health Subcommittee, so I want to give you an example: HealthFlow. HealthFlow is a company that is applying artificial intelligence to transform the diagnosis and treatment of coronary artery disease, which kills one in five Americans. This is significant.

Using a standard CT scan of the heart, HealthFlow's algorithms can determine blood pressure and flow in the coronary arteries, allowing physicians to determine the severity of disease and whether invasive treatment is needed. In fact, HealthFlow's technology has proven to decrease the rate of heart attacks and save the Medicare program more than $3,100 per patient. Per patient.

Our job as lawmakers is to make sure the U.S. continues to lead in AI innovation while protecting American values like data privacy, reliable infrastructure, and fair competition.

Mr. Schmidt—Dr. Schmidt, I want to ask you. Startups play a crucial role. We all know that they play a crucial role in driving innovation in the technology ecosystem.

How can we avoid creating regulatory structures that only large companies with extensive legal teams and lobbying power can navigate?

Dr. SCHMIDT. I agree with the premise of your question, sir. The innovation that is occurring in startups is phenomenal. You see completely new techniques using AI. A typical example would be cancer scoring, right, where you have a bunch of things. I am part of the Mayo Clinic board and so forth, and they have—they are spinning out startups to do precisely this, so it can be done. We need to have the entire ecosystem of venture capital and so forth behind the image that you described.

Mr. CARTER OF GEORGIA. Exactly, and not just where the bigger companies are the ones who are doing this——

Dr. SCHMIDT. Right, and may I add that some of that is actually the data problem that Mr. Wang keeps talking about.

Many of the startups cannot get the data that they need for various regulatory reasons. A simple example would be that if you had opt out of privacy things for healthcare that people could—for research, that you could have research pools, then you could accelerate that. There's a whole bunch of approaches there that are reasonable tradeoffs.

Mr. CARTER OF GEORGIA. OK, let's talk about the role that AI is going to play in developing new treatments and cures. And we know that is going to be the case. How should lawmakers be thinking about integrating AI tools into HHS and CMS and FDA to create a more efficient process like quicker drug approvals?

Dr. SCHMIDT. One of the—well, the biggest problem with drugs is the phase 3 trial cost and the timing.

Mr. CARTER OF GEORGIA. Exactly.

Dr. SCHMIDT. I am involved with a startup that has a new approach using AI to simplify that. We will see if my startup is successful or not.

The current model is static and unchanging. It is not informed by data. A simple regulatory change to allow better analytics around how you prove that the thing is phase 3 trial would really—would deliver a drug in—years ahead of time, and years is lives ahead of time.

Mr. CARTER OF GEORGIA. And we all understand this is—this could be a great benefit. I mean, this could be a game changer with diagnosing, with making sure that we are doing the right treatments. AI in healthcare is going to be phenomenal. I am very optimistic about that. But it is also going to have some downfalls and some things that are dangerous that we need to really guard against.

But we have heard a lot of promise about how it can cut costs and how it can increase efficiency within the Federal Government, especially in some of the organizations like HHS.

How should regulators think about contracting with innovators to integrate AI into the regulatory and oversight functions that we have, particularly in Congress?

Dr. SCHMIDT. I will give you a personal answer.

The Federal Government does a terrible job of procuring software. The Federal Government does quite a good job of building—buying hardware. Software is not managed the same way that you manage hardware. Software is never done. It requires constant attention, the teams are constantly turning over.

Instead, the Federal Government purchases specific contracts for specific outcomes with specific teams. It doesn't work in software. In order to achieve your vision, you have to attack the software problem. The reason our Government is so incredibly inefficient, in my view, is because it doesn't use software correctly.

Mr. CARTER OF GEORGIA. It doesn't use software correctly. Have you got an example of that?

Dr. SCHMIDT. Everywhere you look. I mean, if you look at what the tech companies do in terms of integrated software, there is no analog. Every aspect of data in the Federal Government is insecure. All of them are being attacked by the Chinese and others. The systems——

Mr. GUTHRIE. Thank——

Dr. SCHMIDT [continuing]. Are so bad that people have to add layers on top to fix them.

Mr. GUTHRIE. Thank——

Dr. SCHMIDT. Many of the underlying databases are COBOL——

Mr. CARTER OF GEORGIA. My time is up. Thank you, and I yield back.

Mr. GUTHRIE. So Mr.—so Dr. Schmidt, I know you had a hard stop. Can we do one more?

Dr. SCHMIDT. Yes, of course.

Mr. GUTHRIE. And we will—we have just a handful left, but whenever you are—let me know when you need to be excused.

Dr. SCHMIDT. No, no, I appreciate that. These are very important——

Mr. GUTHRIE. But I want to make sure that everybody gets a chance to ask questions.

So Dr.—Mr. Mullin, you are now recognized from California. Mr. Mullin, you are recognized.

Mr. MULLIN. Thank you, Mr. Chair. Thank you to all of our witnesses for your testimony.

We have heard from our panel today that, to compete on AI, we are going to need a lot more stuff: more energy, more materials, more investment, more of everything. But steel, aluminum, and everything else that goes into powering data centers cost money. And we cannot win the global race on AI if American businesses can't afford the raw materials to build that infrastructure.

Amid this uncertainty, the majority is considering a repeal of the IRA and the Infrastructure Law, two landmark laws that have already leveraged hundreds of billions of dollars of private-sector investment in our country's energy infrastructure. There are also reports coming out that the DOE is planning to unilaterally cancel billions of dollars in grants for hydrogen hubs and long-duration energy storage projects that have already received congressionally approved funding.

Rolling back these laws and unlawfully cutting committed funding will severely undermine the trust in the Federal Government that stakeholders have, until now at least, taken for granted.

So Mr. Turk, in your time as the Deputy Secretary at DOE, you interacted with stakeholders across the energy and AI sectors. What will be the worst impacts of all of this economic and policy uncertainty, including the tariffs which were referenced multiple times today, on the investments that are underpinning AI?

Mr. TURK. So it is the grants, it is the loans, and it is the tax incentives, and getting rid of or even just causing confusion about whether the grants are actually coming.

And I should say on the grants this was money that you all have already given, and this is money already obligated in some instances. And so the private sector needs to rely on the Government doing what it is supposed to do, doing it professionally, doing it without any political interference.

So I think what it does is it not only puts those immediate projects at risk, but it puts the credibility of the Government at risk, as well. And if we are going to be successful competing on AI, building out our infrastructure, doing all the other things that we need to do, we need to have credibility in the Government working in partnership with the private sector.

Mr. MULLIN. So thank you for that, and I fear there will be serious repercussions for our energy system if cuts are made to the IRA programs that are essential for energy as energy demand increases as part of AI.

But as important as the AI race is, we also have to talk about rising costs. People are paying more not only at the grocery store, but losing money in their retirement savings. But recent estimates show these tariffs are going to cost everyday Americans an additional $3,800 a year on their utility bills. To meet both the AI challenge and cost challenge, it is clear that we need more energy resources, and we need to get them online as soon as possible.

Earlier today you mentioned that renewables are the cheapest, quickest sources to deploy when it comes to energy. So what—Mr. Turk, what does Congress need to do to unlock this development and ensure that consumers are not hit with the higher costs yet again by the Trump administration?

Mr. TURK. So the good news is you all have done your jobs. Now, we could use more, but you have got the tax incentives, the grants, the loans in place. What is at risk here is, if those are repealed, just two provisions—the investment and production tax credit, technology-neutral tax credit—if that is repealed, Americans' households are paying, on average, $220 more per year just with those two provisions repealed, let alone the other provisions and grants and loans not going out in the way they are.

So this is—the worst way to keep downward pressure on prices is to repeal these incredibly important tax incentives.

Mr. MULLIN. Great. Thank you for that, sir. And thank you all. With that I yield back.

Mr. GUTHRIE. Thank you. The gentleman yields back. The Chair recognizes Mr. Griffith—oh, I am sorry, Mr. Fry. I apologize.

Mr. FRY. Thank you, Mr. Chairman.

South Carolina is experiencing a remarkable spat of economic growth. From the Grand Strand of the Pee Dee, new businesses are opening, manufacturers are investing, and families are moving in. That growth is a tremendous opportunity, but it does pose some significant challenges.

Yesterday, President Trump issued Executive orders declaring a national energy emergency and directing swift action to boost grid reliability and cut red tape for energy projects. These steps are both timely and necessary. Power demand is rising sharply. There's a lot of contributing factors to that, but it is. And in South Carolina, nuclear power provides more than half of our electricity, giving us a pretty strong foundation.

But permitting delays, premature plant retirements, and transmission bottlenecks threaten not only our State, but all 50 States. We need a Federal policy that keeps pace with innovation. That means faster permitting, support for fuel-secure generation, and a strong, reliable grid. I appreciate the testimony of all the witnesses today.

My initial questions, Mr. Bhatia, I appreciate your comments on the need to reshore semiconductor chip manufacturing and secure our supply chains in this country. As you noted, China controls an overwhelming majority of global capacity for critical material refining and processing, an unacceptable strategic vulnerability on our part. During our hearing with the regional grid operators, we heard that regions like New England, as an example, are facing real constraints on natural gas capacity. That bottleneck is holding

back the type of energy-intensive investments that we need to support AI and manufacturing.

So if we are going to plan for the future, where we reshore significant portions of our supply chain, how important do you believe permitting reform is to infrastructure like natural gas pipelines and the like?

Mr. BHATIA. I think it is critical. And I think the cost of inaction that we have had over the last several years and continue to have is very, very high.

I mean, you have heard multiple data points in testimony around the sharp spike in demand that is forecasted both because of the data centers that are going to be built, as well as the manufacturing in semiconductors, as well as other industry segments. And so, you know, after having, you know, many, many years where supply and demand has been matched and stable, this spike threatens to create a dislocation that could ultimately threaten the viability of some of these projects longer term, whether those are in the data center segment or in manufacturing.

And I think streamlining and working to be able to remove, you know, duplicative processes between Federal and State is something that both parties can get behind. And States—red, blue—red States and blue States both can get behind trying to ensure that there is a streamlined process for critical projects to move forward.

Mr. FRY. Sir, do you think that we can realistically meet our energy demands without those simple reforms that you talked about?

Mr. BHATIA. You know, I am not sure. I believe that we—I don't think we should try and figure that out. I think we should make sure we move forward with the permitting, and I think the permitting needs to be across transmission, it needs to be across generation, and it needs to be across all of the above sources of energy investments that we need to make.

Mr. FRY. Thank you.

Dr. Schmidt, I appreciate you staying a little bit. Your testimony laid out the strategic importance of AI and the race with China in pretty stark terms. You mentioned that AI data centers could require up to 10 gigawatts of power each, and that we risk falling behind.

Given what we are seeing across the country, though, especially in States with business-friendly environments, can you speak to the importance of permitting reform and how it relates to our competitiveness in the AI space?

Dr. SCHMIDT. When you look at people who have the money, they still can't get the permits and, in particular, the interconnection permits that are needed to get into the grid. You can solve that problem by, for example, building your own power plant next to your own data center. But that is not particularly efficient.

There are all sorts of other issues. If you look at the cost of, for example, building—I will give you an example. TSMC built a semiconductor plant in Arizona, and by the time they were done it cost four times more than in Taiwan. Some of that is labor, some of that is permitting, some of it is government. We are not competitive globally against our key partners and competitors with respect to costs and timing.

Mr. FRY. Thank you for that. And you also mentioned the potential for AI to help manage and secure our grid. What role do you see for the Federal Government in AI-enabled grid modernization, particularly for regions like mine in the southeast that are growing so rapidly?

Dr. SCHMIDT. So way back when, before all this was well known, Google did an initiative where we looked at our data centers— which had been designed by the very best scientists, according to us, you know, in our own arrogant way—and we applied our own AI. And it beat our own top people by 15 percent. That 15 percent of efficiency went straight to the bottom line. It showed me that you can take any system and, using AI, do more what is called predictive analytics, and you can predict loads and basically shed loads and handle it much more efficiently. That is where our grid needs to be.

Mr. FRY. Thank you.

Mr. Chairman, I have many more questions, but I got 15 seconds. So with that——

Mr. GUTHRIE. Will——

Mr. FRY [continuing]. I will yield back.

Mr. GUTHRIE [continuing]. You yield to me?

Mr. FRY. Yes.

Mr. GUTHRIE. My purpose—for Mr. Menendez—for asking Dr. Schmidt to be here is not to come as a Republican witness and not tell us what we want to hear, but tell us what we need to hear. And I think we have all heard some things that probably don't fit within our ideology, but things we needed to hear and we can figure out and work through.

So time has expired. I yield back, and I will recognize—I am sorry, I apologize to Mrs. Fletcher for missing her last time. But Mrs. Fletcher, you are recognized for 5 minutes.

Mrs. FLETCHER. Thank you so much, Chairman Guthrie. I appreciate it. And I appreciate all of our witnesses for being here today and for your testimony.

I think this has been a really useful and important hearing. You have given us lots to think about, and we have heard from all of you, right, that the United States is really on the brink of an AI revolution, that there are many things we need to be thinking about, and just kind of the transformational change that this is going to bring, including demand for energy.

And in normal times that should be great news for my home state of Texas, where we already have a growing industry, a cluster of data centers, and we have the energy resources and the know-how to meet this sort of record high demand. But President Trump's policies are eroding the certainty and predictability that the people who run businesses and make investments need to succeed at every turn. And this is particularly true when it comes to building our infrastructure for our energy to meet tomorrow's demand. So I want to focus a little bit on that.

But Mr. Schmidt, I really appreciated your opening testimony today before the panel, and I wrote down a few things that you were speaking about that I want to follow on. And you mentioned— you referenced sort of the balance of power globally, and I think we

can all acknowledge that we are in a very uncertain and shifting moment in our history. It is changing minute by minute.

And—but you said something I thought that was really important, kind of—that I want to ask you about that in the context of something you said in your written testimony, which really struck me. And I am just going to quote from your testimony, but you said, "The Government can't win this technological race alone. We must reignite America's unique innovation power, the potent collaboration between government, private industry, and academia"—and I won't read the whole quote in the interest of time.

But before I served on this committee, I served on the Science, Space, and Technology Committee, and I was struck at every single hearing by the witnesses. We always had a witness from academia, from the Government, and from industry talking about how well and efficiently and effectively they collaborated.

And so I assume that you would agree with me that the disruptions that we are seeing are challenging in this moment. I assume you would agree with me that regulatory certainty is an important factor for private industry and attracting capital and to projects.

That is yes?

And I assume you would agree that the supply chain disruptions and other kinds of things that we are experiencing are going to hurt productivity.

Dr. SCHMIDT. Yes.

Mrs. FLETCHER. I also assume that you are aware, based especially on your testimony about your involvement with the Mayo Clinic, that you are aware of the cuts to academic research that are happening. Whether it is through the NIH and the cost sharing for medical research or grant funding at various institutions, I keep hearing from my constituents in every industry that the increased uncertainty that we are experiencing as a result of this administration's policies—these are all new changes this year—is really an impediment.

And so I just want you to elaborate with the time we have left, which is about 2 minutes, on your vision for revitalizing the partnership that you described between industry and academia and the Government, and then share your thoughts on how we can and should do that in this environment, and what kinds of changes we should make to make that possible.

And I know we don't have everybody in the room today, but I have heard our colleagues on both sides of the aisle are listening, and I think your insights here would be really important.

Dr. SCHMIDT. Thank you. The—Vannevar Bush post-World War II constructed the sort of structure that you are describing. The Government is a regulator and a proposed—and a proponent, and also does basic research funding. Universities do that research, and then venture capital takes huge risks to do this.

You see this in traditional Democratic areas, but also Republican areas. For example, fracking was an American invention following the same problem, and it produced enormous benefits to America by virtue of economics and so forth. Everybody is aware of that. We are now essentially energy independent.

So the role of innovation is core. I call this innovation power. I have written about this at some level. The future of America will

be determined about the rate at which we can innovate. And we have, unfortunately, somebody who is trying to copy us and moves very quickly. Their innovation model is more centralized, but they are plenty smart, they got lots of resources, and they are very focused, and they do all the right things with respect to—of course, it is not a democracy—getting the right smart people in the right place. They produce national champions, as Alex mentioned, and they push them and they push them hard for globalization.

China is now, in fact, overbuilding manufacturing so that they can essentially become the world's manufacturer, again, with huge impacts economically to everybody. You see the power of innovation right in front of you there in China. Why are we not going after that in AI? We should. We invented it. It is right in front of us. It is the core of everything we can do, new developments in physics and biology and science and so forth.

The current administration's cuts—the 15 percent indirect cost recovery, the NIH costs—are not consistent with that vision. If they have a problem with specific programs, do it specifically, not generally.

Mr. GUTHRIE. Thanks.

Mrs. FLETCHER. Thank you so much. I have gone over my time. I really appreciate it.

Mr. GUTHRIE. Thank you, I appreciate——

Mrs. FLETCHER. And Chairman Guthrie, I yield back.

Mr. GUTHRIE. I appreciate it very much. The gentlelady yields back.

Mr. Evans, you are recognized for 5 minutes.

Mr. EVANS. Thank you, Mr. Chairman and Ranking Member, and, of course, to the witnesses for taking the time to testify today.

Dr. Schmidt, my first question will be to you. In your testimony, you talk a lot about China's investment in a lot of different forms of energy like wind, solar, and newer technologies like fusion. The United States has made similar investments in the past several years, but I think it is also important to highlight that not all energy is necessarily created equal.

And so the first question to you is, in your opinion, which nation has brought more dispatchable baseload energy generation online over the last 5 years between China and the U.S.?

Dr. SCHMIDT. It is almost certainly China.

Mr. EVANS. And then, in your opinion, which nation has taken the most dispatchable baseload energy offline in the last 5 years?

Dr. SCHMIDT. Almost certainly the United States.

Mr. EVANS. Thank you, and I agree with your answers there. Obviously——

Dr. SCHMIDT. I should include Germany for shutting down all of its nuclear plants, which was also a mistake.

Mr. EVANS. Thank you. But yes, I agree with your answers there.

We know that China's thermal power generation has reached a record high just last year, and that is driven by things like coal-fired plants, which have also reached a record high as a percentage of what it is generating in China.

And by comparison, the United States is on track to retire 12.3 gigawatts of dispatchable power this year. And for me personally, that is concerning because over 10 percent of that—about 1.3 per-

cent of that is retirements of dispatchable baseload power that is taking place in Colorado, even though we are only 1.3 percent of total energy production in the United States.

So with that focus on Colorado, the next question to you is, we are taking over a gigawatt of power—or scheduled to take a gigawatt of baseload power offline in Colorado this year, 5 gigawatts of dispatchable baseload power offline by 2030, at the same time that my Governor is saying he wants to make our State a—or, excuse me, a hub for quantum technology and AI.

So the question to you is, if you wanted to be your State—make your State a leader in quantum computing AI, what would be the energy policy that you would want to see to support that?

Dr. SCHMIDT. It probably makes sense to retire the coal plants and replace them by natural gas plants. It makes sense in Colorado because you have such great natural resources to work on enhanced geothermal. So there are things that you can do.

But the core message, I think, from the entire panel here is we want more of everything, right, and that we want it sooner. And not only do we want it, we need it for American exceptionalism.

Mr. EVANS. Thank you, and I appreciate your reference to the gas plants, because my district is truly an all-of-the-above energy district: 83 percent of the oil, 56 percent of the natural gas in Colorado, largest wind generating, you know, the wind turbine manufacturing facility probably in the United States is headquartered in my district. Geothermal, solar, we truly are an all-of-the-above.

But specifically with gas plants, one of the things that I have heard there is that there is a major backlog in getting the gas turbines. So can you speak a little bit more to the timing of retiring coal generation if you don't have a gas alternate immediately ready to go?

Dr. SCHMIDT. I am not enough of an expert to give you a precise answer. The reason that natural gas plants have become more expensive is demand, which is—and is sort of what we want, right? We want more of everything, and then the market will react.

The problem is that these things take years to—backlogs get—years. That delay in natural gas plants will hurt AI competitiveness because it is the best source of power in certain situations.

My personal advice is start by—since China is allegedly dumping solar panels, just buy them, right, because they lower energy costs, right? Do whatever it takes to get more power into America—as Mr. Turk says, more electrons.

Mr. EVANS. Thank you for that.

Mr. Wang, kind of pivoting off of that conversation, I am just curious if you can speak to—in my remaining 45 seconds—just briefly, what happens if we lose this AI race with China?

What does the world look like if China becomes the leader in that space and no longer the United States in part because we retired too much power?

Mr. WANG. I spoke to this, and I think Dr. Schmidt made some relevant comments that, you know, AI is on the brink of becoming a very, very powerful technology that is much more than just ChatGPT. It is a reasoning engine. It has the ability to, you know, very soon conduct cyber attacks, you know, be really a very important technology for national security.

So to sum it up, I guess, in 10 seconds, you know, in a world where the Chinese Communist Party wins, they have clear intention to utilize AI as a mechanism to export their ideology globally, as well as potentially, you know, enable them and other authoritarian countries to lead.

Mr. GUTHRIE. His time has expired on this. So thank you, Mr. Evans. He yields back. We are trying to keep—we have three more to go, Mr.—Dr. Schmidt.

So Mr. Landsman.

Mr. LANDSMAN. Thank you, Mr. Chair, and thank you to all of our panelists for your testimony today. This has been incredibly helpful. And, you know, the issue of AI is one that, you know, we have to get right. There is no debate about that. Winning on AI and harnessing it for good requires, as you all have said very, I think, impactfully, clear instructions and guidance and meaningful investments.

Mr. Turk, let me start with you. Congress has struggled to do this, and I am not picking a fight here, I am not leading you in any direction. I am genuinely curious.

What do you think the barriers are, in terms of us laying out that clear guidance and making the necessary investments?

Mr. TURK. So the good news is Congress provided that certainty, provided that window of investment. That is one of the brilliant parts of the legislation that you all passed on the tax credit side to have tax credits in place for 10 years that investors, that developers, that utilities, that AI companies can rely upon and know will be there so that they can make investment decisions that will come to fruition over a period of years.

So the good news is the biggest thing you have to do at this point is leave those tax incentives, let that grant money do what the grant money was intended to do by Congress, but just execute on that.

Mr. LANDSMAN. That is on the investment and—so thank you for that—on the investment and—piece of this. But on the clear instructions and guidance, I mean, what do you think is holding us back from providing that framework that everyone has been asking for?

Mr. TURK. Well, this is where the private sector will do what the private sector does best. When it has that certainty, it doesn't have the chaos from tariffs, it doesn't have the chaos from repeal of provisions.

I also completely agree with all the panelists. I don't think there is disagreement. We need to build, and we need to build quicker in this country, including transmission, but a whole range of clean energy resources. Permitting takes too long in our country. It is complicated. We have made some progress on that, but we need to make more progress.

Mr. LANDSMAN. I totally agree.

Mr. TURK. To make it durable it needs to be bipartisan. And so I know there is conversations happening. We just need to get on with it.

Mr. LANDSMAN. Mr. Schmidt—thank you, I agree with that.

Mr. Schmidt, I—can you just talk a little bit about how important talent is? You discussed it earlier, but how important talent

is to this whole process and the impact of the chaos around the administration's immigration policies.

Dr. SCHMIDT. So Silicon Valley and the world I represent is powered by the smartest people, or at least the self-proclaimed smartest people in the world. And we collectively need them because the algorithms and the approaches we take are incomputable by normal people. I don't understand what most of these people are doing, and I have a Ph.D. in this area.

Mr. LANDSMAN. Yes.

Dr. SCHMIDT. That is how complicated this stuff is. The new AI stuff is largely math, and it is a new set of math. In fact, there are people who are working on what are the limits of AI using—again, trying to find out where the—really, limits are. All of that knowledge is in the heads of people around the world who are highly specialized. They are not normal people. They are just geniuses in one way or the other, men and women. I want all of them here. It is insane to not let them in here.

If you look at polymaths—I wrote a book on this called "Genesis," and we studied polymaths. A single polymath, the person who invents something—this is the Leonardo da Vinci-type person—can generate a $1 trillion industry. Carver, Mead, and so forth in the 1970s invented semiconductors, now a multitrillion-dollar industry. We need those people in America. Imagine if each and every one of those people did not live in America, they lived in another country, and in particular China.

Furthermore, we have lots of evidence, for example, that the quantum lead that China now has occurred because a specific quantum physicist was not allowed to stay in the country, and he said, "OK, I will go back and work for China," and the rest is history. And quantum is a huge national security issue for America right now.

Mr. LANDSMAN. Thank you for that. Also, Dr. Schmidt, I just wanted to talk a little bit about the prices. I only have a few seconds, but prices have gone up, electricity prices in Ohio, and obviously this is going to cause even more pressure on prices. Is it the tax credits? And is that the most important thing we can do to keep prices down, or do you want Congress to do more?

Dr. SCHMIDT. I want more supply.

Mr. LANDSMAN. Yes.

Dr. SCHMIDT. More supply should lead to better and tougher competition and more—a more dynamic network, which would allow vendor choice.

The way—the Congress should not set prices. The Congress should enable competition at every level in the value chain in every industry, and in particular in electricity.

Mr. GUTHRIE. Thanks. We have two more. Two more. If somebody else comes in after, we are going to excuse you, Dr. Schmidt, and we will keep going.

But Mr. Griffith is—thanks for yielding back. Mr. Griffith is recognized for five.

Mr. GRIFFITH. Thank you very much. Let's continue talking about prices.

So it makes absolutely no sense to retire a coal plant, let's say, that was opened up in 2012 or 2013 that has a life expectancy of

more than 50 years because we have decided we hate coal. Isn't that right, Mr. Schmidt—Dr. Schmidt?

Dr. SCHMIDT. It has to do with how long—it is a more complicated answer.

Mr. GRIFFITH. OK.

Dr. SCHMIDT. It has——

Mr. GRIFFITH. So for the question—let me cut through some of the complications. For the question that Mr. Landsman asked, he said our prices are going up, what do we need to do, you said we need more supply. I agree with that.

But also, we can't leave stranded assets out there, because this was opened up in my district in 2012 as the cleanest coal plant at the time in the world, and—a very clean plant, and it is underutilized right now, and there's movements afoot to have it close up early, and that takes power away from us, and that affects prices because the consumer not only can't access the power because there is not enough supply—which you just said—but it also puts them in a situation where they are paying for the stranded asset of the existing coal plant and the new plant that might replace it with whatever fuel source it uses, whether it be nuclear, which I am also in favor of, or whether it be natural gas, or whether it be wind or solar.

That is fairly straightforward, isn't it? Because if you leave the stranded asset, the ratepayer is paying for both the old and the new.

Dr. SCHMIDT. I grew up in the coal country of Virginia, so I do understand.

Mr. GRIFFITH. Oh, what county?

Dr. SCHMIDT. Blacksburg.

Mr. GRIFFITH. OK. Well, they did have coal mining there at one time, but, yes, I represent that area. That is my district.

Dr. SCHMIDT. The important thing about coal is that over the long run coal is going to get regulated out, because it is such a—coal is much dirtier than natural gas.

Mr. GRIFFITH. Yes.

Dr. SCHMIDT. You would always choose natural gas over coal if you made that decision today.

Given that you have an underutilized coal plant, I would encourage you to look at the network interconnect. Why is it not fully used? Why are we not taking that resource that you described and fully using it right now?

Mr. GRIFFITH. Because we are overregulating coal. I will just answer that one for you.

Now, I also have—and this gets to be interesting—I have an underutilized natural gas plant as well in the area, and so we are trying to attract investment into that region that you grew up in. Blacksburg is a wonderful town. I also represent the coal fields where they still produce the coal and natural gas as well, because of our coal bed methane. And we have got a natural gas facility that used to be a coal facility—it was converted—that is also underutilized.

And we would love to see folks take a look because, as you know, having come from that region, these are very industrious people. And whether or not they have that diploma, I am reminded of the

scene in "The Wizard of Oz," that there is a lot of smarts out there, and I believe that both data centers and AI could benefit by being in the region.

But when you close down these facilities—and I understand you have a preference for natural gas, and I understand that. But when you close down these facilities, that creates a problem, because wouldn't you agree we—right now, in the last year, the American Electric Reliability Corporation's long-term assessment estimated that 115 gigawatts of dispatchable generation is planned to retire over the next 10 years, in comparison to what they estimate to be an increased demand of 150-plus gigawatts. Doesn't that impede or make it more difficult for us to have space to grow AI and power our AI as we need to?

Dr. SCHMIDT. Again, I think all of us believe in more.

Mr. GRIFFITH. Yes.

Dr. SCHMIDT. With respect to the specifics, you have regulatory issues which you pointed out, which I think should be loosened. But I also think the long term for coal is to be replaced by natural gas, and I think we should get organized around that. And eventually, natural gas will be replaced by fusion, which will ultimately solve all of our problems 15 years from now.

Mr. GRIFFITH. Yes, I am looking forward to fusion getting here. I hope that you are right on your estimate.

I would say this, as well, because so many times people hear statements like that in my district, and they automatically assume that that means coal production is going to end, and they don't realize that what you are talking about is coal production for the creation of electric generation. And my district has a rich seam, as you are probably aware, of metallurgical coal, which for those who don't know, means that we mined that coal to make coke and steel out of it so that we can produce the steel that is needed for this country. I think somebody mentioned it earlier today that we need the steel so we can make sure we build the equipment and so forth to do the AI with, the buildings, et cetera. And you are not going to make that really good steel without burning some of my metallurgical coal.

I yield back, Mr. Chairman.

Mr. GUTHRIE. The gentleman yields back, and the Chair recognizes Ms. McClellan——

Ms. McCLELLAN. Thank you, Chairman.

Mr. GUTHRIE [continuing]. For 5 minutes.

Ms. McCLELLAN. Thank you, Chairman Guthrie and Member Pallone, for planning this hearing. This is probably my favorite hearing of my entire almost a little over 2-year congressional career. It is definitely the most important.

And Dr. Schmidt, I am glad you stayed, because in your opening statement you said that the sheer speed of AI development is outpacing our societal and government ability to adapt, and I wholeheartedly agree with you. In fact, 7 years ago, in 2018, I attended a conference at which a speaker was talking about the rise of AI and megatrends and all of these things, and he basically said the same thing. And I came to the conclusion 7 years ago that none of our systems in the United States at all—government, education, none of them—are prepared for what is coming.

But at the same time, as Mr. Wang testified, at that point 7 years ago China already had an AI master plan, advanced capabilities, and President Xi Jinping declared China's plan to dominate AI by 2030. Yet this committee held its first hearing on AI in 2023. The race for AI dominance is reminiscent of the Space Race, but instead of the Soviet Union, now it is China.

But the stakes are even higher. And we won the race to land a man on the moon, and that was critically important to our economy and our national security and innovation and scientific advancement. And to win the race for AI is just as important.

But as Mr. Wang testified, while the U.S. leads on computing and we are tied with China on algorithmic development, China leads on data, which is the raw material that enables AI to learn, adapt, and improve over time and, as Mr. Wang said, is AI's oil, gas, wind, solar all wrapped in one. So if we lose the race to lead data, we lose the race for AI dominance.

Now, the Trump administration's actions since January 20th have directly undermined our ability to win the race for AI dominance. The haphazard firing of Federal workers, freezing or cutting Federal funds for government agencies and universities critical to supporting competing AI hinders our ability to implement the recommendations of Mr. Wang's testimony and his four pillars to win.

This war on renewables that the President has engaged in and attempts to repeal the Inflation Reduction Act tax credits undermine the ability to meet our energy demands for data centers. And Trump's reckless tariff policy is increasing costs, exacerbating supply-and-demand issues already occurring, and raising the cost to build new data centers and semiconductor manufacturing plants that are critical for our AI success. Because while semiconductors have been exempted from the tariffs, the equipment and machinery used to build and run the data centers have not.

This is not theoretical. Just this week, Microsoft announced that it is backing off plans to build three data centers in Ohio. So, given this committee's clear desire to position the U.S. to win the competition with China for AI dominance, I am perplexed by my colleagues on the other side of the aisle's silence over the Trump administration's actions that hinder our ability to do so, and the blank check it looks like we are about to give the President to take those actions.

So Mr. Wang, you offer two options for AI dominance in the future, and recommend working with our allies to promote an American model of AI technology. But this trade war is actively undermining our ability to work with our allies to do so. Can you elaborate quickly on the steps that we should actually take to work with our allies to promote a U.S. model of AI usage and governance?

Mr. WANG. Yes. So the first thing is we need to ensure that NIST, the National Institute of Standards, is properly resourced and we are able to make progress on AI measurement science and, ultimately, the development of these AI standards.

Then we need to codify this into a set of standards that we ultimately agree with in terms of how we should measure AI performance, how we should—what are the characteristics of safe and performant AI systems in the future, and then we should utilize the global network of AI safety institutes, which is—which already

exists. Many, many countries have stood them up, you know: France, the UK, Japan, India, Korea.

I have met the heads of many of these AI safety institutes. They are all looking towards the United States because, you know, they understand that we are the leader in the technology, and we need to give them our standards and export it globally.

Mr. GUTHRIE. Thank you.

Ms. MCCLELLAN. Thank you, and I yield back.

Mr. GUTHRIE. Thank you. The gentlelady's time—I had committed to Dr. Schmidt that he got—we have—Dr. Schrier did come in, but I committed to you, Dr. Schmidt, to leave.

You—Dr. Schrier, you are recognized for 5 minutes.

And if anybody else shows up, you are—I will let you walk out and go. Thank you for your—because it has been valuable. I will shut up and let her go.

Ms. SCHRIER. I am so glad you are staying.

Let's see. Thank you. Thank you, Mr. Chairman, and thank you to all our witnesses. This is a fantastic hearing.

I am from the Pacific Northwest, and chip manufacturing and data center expansion are the big energy demand drivers to the region, so I am thrilled to have this discussion.

We are at this inflection point. We all know that we are really headed straight to an energy crisis if we don't act quickly on this. It impacts AI and data centers, as we have heard a lot about, but also we have been talking nationally a lot about manufacturing, and we need affordable energy for that.

One of the best ways to maximize access to the power we already have in the U.S. is strategically building out transmission. And last year Senators Manchin and Barrasso introduced the bipartisan Energy Permitting Reform Act, and I will be really clear it is not the bill I would have written. I was not a fan of all the provisions. But we need to move forward, and that is the whole idea, that we need compromise in order to move the ball forward.

Mr. Bhatia, in your testimony I see this prime example that you have talked about a couple places, a couple times, where this bill for speeding permitting would make a difference. It was the Boardman to Hemingway transmission project that connects Oregon to Idaho. And in the Pacific Northwest our peak energy demand is in the winter, when we turn on the heat, and yet we have our peak hydropower generation in the warmer months, when the snow melts. The opposite is true in the mountain region, where we see the opposite. So irrigation and air conditioning drive that demand and in the summer, and then wind energy is more abundant in the spring and winter.

So connecting those two regions would allow us to correct this mismatch and meet the demand. The project, as you said, is about to hit its 21st birthday, and it has been stalled for almost 21 years.

If we continue to require transmission projects to jump through all of these hoops and red tape, how is that going to hamper our ability to onshore tech, keep onshore tech, and expand manufacturing here at home?

Mr. BHATIA. Well, absolutely, you know, EPRA is something we are absolutely supportive of because what it is going to do is exactly what you mentioned. You know, we have talked about invest-

ing in the grid, we have talked about modernizing the grid, creating more flexibility so that you can balance supply and demand.

And, you know, the big data centers, certainly the large semiconductor manufacturing which we are under construction right now in Boise of what will be the largest—the only large-scale memory manufacturing facility in the country, the first leading-edge one in more than 25 years—needs that transmission to be able to ensure that we can have that stable power for the consistent and long-term load growth that we have.

Ms. SCHRIER. And Dr. Schmidt, basically, same question. If we don't have good transmission and the ability to move energy across the country, how does that impact our ability to remain dominant and win the AI race?

Dr. SCHMIDT. When I think about your State, I think about all of the incredible natural resources you have, whether it is the west or east part of your State. That power does not have the path out of your State that is strong enough. It needs to get fixed.

Ms. SCHRIER. Yes, thank you.

I just want to emphasize for my Republican colleagues that if they introduce a bill like that one, they will have Democratic partners because we all understand, especially after this hearing, that we need to get——

Mr. BHATIA. If I could just add one more, just one more thing to add to this.

Ms. SCHRIER. Yes.

Mr. BHATIA. It is not just about the success of those projects. I know we are talking a lot about AI, but it is about jobs that are being—that all of this investment in manufacturing are going to be creating, high-paying jobs, higher-paying jobs in—today.

And domestic supply of semiconductors, while critical and important for AI, is also critical for many, many other industries that we haven't been able to talk about. The automotive industry, for example. Fifty percent of the cars on the road have a chip made in Micron's facility.

Ms. SCHRIER. That is right, and we need to manufacture——

Mr. BHATIA. And so there are many, many industries that need these projects to be successful.

Ms. SCHRIER. I am going to turn one more question quickly to Dr. Schmidt.

AI, as I read in Dr. Wang's testimony—Mr. Wang's testimony—brings potential benefit, potential risk. We have seen the abuse of AI in China for public surveillance and crackdowns. Now, unfortunately, I am having to think about that in our country, too, with what we are seeing now as suppression of dissent and retribution efforts to crack down on free speech and stymie scientific research, target nonviolent university protesters who I may not agree with, but we all have the First Amendment rights.

And we have also seen insurance companies with Medicare Advantage use AI to deny or delay coverage. So as you think about—we only have—we actually don't have any time. If you could write me an answer to what you would suggest for guardrails for AI as we move forward, we want to be able to keep up and do this wisely.

Dr. SCHMIDT. I will do so. Thank you very much.

Ms. SCHRIER. Thank you.

Mr. GUTHRIE. All right. Seeing no further folks here to ask questions, I ask unanimous consent to insert in the record the documents included on the staff hearing documents list.

Without objection, that will be the order.

[The information appears at the conclusion of the hearing.]

Mr. GUTHRIE. I remind Members they have 10 business days to submit questions for the record, and I ask the witnesses to respond to the questions promptly.

Without objection, the committee is adjourned.

[Whereupon, at 2:30 p.m., the committee was adjourned.]

[Material submitted for inclusion in the record follows:]

U.S. House Committee on Energy and Commerce
Full Committee
"Converting Energy into Intelligence: the Future of AI Technology, Human Discovery, and
American Global Competitiveness."
April 9, 2025
Documents for the Record

1. Report entitled "The Electricity Supply Bottleneck on U.S. AI Dominance" March 2025, submitted by Chairman Guthrie.
2. Letter to Chairman Guthrie and Ranking Member Pallone from the Digital Energy Council, April 9, 2025, submitted by Chairman Guthrie.
3. NERC report entitled "2024 Long-Term Reliability Assessment" December 2024, submitted by Chairman Guthrie.
4. CATO Institute Policy Analysis report entitled "The Budgetary Cost of the Inflation Reduction Act's Energy Subsidies" March 11, 2025, submitted by Chairman Guthrie.
5. Letter from SAFE to Chairman Guthrie and Ranking Member Pallone, submitted by the Majority.
6. Report from the Environmental & Energy Law Program at Harvard Law School entitled "Extracting Profits from the Public: How Utility Ratepayers Are Paying for Big Tech's Power" March 2025, submitted by Rep. Castor.[1]
7. Article from Reuters entitled "Exclusive: Micron to impose tariff-related surcharge on some products from April 9, sources say" April 8, 2025, submitted by Rep. DeGette.
8. Article from PoliticoPro entitled "Why Trump's tariff and tax policies could derail efforts to boost US power supply" April 8, 2025, submitted by Ranking Member Pallone.

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[1] The report has been retained in committee files and is included in the Documents for the Record at
https://docs.house.gov/meetings/IF/IF00/20250409/118133/HHRG-119-IF00-20250409-SD095.pdf

The Electricity Supply Bottleneck on U.S. AI Dominance

By Cy McGeady, Joseph Majkut, Barath Harithas, and Karl Smith

It is now well understood that the rapid technological progress of artificial intelligence (AI) has profound energy sector implications. AI technology is effectively the result of three inputs: chips, data, and electricity. This paper focuses on electricity on the basic premise that electricity supply is the most acutely binding constraint on expanded U.S. computational capacity and, therefore, U.S. AI dominance.

This paper starts with a survey of demand-side forecasts. It then highlights data on the geographic distribution of data center development currently underway in the United States, the supply-side dynamics underway in response to demand growth, and challenges to meeting this new demand. The role of coal, gas, renewables, and nuclear power in meeting new demand are each assessed. The central principle for understanding these developments is speed-to-power, or the measure of how fast a potential data center site can access the electricity needed to power its stock of chips.

Speed-to-power should likewise be used to organize federal policymakers' approach to permitting policy and use of emergency authorities in the near term. On the other hand, five years from now is tomorrow in the power sector. A severe near-term supply crunch must not distract policymakers from the need for long-term thinking in the electricity sector. Numerous long-standing policy challenges in the power sector deserve renewed attention, including gas-electric coordination, interregional seams management, and improved cost efficiency in transmission planning. This paper closes by proposing several new policies and authorities that contribute to these issues, but which are primarily organized around establishing U.S. electricity supply dominance in a bid to advance U.S. AI leadership. A new era of electricity-intensive economic growth has arrived, and the need for strategic thinking in the electricity sector has never been greater.

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The Age of AI and Electricity Demand

The basic reality of a surge in data center-based electricity demand has been confirmed by a wide range of work from the private sector, civil society, and national labs. Recent **estimates** from the Lawrence Berkeley National Laboratory (LBNL) place electricity consumption by data centers at 176 terawatt-hours (TWh) in 2023, representing 4.4 percent of total U.S. electricity demand.

Table 1: Data Center Electricity Consumption Forecasts

Group	Forecast Subject	Current Value	Forecast Value	Growth Value
CSIS (author's analysis)	U.S. AI data centers	4 gigawatts (GW) in 2024	84 GW by 2030	2,100 percent
LBNL	U.S. data centers	20 GW in 2023	74 to 132 GW by 2028	370–660 percent
RAND	Global AI data centers	11 GW in 2024	68 GW by 2027 and 327 GW by 2030	618 percent
SemiAnalysis	Global data centers	49 GW in 2023	96 GW by 2026	196 percent
BCG	Global data centers	60 GW in 2023	127 GW by 2028	212 percent
McKinsey	Global data centers	55 GW in 2023	171 to 219 GW by 2030	311–398 percent
Goldman Sachs	Global data centers (excluding crypto)	400 TWh in 2023	1,040 TWh by 2030	260 percent

Source: Authors' analysis.

The range in future estimates of AI power demand highlights the complex set of factors—hardware technology, algorithmic progress, commercial strategy, economy-wide uptake of AI, and power sector capacity—that interact to create uncertainty over the exact trajectory of electricity demand from the computation sector. The sector is attracting enormous volumes of **capital investment** and competition is driving rapid innovation throughout the ecosystem. Developments including sudden efficiency jumps such as those achieved by **DeepSeek** or progress on **distributed data center training** capabilities are to be expected. Such developments will impact specific firms, commercial strategies, and technology paths, but are indicative of continued sectoral scaling rather than signs of imminent sectoral crash correction. Policy should see past short-term perturbations and grasp that growth is the definitive long-term direction of AI technology and computation demand.

Despite the dynamic nature of the current moment, policymakers can be certain a new era of electricity demand growth has arrived. Data from SemiAnalysis, which provides best-in-industry tracking of chip production, chip orders, and individual data center developments, shows that **over 80 GW of data center capacity** under various stages of development could be brought online in the United States by 2030. These facilities could consume over 800 TWh per year, which alone represents a 3 percent annual growth in total U.S. power demand. The biggest risk to this forecast is in the electric power sector's ability to serve this demand.

The U.S. electric power sector is facing a stunning and sudden paradigm shift. For roughly two decades, top-line national electricity consumption has **stagnated**, growing at a compound annual growth rate of nearly 0 percent since 2007. The electric power industry as a whole has been decelerating since the 1970s; recent decades of near-zero demand growth follow decades more of steadily declining growth rates. Multiple generations of commercial strategy, regulatory norms, and policy debates have been conditioned by this seemingly inexorable trajectory and are now out of date.

This **story** extends beyond AI. Electricity demand is also growing from other electricity-intensive industries like semiconductor fabrication and battery manufacturing. The broad political consensus to reindustrialize the U.S. economy will drive growth in energy-intensive industries like mining, minerals processing, metallurgy, and beyond. A deep technological trend toward electrification means industry, along with the transport and heating sectors, is growing more electricity-intensive each year. Successfully navigating a new era of electricity demand growth will deliver the United States a lasting advantageous position in the **technological commanding heights** of the future.

The Future of Data Center Demand

Today, access to electricity supply is the binding constraint on expanded computational capacity and therefore on continued U.S. leadership in AI. This fact is demonstrated by a total focus among data center developers on "speed-to-power." Speed-to-power is the time it takes a potential data center site to receive access to electricity supply. In Northern Virginia—the nation's and the world's largest data center market—speed-to-power is growing worse, as data centers now face electricity supply **wait times** up to 7 years.

For data center developers, speed-to-power far outweighs other factors like the price of power or access to land. Even access to high-end chips is a secondary concern, as hyperscalers cannot access enough electricity supply to power their existing stocks of chips. An example of the high value placed on speed-to-power relative to price is the xAI **data center facility** in Memphis, Tennessee, which, due to long wait times for grid-supplied power, instead rented road-portable gas-fired generators which operate at far higher unit costs than large grid-connected combined cycle power plants. The race for progress on the AI frontier and the rapid growth in computational demand for AI services make speed-to-power the central principle driving data center investment in the near term.

Data from SemiAnalysis again provides **clear indications on the scale and distribution** of this demand boom. Virginia, already the world's largest data center market, is on track to see enormous growth over the next five years and will remain the country's most important computing cluster. Despite severely constrained power supply data centers continue to expand in the area **because** of access to key internet infrastructure such as fiber networks, latency, and other provision of service

considerations. By 2030, the region could **host** 20 GW of data center capacity. A central policy objective for federal AI strategy should be to improve speed-to-power for this computing cluster.

Table 2: Data Center Boom by Region (Active and Planned Capacity, GW)

Region	2024	2030	Growth
Southeast	13	49	36
West	12	43	31
Midwest	7	30	23
Northeast	1	3	2
U.S. Total	32	124	92

Source: "Datacenter Industry Model," SemiAnalysis, February 2025, https://semianalysis.com/datacenter-industry-model/.

Those data centers that are not constrained by service provision concerns, such as data centers dedicated to model training, are seeking out new geographies that offer faster speed-to-power. SemiAnalysis shows that **twenty-nine states** are slated to see over 100 percent growth in hosted data center capacity. States like **Louisiana** and **Mississippi** currently host no data center capacity and have recently attracted multi-gigawatt datacenter investments. Despite a flight to new geographies, computing capacity will remain regionally concentrated. By 2030 just nine states will host 70 percent of the nation's data center capacity. Virginia and Texas are the standouts, projected to together represent 34 percent of the nation's data center capacity in 2030.

Texas, the Midwest, Southeast, and Southwest stand out as new regions attracting large volumes of data center investment. In contrast, California and the Northeast stand out for low levels of data center development. Data center investment is flowing where state-level power sector policy, permitting, and land-use issues are permissive to a rapid buildout of new generation needed to power new data centers.

The State of National Generation Base

How did electricity supply suddenly emerge as a binding constraint on data center expansion and AI progress in 2025? After all, Energy Information Administration (EIA) **data** shows that since 2010, nameplate generation capacity in the United States has grown by 172 GW to a total of 1,318 GW.

The non-firm nature of wind and solar generation makes nameplate capacity a deceptive measure of the nation's generation base. To maintain reliability, utilities and grid operators account for and plan using the effective capacity of generation resources, which accounts for the likely availability of each class of generation technology during peak demand scenarios. An example is the **Effective Load Carrying Capacity** (ELCC) measures used by PJM, the largest power grid in the nation, in its capacity markets, which are designed to ensure sufficient generation resources to meet demand over the long term. Applying the PJM ELCC factors to the nameplate capacity dataset results in a dramatically different picture of the national generation mix.

Figure 1: U.S. Generation Mix-Nameplate Capacity vs. Effective Capacity (GW)
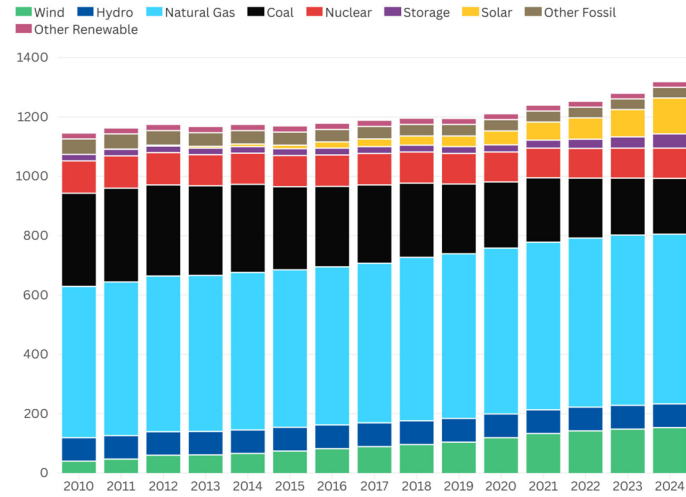
Source: Author's calculations; Preliminary Monthly Electric Generator Inventory, U.S. Energy Information Administration, February 2025, https://www.eia.gov/electricity/data/eia860m/.

Source: Author's calculations; Preliminary Monthly Electric Generator Inventory, U.S. Energy Information Administration, February 2025, https://www.eia.gov/electricity/data/eia860m/.
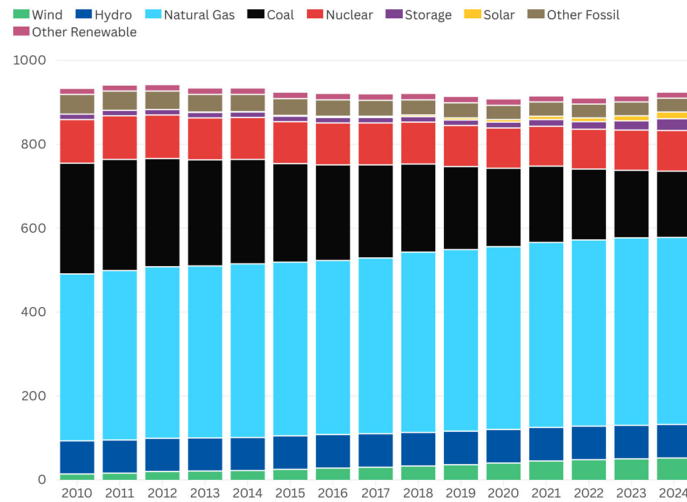
Though this is a rough adjustment—in reality each utility and grid operator employs distinct capacity adjustment factors—the overall effect is directionally correct. The total effective capacity of the U.S. generation base has stagnated since 2010, and it may have even declined. Coal-fired generation with high ELCC ratings (84 percent) has been replaced by low ELCC resources like onshore wind (34 percent) and solar (13 percent). Even dispatchable gas-fired generation (78 percent) has a lower rating than coal and nuclear (95 percent) because of fuel supply and gas-electric coordination **issues** during winter storms.

A stagnant base of effective capacity has only been possible (i.e., compatible with the reliability imperative) because it coincided with a period of near-zero load growth at the national level. And yet, even small amounts of demand growth combined with a flat or declining base of effective capacity equates to thinning reserve margins. This is a finding compatible with **repeated reporting** from the North American Electric Reliability Corporation (NERC) and reports from regional grid operators like **MISO** and **PJM**, which all warn of thinning generation reserve margins. A series of capacity shortfall incidents in California (**2020, heat wave**, Western Interconnection), Texas (**2021, Winter Storm Uri**, Electric Reliability Council of Texas (ERCOT) Interconnection), and the southeast (**2022, Winter Storm Elliot**, Eastern Interconnection) have demonstrated that increasingly narrow capacity margins are leading to reliability failures.

On a national level, there is effectively no "spare capacity." Though regional pockets and individual generators where spare capacity exists, these are exceptions to the broader national trend. Today, every new gigawatt of data center demand must be met with matching new gigawatts of effective capacity sited within the borders of the same reliability planning region. The past failure to grow effective capacity explains why a focus on speed-to-power necessarily follows from the data center boom and AI technology race.

The Coal Option

The sudden emergence of electricity demand growth has definitively slowed the rate of decline in the coal fleet. Major utilities have **proposed** integrated resource plans (IRPs) with **suspended or delayed** coal retirement schedules. **Soaring capacity prices** in PJM have improved prospects for merchant-owned coal plants. Rising market **valuations** for coal plant operators further illustrate the improved economic outlook for existing coal.

As of December 2024, the U.S. coal fleet is **composed** of over 400 units representing 188 GW of capacity. As recently as 2023, **expectations** were for 70-100 GW of this capacity to retire by 2035. The Environmental Protection Agency's (EPA) modeling for its 2024 **greenhouse gas emissions rule** indicated 150 GW or more of retirements were possible by 2035. But the Trump administration's goal to **repeal** the EPA greenhouse gas rule, combined with improving market signals and shifting utility IRPs, means these rapid retirement scenarios are unlikely to materialize. In fact, the Trump administration's exploration of using emergency authorities to keep coal plants open is unlikely to be broadly necessary.

In the near-term speed-to-power era, delayed coal retirements make the problem of supplying new AI demand more manageable. The retirement of a coal plant creates a "backfill" requirement for new generation that delivers the same amount of effective generation capacity. Preserving reliability is the first priority for utilities and reliability authorities, so new generation capacity is generally allocated to

the backfill requirement before new demand customers like data centers. In short, backfill competes with new demand for a limited supply of new generation projects and must always win. Therefore, slowed retirement schedules mean that most new generation resources can be allocated to serve new data center demand, a result which increases speed-to-power for AI data centers.

Improved near-term prospects notwithstanding, the coal fleet is aging and remains in terminal decline. Over 130 GW of the capacity (70 percent of the fleet) is at least 40 years old. Age and declining economic competitiveness with gas and renewables has pushed down utilization; in 2023 the coal fleet nationwide produced at a 42 percent **capacity factor**, down from 61 percent in 2014. Near-term demand growth may drive increased utilization at certain plants, but increased wear and tear brings forward large maintenance investments, which in many cases will bring forward ultimate retirement dates.

At the strategic level, the delayed coal retirement strategy buys time but shifts the challenge to the future. Retirements will slow down in the near term and then accelerate again in the mid-2030s and beyond. As the large effective capacity contribution of the coal fleet rapidly retires in the 2030s, a smooth and low-cost deployment schedule for new replacement generation is essential to maintain reliability. Policymakers need to start planning and enabling investment today to ensure this future.

Gas Boom

A boom in natural gas generation is clearly underway in the U.S. power sector today. Data from the EIA **shows** nearly 30 GW of new gas generations in various stages of development will come online by 2030. A more comprehensive **survey** of development plans from S&P shows over a hundred projects totaling more than 70 GW is possible. The scale of the boom is not without precedent: Over 220 GW of capacity was deployed in the five-year period from 2001 to 2005.

Utilities and independent power producers (IPPs) are turning to gas generation to serve new demand because there is no other technology that brings as much effective capacity online, in as fast a timeline, with as much siting flexibility, under such a manageable financial profile.

Gas generation can be sited at or very near data center sites, which creates grid stability benefits and reduces overall transmission system investment costs. Meta's new 2 GW **data center** in Richland Parish, Louisiana, will host two combined cycle gas plants. Some gas generation will be deployed alongside data centers fully islanded from the grid, a model which avoids interconnection costs and delays. ExxonMobil has **announced** plans to develop 1.5 GW of fully islanded gas generation fitted with carbon capture technology and co-located with data centers, most likely sited in Texas. Siting of gas generation is somewhat constrained by the need to access pipelines for fuel. Ease of access to existing networks and easier permitting explains the strong growth in gas deployment in Texas and the Southeast. With natural gas production booming and prices at or near all-time lows, access to fuel volumes at reasonable prices is a nonissue.

The gas generation boom is creating upstream supply chain constraints. Orders for new gas turbines are rapidly piling up at major manufacturers like **GE**, **Mitsubishi**, and **Siemens**, with these firms reporting order books with delivery now stretching out past 2028. Though construction of a new gas plant can take as little as a year, with these backlogs, a project placing an equipment order today is unlikely to come online until 2030 or beyond. This order backlog inevitably includes a huge number of U.S.

projects at later stages of planning and development, so gas deployment will continue the coming years, but scaling growth rates will be a challenge.

The Solar and Storage Portfolio Play

The gas generation boom goes hand in hand with a boom in solar and storage deployment. Across different states, markets, and policy paradigms, the current economics of power generation technology favor a hybrid portfolio of gas, storage, and renewables. Gas generation delivers the effective capacity necessary to ensure demand can be served under all scenarios. Renewables, particularly solar, deliver ultra-low marginal cost electricity production on rapid deployment timelines, which improves overall portfolio costs, improves speed-to-power, and reduces the emissions profile of projects. Battery storage adds value by smoothing operations through renewable ramping periods, delivers ancillary services like frequency regulation at low cost, and brings option value that improves the overall economic and reliability profile of a generation portfolio.

Dominion Energy, the utility that serves the Northern Virginia data center market, provides an illustrative example. Its 2024 IRP includes **plans** for 6 GW of gas, alongside 12 GW of solar, 6 GW of offshore wind, and 4.5 GW of storage by 2039. Plans from other major integrated utilities like **Georgia Power** and **Duke Energy** also display a similar portfolio approach.

Solar is rapidly coming to dominate the overall market for new generation capacity and increasingly overshadows wind's contribution. A record 30 GW of solar were **deployed** nationally in 2024; in contrast, wind deployment was at its weakest since 2014, at just 5 GW. Transmission system congestion in the nation's best wind resource regions (e.g., the Great Plains) creates long and costly interconnection processes and is a major obstacle to new wind generation. Meanwhile, solar paired with storage, directly on-site or in portfolio, has been shown to greatly **improve** the project value to electricity buyers, which has made such projects more attractive to developers and financiers relative to stand-alone wind development.

The overwhelming dominance of Texas in deploying new generation resources, with solar the dominant category, must be noted. Texas attracts investment with a low-barriers permitting environment, fast access to grid connection under the ERCOT "**connect-and-manage**" model, and plentiful land. In Texas, which is served via a competitive market rather than an integrated utility, interconnection queue data indicates incredible interest in developing solar and storage. As of January 2025, 28 GW of gas, 38 GW of wind, 153 GW of solar, and 165 GW of storage are **active** in various stages of the ERCOT interconnection queue. While many of these projects are speculative and unlikely to come to fruition, the distribution of volumes is a useful indicator: Solar and storage dominate the project development pipeline, though small behind-the-meter or fully islanded gas generation projects are excluded and would likely shift the balance slightly.

Available information about specific data centers shows that companies are building renewables to meet demand. Meta's recently announced 2 GW data center in Louisiana will be **backed** by 1.5 GW of **solar procurement** along with natural gas plants. Project Stargate, a **joint venture** between OpenAI, Oracle, and SoftBank, is anticipating data centers at the 5 GW scale. The project's first site in Abilene, Texas, will be supplied by **solar and storage projects** developed elsewhere in the ERCOT grid alongside on-site gas generation.

Figure 2: Diverging Fortunes for Wind and Solar, by Year and by State
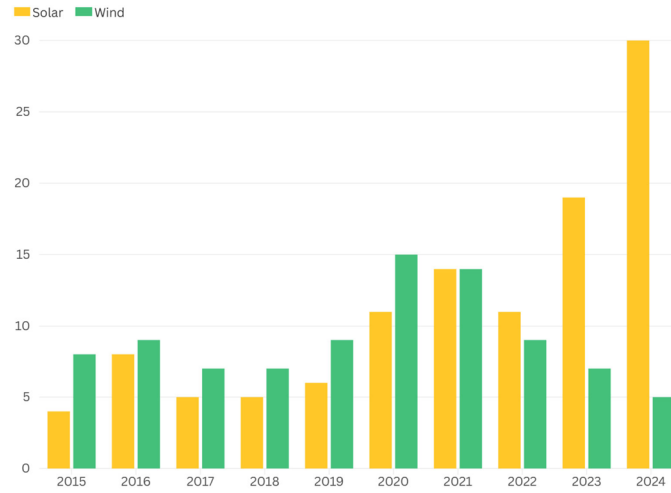
Source: Preliminary Monthly Electric Generator Inventory, U.S. Energy Information Administration, February 2025, https://www.eia.gov/electricity/data/eia860m/.

Source: Preliminary Monthly Electric Generator Inventory, U.S. Energy Information Administration, February 2025, https://www.eia.gov/electricity/data/eia860m/.
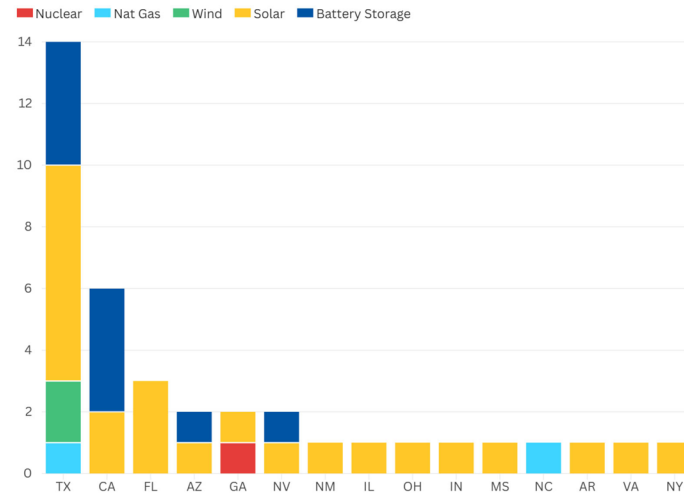
Turning Point for Nuclear

The next five years will be dominated by deployment of large volumes of gas generation, solar, and storage. What, then, is the role of nuclear power? A series of commercial deals announced in 2024 signaled that nuclear power will also be a winner in the new era of electricity demand growth. But nuclear remains–for now–a fundamentally slow-moving technology whose primary contribution will be post-2030.

The first and now easily overlooked shift in nuclear power is the certain end to the era of premature nuclear retirements based on economics. As **recently** as 2021, over 10 GWs of reactors were planning for or at risk of early retirement. The Palisades nuclear plant was shuttered in May 2022 just months prior to the release of ChatGPT in November of 2022, which in many ways marks the start of the AI-fueled electricity demand boom.

The first pathway to "new" nuclear power is through reactor restarts. Microsoft's **deal** with Constellation, the largest nuclear operator in the country, to restart Three Mile Island Unit 1 will bring 835 MW of high effective capacity generation to southeastern Pennsylvania in 2028. Importantly, the plant is located very close to the Northern Virginia computing cluster. The Palisades project in Michigan (800 MW) is slated to **return to service** as early as October 2025. A restart at the Duane Arnold nuclear reactor in Iowa (600 MW) is under **consideration**, but no final investment has been announced. Capacity from nuclear restarts is structurally limited however because all other retired reactors are too far along in decommissioning to be brought back online.

Uprates at existing nuclear plants can deliver relatively small volumes of incremental new capacity. A **recent deal** between the U.S. General Services Administration (GSA) and Constellation will help finance uprates at existing nuclear plants. In 2023, Constellation **announced** an $800 million uprate investment at two Illinois nuclear plants that will deliver an additional 135 MW of capacity. In total, the Nuclear Energy Institute **estimates** that upwards of 3 GW of new uprates are possible.

Truly new nuclear projects will commence in the next five years. Several first-of-a-kind reactor projects are slated to finish by roughly 2030. These include Department of Energy (DOE)-**supported** advanced reactor designs developed by firms like **Kairos**, **X-Energy**, and **TerraPower**. These smaller-capacity and easily replicated (in theory) designs have the potential to radically alter the economics of nuclear energy from that of megaproject to something comparable to a gas-fired combined cycle. It is this theory of scaling that has attracted investment from tech firms like **Google** and **Amazon**. But policymakers should not expect perfect performance from day one from first-of-a-kind reactors. There will **inevitably** be early operational learning and design iteration periods before true commercial scaling commences. Significant contributions to the national generation mix from this segment can only be expected by the mid-2030s.

New large reactor projects, most likely utilizing the AP1000 reactor technology deployed at the recently completed Vogtle plants, are increasingly possible but not certain. New hyperscale data center clusters with demand up to 5 GW in size would appear to be natural matches for large-scale reactors. Abroad, the United Arab Emirates' **deployment** of gigawatt-scale reactors is attracting data center investment from hyperscalers and is a model for the strategic value of large-scale nuclear in the AI era.

Despite a clear economic and strategic value proposition, the sheer size of the capital investment and cost-overrun risks loom large. The **final cost** of the recently completed Vogtle 3 and 4 reactor projects was $32 billion, which includes $18 billion of cost overruns. Illustrative of the challenge are recent **comments** from the CEO of Entergy, which operates multiple nuclear reactors, on prospects for new nuclear projects: "The size of the potential plant could be bigger than the entire balance sheet of the existing company, which just gives you a sense for the scale of risk that might be there for that operating company."

Absent significant policy or commercial developments, it is not certain that new large-scale reactor projects will emerge. Restarting construction at the half-finished V.C. Summer reactor project in South Carolina is a **possibility**. Additional units at Vogtle in Georgia, reactors 5 and 6 at the plant, is likewise a plausible option. Stephen Kuczynski, former Southern Company nuclear chairman who oversaw the completion of Vogtle 3 and 4, **recently characterized** construction risk as "exaggerated" given the enormous and expensive lessons learned at the Vogtle projects. New entities like **the Nuclear Company** propose to innovate on the commercial model as an integrated project developer of large-scale. Combined with growing state-level policymaker **interest**, this indicates a plausible path forward, but more policy assistance may be needed.

Regardless, even in a best-case **construction scenario**, a new AP1000 project will take six years or more, resulting in the earliest possible contribution to the resource mix starting in the early 2030s. A steady scaling of nuclear supply chains, workforce, and technology maturation is crucial for nuclear to play a role in smoothing coal (and existing nuclear) retirements in the 2030s and beyond. Nuclear will play a limited role in the near-term speed-to-power era but could deliver enormous economic and strategic value to the nation over the medium and long term.

Federal Electricity Policy in an AI Era

What can the federal government do to ensure that the United States can power data centers and win the global race for AI? Federal policy must both address the near-term speed-to-power moment and set a long-term course toward a lasting advantage in electricity supply. In the speed-to-power era, permitting, siting, and other permissions are key areas where federal policy can help, while the generation investment choices will largely be made by the private sector and state policy makers (and rely mostly on a gas, solar, and storage expansion).

But in a sector defined by long lead times and long-lived infrastructure–a new nuclear plant or high-voltage transmission line can comfortably last 80 years–policymakers must keep an eye on the future. Investment decisions during the next several years will determine whether the U.S. grid in the 2030s and beyond allows for unconstrained electricity demand growth, at globally competitive prices, with a world-leading reliability profile–or if dramatic load growth leads to instability and internal conflict over a scarce resource.

Federal policy must also work within the framework of energy federalism. Securing U.S. dominance in AI technology is a clear national strategic priority which only federal policymakers are positioned or authorized to pursue. But federal policymakers face a jurisdictional dilemma. Electricity supply–the gating constraint on continued U.S. AI dominance–is primarily the **domain** of state-level authorities. By virtue of the long-standing **Federal Power Act**, authority over retail rates and utility generation

investments lies primarily with state policymakers. Rather than radically altering this framework, federal policy should focus on greatly improving the option set for state policymakers.

Lastly, a key area for attention is minimizing cost inflation for existing ratepayers. Electricity prices are rising rapidly, recently **outpacing inflation**. State legislatures and public utility commissions (PUCs) are facing a wave of **utility investment requirements** that translate into increasing rates. Wherever possible, federal policy should enable and encourage policy that lowers costs for generation and grid investment and reduces ratepayer exposure to investment directly tied to data centers. In cases where projects deliver clear national strategic value in the AI race, federal funding should buy down project costs to reduce ratepayer cost inflation.

Enabling the Speed-to-Power Era (2025-2030)

For the power sector, five years away is tomorrow. Demand growth over the next five years will be almost entirely served by projects already under development or construction. The data indicates clearly that generation deployment will be dominated by gas, solar, and storage. In the near-term, federal policy can primarily assist in clearing obstacles to deployment.

EMERGENCY SITING, PERMITTING, AND PLANT RETIREMENT DELAY AUTHORITIES

President Trump has already signed executive orders declaring an **energy emergency** and establishing a new **National Energy Dominance Council**. These authorities should be directed toward improving the permitting environment for generation projects that are under development in an all-of-the above generation strategy. Fast-tracked permitting for the gas midstream, electric transmission, and electric generation projects would support speed-to-power for AI data centers. Support for enhanced geothermal on federal land is crucial for a nascent, but potentially **globally competitive**, American technology.

Most coal power plants that are operating today will likely remain open for the near term based on the new economic and reliability value proposition in the speed-to-power era, independent of the use of emergency authorities. In exceptional cases, the use of emergency authorities may be justified where state policy forces coal plant closures that raise reliability risks. Nonetheless, emergency powers are a short-term solution and should be supplemented with support for new generation that will serve the long-term multi-decadal demand growth challenge (see below).

The Northern Virginia computing cluster should be the primary focus of emergency authorities, as it is the region facing the most severe constraints on data center expansion. The administration should consider fast-tracked permitting for generation resources in the region, including offshore wind under development off the Virginia coast, which will improve speed-to-power for the strategically vital Northern Virginia computing cluster.

Emergency authorities should also target siting approval for late-stage high-voltage transmission projects that, once completed, will create room on the grid for new generation and demand resources. Focus should be paid to transmission projects that improve integration of the Northern Virginia computing cluster with new and existing generation in surrounding states. PJM has approved a series of transmission projects for this express purpose that in many cases are held up by state-siting and permitting hurdles. This authority should also consider transmission projects in the emergent demand

clusters in the Midwest, Southeast, and Southwest, which are serving a combination of strategically vital data centers, semiconductor fabrication, and battery manufacturing loads.

CO-LOCATION AND ISLANDING

The focus on speed-to-power has resulted in a strong trend toward co-locating data centers directly on-site alongside power plants. Siting new generation projects alongside new data centers is a widely pursued development strategy that poses no significant policy question. In contrast, siting new data centers alongside existing generation, as **proposed** at the Susquehanna nuclear plant in the PJM market, raises significant reliability and affordability concerns. The Federal Energy Regulatory Commission (FERC) rejected the Susquehanna proposal on narrow technical grounds but has yet to issue a formal, broadly applicable **policy** on the issue.

Numerous merchant-operated nuclear power plants in the 13-state PJM market could likely pursue similar deals if such co-location deals were okayed by the FERC. This path would radically improve speed-to-power for data centers in the mid-Atlantic market but also raise considerable reliability risks. This would in effect look like the sudden retirement of a large amount of generation from the grid without any obligation to bring on new replacement generation resources. Prices in PJM's **capacity market** would soar (if they are **allowed** to), and ratepayer prices would rise in response. The Trump administration needs to weigh the reliability and affordability risks on the one hand versus the race for AI dominance on the other.

A path forward might grant the DOE a time-limited window (e.g., through 2030) to approve co-locating at existing nuclear plants on a case-by-case basis, based on reliability assessments. One option would be to approve such arrangements only if those deals include firm plans and financial commitments to begin construction of equivalent new generation resources. Such plans could include federal support (see below). This could potentially thread the needle between speed-to-power for AI data centers and reliability.

Full physical islanding of power generation and data centers in gigawatt scale or larger "microgrids" is a way to accelerate private capital investment and improve speed-to-power. From a policy perspective this path is **attractive** becomes it carries no financial risk to ratepayers and poses no risk to grid reliability. Federal policy can help by clarifying that these private grids would not be subject to FERC oversight, given that they are purely commercial arrangements between private businesses. It would then lie with state policymakers to legalize such arrangements under state law and establish light-touch PUC oversight.

Building a Strategic Electricity Advantage Era (2030 and Beyond)

Federal policy in the near term can dramatically alter sectoral trajectory in 2030 and beyond for the better in terms of costs, reliability, and global strategic energy advantage. Solar will run into land-use and permitting constraints, especially outside of Texas and east of the Mississippi, where a significant volume of new data center demand is sited. It is unlikely that any state or market will be able to match the rapid interconnection rates achieved in Texas under the connect-and-manage model absent significant, slow, and politically challenging market restructuring.

Gas deployment will face delays and cost increases sourced from the turbine backlog. More importantly, in an age of liquefied natural gas exports, a growing domestic gas burn in the power sector competes with growing high-margin exports for natural gas. The fundamental **basis of energy security is in variety**, and growing reliance on a single fuel source in the power sector—in this case natural gas— eventually veers into overreliance. Though the United States possesses vast natural gas reserves, wellhead prices will eventually climb, and this will directly translate into higher electricity prices. The United States would be wise to cultivate diversity in the electricity sector, which would have the bonus value of freeing up gas volumes for high-margin overseas exports.

With these principles, constraints, and risks in mind, federal policy should focus on developing nuclear power to anchor a long-term global electricity supply advantage that supports AI dominance. Abroad, data center development is increasingly likely to flow to countries with existing or growing nuclear capacity such as China, France, Japan, and the United Arab Emirates. A nuclear-centric AI energy strategy provides the additional benefit of ensuring China does not grow to dominate the global nuclear power market as it already has with solar and storage. Over the last decade, China **built** 27 nuclear reactors compared to two in the United States, and it has another 23 reactors in various stages of construction; the United States is at risk of being left behind. Policymakers should act today to enable a post-2030 power sector that enables reliable, low-cost, demand expansion.

NUCLEAR COMPUTATION HUBS

Nuclear computation hubs would direct federal resources to states interested in both developing new nuclear power and attracting data center investment. A **10-state coalition** launched in February 2025 indicates the growing appetite for a state-led, federally supported model. States want nuclear energy but are reluctant to expose ratepayers to the risk of cost overruns. Coordination challenges hamper an alternative model that brings data center developers together around a multi-plant, multistate investment plan. Nuclear computation hubs roughly modeled after the **DOE's Hydrogen Hubs** program would cut through these hurdles. The **slow development** that has characterized clean hydrogen hubs is primarily a function of limited financial upside and investor appetite in a nascent market. In contrast, nuclear computation hubs would rapidly attract vast amounts of private capital eager to invest in the economic opportunity represented by AI and the boom in computation and electricity demand.

Nuclear computation hub applications would likely be partnerships between state energy offices, data center developer and operators, and a power developer—either an IPP or an investor-owned utility— targeting sites capable of hosting a 2 GW data center and 2 GW or more of nuclear capacity. Sites should also have plausible access to high-voltage transmission and access to additional sources of generation (e.g., gas, solar, geothermal, storage) which can support data center operations while nuclear construction proceeds.

Selected hubs would receive access to federal loan guarantees (under the DOE Loan Programs Office or equivalent authorities), grant funding for pre-Final Investment Decision site development work, federal cost sharing for high-voltage transmission investments needed to connect the cluster to the grid, expedited federal permitting, and, potentially, DOE nuclear offtake (see below). States would be encouraged to establish nuclear and data center workforce development plans for engineers, welders, and electricians, which federal funds could further support. Finally, federal support could

be made contingent on states streamlining their permitting processes for energy and infrastructure more broadly.

DOE ANCHOR OFFTAKER AUTHORITY AND NUCLEAR PROCUREMENT TARGET

As part of the Infrastructure Investment and Jobs Act, Congress created a new **anchor tenant authority** which enables the DOE to buy capacity rights (or "offtake") in merchant transmission projects. Anchor tenancy by the federal government enables private transmission projects to secure funding from private capital markets and attract other capacity offtakers, which speeds overall deployment timelines. As other customers crowd in to contract offtake from the new transmission project, the government can surrender or auction off its contracted volumes.

Congress could authorize and fund the DOE to pursue the same model for new nuclear power. In such a model, the DOE, optionally working in consort with a federal Power Marketing Administration or the Tennessee Valley Authority, would enter into power offtake contracts with nuclear project developers. As the construction period proceeds towards commercial operation, offtake capacity can be sold off in part to private firms (hyperscalers, semiconductor fabs, etc.) or transferred to rate-regulated utilities so that the broader rate base can access the benefits of nuclear power at no risk of cost overruns. To protect taxpayers, offtake contracts should be entered into at market rates and terms. Risk sharing should be authorized insofar as it is shared across parties; this authority should not be implemented as a form of cost overrun insurance. A target of contracts supporting 10 GW of new nuclear construction underway by 2030 would radically expand the domestic nuclear construction program and ensure the 2030s are an era of rapid nuclear power growth and U.S. nuclear power leadership at home and abroad.

STRATEGIC ELECTRICITY PRODUCTION SITES ON FEDERAL LANDS

An **executive order** issued by President Biden in the closing days of his administration directed the Department of Defense, the Department of the Interior, and the DOE to identify and prepare federal sites for data center development, leveraging existing infrastructure and streamlined permitting authorities. This order should be recast with a primary focus on identifying sites for nuclear, geothermal, and solar generation. Federal land combined with fast-tracked federal permitting could be attractive for data centers only if the site delivers competitive speed-to-power. The "**three pillars of additionality**" (new clean supply, hourly matching, and deliverability) clean-energy mandate embedded in the Biden administration executive order should be scrapped to allow gas generation to be deployed as part of a portfolio power solution that prioritizes speed and flexibility. Identified sites should be made available for partnership and participation in state-led nuclear computation hubs to improve opportunities for states with large amounts of federal land.

STRATEGIC GRID INVESTMENT

The Infrastructure Investment and Jobs Act appropriated $10.5 billion to the DOE to establish a Grid Resilience and Innovation Partnerships (GRIP) fund. Through two rounds of funding, The Grid Deployment Office has **disbursed** $7.6 billion for 105 projects, including smart grids, renewable energy interconnection, and emergency repair projects in response to Hurricane Helene.

The program's remaining funds should be narrowly focused on high-voltage grid investments that support the strategic goal of rapid data center interconnection. Large hyperscale computing clusters and large generation projects (e.g., combined cycle natural gas or nuclear power plants) both must

be sited close to high-voltage transmission. It is no coincidence that Meta's 2 GW Richland Parish data center in Louisiana is sited only a few miles from a branch of the U.S. Southeast's 500 kilovolt (kV) backbone transmission system. Likewise, AEP utilities in Ohio and Illinois are attracting data centers in large part due to the existing 765 kV grid system in the region.

Utilities across the country are proposing **investment** in high-voltage substations and transmission lines to support data center demand growth, and federal dollars should be deployed to reduce or eliminate ratepayer exposure to these strategically vital investments. Unlike generation, the costs of which can be easily assigned to a single large datacenter, grid investments network infrastructure whose costs and benefits are spread widely. Offsetting portions of this AI-based investment with federal dollars is key to reducing costs for ratepayers and advancing the national interest. The remaining $2.4 billion is nowhere near sufficient to accomplish these goals. Congress should consider replenishing and expanding this fund to support the proposed nuclear computation hubs and national energy transmission corridors (see below).

National Interest Energy Transmission Corridors

Interstate energy transmission infrastructure, be it via pipeline or wire, provides broad long-term strategic benefits to the nation. Long-term policy, permitting, and political hurdles to all types of energy transmission infrastructure have undermined energy security and competitiveness.

The existing National Interest Electric Transmission Corridor (NIETC) **authority** should be expanded into a National Interest Energy Transmission Corridor authority that applies to both gas and electric transmission projects. Enabling legislative language should be streamlined to give the secretary of energy wide discernment to identify projects that serve the strategic national interest as set forth by the president. If the federal authority is invoked to site a project based on strategic national interest, then it makes sense that federal funding should likewise be deployed to pay for that national strategic value and reduce or eliminate ratepayer impact. A reformed NIETC authority would require that projects are given access to federal funding via grants (e.g., GRIP funds), low-interest loans (e.g., DOE Loan Programs Office), or anchor tenant contracts. Selected projects should also receive fast-tracked emergency permitting.

This authority could target pipelines and electric transmission projects that improve speed-to-power for existing computation clusters (e.g., Northern Virginia) and emerging computation clusters in the Midwest, Southeast, and Southwest. For example, this authority should be used to authorize and partially fund the **Piedmont Reliability Project in Maryland** which has been approved by PJM but faces political challenges at the state level. This and similar projects will boost desperately needed transmission capacity between the Northern Virgina computing cluster and the Three Mile Island nuclear plant, as well as bolstering access other firm generation resources in Pennsylvania and the Midwest. It could also be used to advance energy transmission projects which support nuclear computation hubs or to deploy pipelines which lower costs and improve reliability in pipeline constrained regions.

Conclusion

For decades, U.S. energy strategy has revolved around U.S. exposure to global oil markets. Abroad, this resulted in a focus on oil-shipping sea lanes, most notably the Persian Gulf. Domestically, this resulted in

a focus on energy independence. As an organizing principle, this is increasingly out of date. The United States has been a net energy **exporter** since 2019, and in 2024, it was the world's largest producer of both **oil** and **natural gas**.

The rise of AI has elevated electricity supply to a new level of strategic importance. A new long-term U.S. energy strategy should seek to establish global dominance in electricity supply comparable to the achieved global dominance in the oil and gas sector. The present reality of electricity scarcity that inhibits AI progress should be transformed into a long-term position of global dominance in electricity supply.

Scaling of this sort is achievable: In the decade between 1982 and 1991, U.S. electricity consumption grew by about 800 TWh, and the power sector built 43 nuclear reactors totaling 52 GW of capacity. All of this was accomplished without the aid of any modern digital engineering, manufacturing techniques, or construction technology, let alone AI itself. Whether it is nuclear, gas, solar, storage or geothermal the needed technology exists. Simply put, the engineering and technology challenges associated with meeting AI energy demand are not difficult. The onus is on policymakers to break through the status quo and unleash a future of U.S. electricity supply dominance. ■

Cy McGeady is a fellow in the Energy Security and Climate Change Program at the Center for Strategic and International Studies (CSIS) in Washington, D.C. Joseph Majkut is director of the Energy Security and Climate Change Program at CSIS. Barath Harithas is a senior fellow in the Economics Program and Scholl Chair in International Business at CSIS. Karl Smith is an economic policy consultant specializing in AI.

⚡ DIGITAL ENERGY COUNCIL

Submitted via email

The Honorable Brett Guthrie
Chairman
House Committee on Energy and Commerce
Washington, DC 20515

The Honorable Frank Pallone
Ranking Member
House Committee on Energy and Commerce
Washington, DC 20515

April 9, 2025

Dear Chairman Guthrie and Ranking Member Pallone:

The Digital Energy Council (DEC) appreciates the opportunity to submit this Letter for the Record as part of the House Committee on Energy and Commerce's hearing entitled, "Converting Energy into Intelligence: the Future of AI Technology, Human Discovery, and American Global Competitiveness." Highlighting the intersection of artificial intelligence, energy infrastructure, and global competitiveness is a critical opportunity to reinforce the role of energy innovation, particularly digital energy infrastructure, as a cornerstone of the United States' technological and economic leadership.

About the Digital Energy Council
The Digital Energy Council is a non-profit advocacy organization whose members work at the forefront of the energy and technology industries. DEC was founded to shape the future of energy use and inform policymakers about the important cross-section between the energy industry and the digital applications driving a new economy. As society becomes increasingly digital, the energy sector must evolve to keep pace. It is essential for the energy ecosystem to embrace new technologies and adapt to meet growing demand.

Need for Congressional Action
The U.S. energy system is experiencing a significant growth in demand driven by the 21st century digital economy. The energy sector is exploring innovative methods of leveraging energy resources to meet demand associated with digital technologies. Developments in technology are using approximately 2-3% of the total electricity in the United States, according to NERC's 2024 Long-Term Reliability Assessment found that demand is estimated to increase by 151 gigawatts. in conjunction with buildout of large-scale computing facilities.[1]

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1 N. AM. ELEC. RELIABILITY CORP., 2024 Long-Term Reliability Assessment (Dec. 2024),

https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_Long%20Term%20Reliability%20A ssessment_2024.pdf.

In reference to artificial intelligence (AI), bitcoin mining, and high-performance computing (HPC), the concept of "digital energy" represents the synergy between the broader energy sector and the technologies driving the digital economy that require significant computational power. These new technologies can work with our energy systems efficiency, reliability, and can even foster new domestic resource development. To meet the rising demand for energy, it is imperative that Congress acts to support innovative solutions in this growing field.

Policy Recommendations
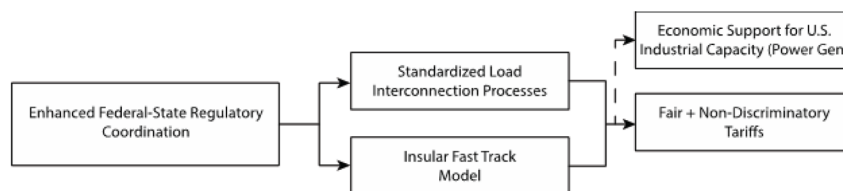
1. ***Enhance Federal-State Regulatory Coordination*** – Energy infrastructure and markets span multiple states, a patchwork of state regulatory policies can lead to shifting costs and negatively impact retail customers within states, regions, and even nationwide. Enhancing federal-state regulatory coordination can lead to best practices and promote consistent policies that prevent unfair cost burdens and promote efficient project execution.
    a. Identify a single point of interface for all parties to sign off on permits (e.g., similar to the Grid Deployment Office's (GDO) CITAP for transmission). This could allow all generation permits and interconnect requests to be put in one place.
    b. Establish a coordinating body for priority projects with both oversight of the process but also political power to move the various parts of federal and state governments.
    c. Identify criteria for entry into the permit 'fast lane.' These criteria should be technology agnostic, but does not have to be criteria agnostic. For instance, access to the 'fast lane' should be given only to projects that meet a 90/10 test (i.e., the project demonstrates 90% deliverability in 10% peak net load hours) as well as being able to demonstrate commercial viability.

2. ***Develop Best Practices for Standardized Load Interconnection Processes*** – Establish a simplified standard process that can be leveraged to better assess load interconnection requests strictly based on existing grid conditions. For fast-track projects, processes can be done provisionally but are not binding to the utility until other permits are complete (i.e., it happens last, therefore prioritization goes to projects that are real).

3. ***Ensure Fair and Non-Discriminatory Electricity Tariffs*** – Establish equitable tariff structures that are based on actual usage and energy load, rather than directed end use

categories. These tariffs should apply to all firms in a distinct tariff class, driven solely by their energy consumption and not by their sector or size. Additionally, these tariffs should support large-scale, energy-intensive technology development while promoting global competition for data and AI leadership. It is crucial that the tariff structures do not unfairly transfer costs to smaller manufacturers in other sectors or to residential customers, ensuring that all players in the tech ecosystem are treated equitably.

4. *Economic Support for U.S. Industrial Capacity* - Congress can help strengthen U.S. industrial capacity by facilitating investment in enabling infrastructure such as pipelines and transmission lines through targeted funding and credit support. It can also reduce deployment constraints by streamlining permitting processes and encouraging coordinated, cross-jurisdictional planning for large-scale projects.

5. *Federal Land and National Lab Utilization* - Support greater collaboration between national laboratories and the energy and technology industries. Building on recent proposals, including the Trump Administration's identification of 16 federal sites—many of which include national labs—the DEC calls on Congress to allocate dedicated funding to these laboratories. This funding should support critical efforts in modeling, technology development, and research advancement necessary to drive progress in the digital energy sector.

6. *Modernize Outdated Regulations and Permitting Processes* - Policymakers have a vital role in enabling smart, efficient energy infrastructure investment. In most cases, planning for new energy and technology deployment requires 5-7 years to proceed through all regulatory considerations when associated with new co-located power generation. DEC supports clear, forward looking regulatory frameworks that empower private sector innovation in both energy and technology, and streamlines permitting to accelerate deployment of digital energy capabilities.

7. *Support Economic Development in Rural Areas* - The development of digital infrastructure will provide jobs in rural areas by driving local economic growth through the establishment of infrastructure and technology hubs. Additionally, energy and technology can spur growth in related sectors, such as construction, maintenance, and service industries, further increasing job prospects. As technology development often relies on low-cost energy sources, rural areas with access to lower electricity rates can attract these investments, contributing to long-term regional development and improved local economies.

8. *Provide Clear, Uniform Definitions* - Uniform definitions are essential for the government to effectively regulate new technology and energy coordination because they provide clear, consistent standards that ensure fair application of laws and policies. By establishing uniform definitions, governments can create a level playing field, ensure transparency, and safeguard public interests, while also fostering innovation.

Texas Leads in Grid Innovation

Under existing regulatory structures, Texas represents the best-in-class environment for data, AI, and manufacturing sectors to deploy digital energy infrastructure. This is a result of several unique characteristics:

- The Texas utility sector (ERCOT) operates as its own island, independent of interstate commerce, thereby bypassing the need for federal approval through the Federal Energy Regulatory Commission (FERC).
- Enhanced access to natural gas supply abundance requiring relatively little new infrastructure deployment (i.e., pipeline networks).
- Incentivizes new technology development through programs such as the ERCOT Demand Response Program allowing large electricity consumers to shift power usage during peak demand periods in exchange for financial benefits.
- Texas offers a conducive business environment including regulatory certainty for companies to invest in infrastructure projects in the state.

Conclusion

The Digital Energy Council applauds the Committee's leadership in convening this timely hearing. As AI continues to reshape energy and technology markets, the United States must ensure its energy strategy is resilient, robust, and reliable. DEC looks forward to continued engagement with the Committee to promote policies that harness digital energy to power American innovation. Please feel free to utilize the DEC as a resource for these important and complex issue areas. If you have any questions, we can be reached at info@digitalenergycouncil.org.

Best Regards,

Tom Mapes
Founder and President
Digital Energy Council

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2024 Long-Term Reliability Assessment

December 2024

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

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Preface

Electricity is a key component of the fabric of modern society and the Electric Reliability Organization (ERO) Enterprise serves to strengthen that fabric. The vision for the ERO Enterprise, which is comprised of NERC and the six Regional Entities, is a highly reliable, resilient, and secure North American bulk power system (BPS). Our mission is to assure the effective and efficient reduction of risks to the reliability and security of the grid.

Reliability | Resilience | Security
Because nearly 400 million citizens in North America are counting on us

The North American BPS is made up of six Regional Entities as shown on the map and in the corresponding table below. The multicolored area denotes overlap as some load-serving entities participate in one Regional Entity while associated Transmission Owners/Operators participate in another.
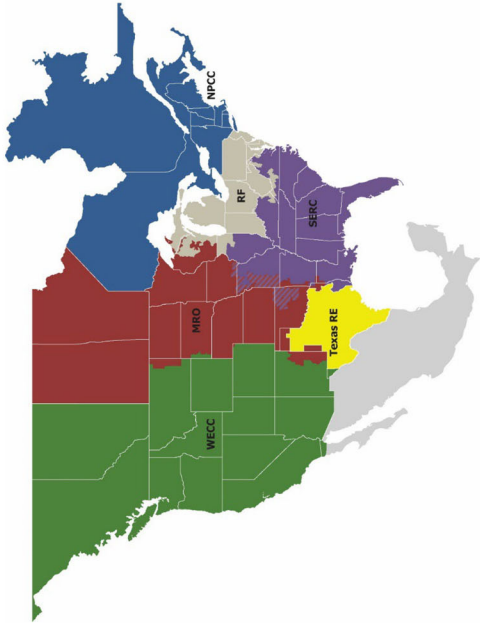
MRO	Midwest Reliability Organization
NPCC	Northeast Power Coordinating Council
RF	ReliabilityFirst
SERC	SERC Reliability Corporation
Texas RE	Texas Reliability Entity
WECC	WECC

About This Assessment

NERC is a not-for-profit international regulatory authority with the mission to assure the reliability of the BPS in North America. NERC develops and enforces Reliability Standards; annually assesses seasonal and long-term reliability; monitors the BPS through system awareness; and educates, trains, and certifies industry personnel. NERC's area of responsibility spans the continental United States, Canada, and the northern portion of Baja California, Mexico. NERC is the ERO for North America and is subject to oversight by the U.S. Federal Energy Regulatory Commission (FERC, also known as the Commission) and governmental authorities in Canada. NERC's jurisdiction includes users, owners, and operators of the North American BPS and serves more than 334 million people. Section 39.11(b) of FERC's regulations provides that "The Electric Reliability Organization shall conduct assessments of the adequacy of the Bulk-Power System in North America and report its findings to the Commission, the Secretary of Energy, each Regional Entity, and each Regional Advisory Body annually or more frequently if so ordered by the Commission."

Development Process

This assessment was developed based on data and narrative information NERC collected from the six Regional Entities (see **Preface**) on an assessment area basis (see **Regional Assessments Dashboards**) to independently evaluate the long-term reliability of the North American BPS while identifying trends, emerging issues, and potential risks during the upcoming 10-year assessment period. The Reliability Assessment Subcommittee (RAS), at the direction of NERC's Reliability and Security Technical Committee (RSTC), supported the development of this assessment through a comprehensive and transparent peer-review process that leverages the knowledge and experience of system planners, RAS members, NERC staff, and other subject matter experts; this peer-review process ensures the accuracy and completeness of all data and information. This assessment was also reviewed by the RSTC, and the NERC Board of Trustees subsequently accepted this assessment and endorsed the key findings.

NERC develops the *Long-Term Reliability Assessment* (LTRA) annually in accordance with the ERO's Rules of Procedure[1] and Title 18, § 39.11[2] of the Code of Federal Regulations;[3] this is also required by Section 215(g) of the Federal Power Act, which instructs NERC to conduct periodic assessments of the North American BPS.[4]

Considerations

This assessment was developed by using a consistent approach for projecting future resource adequacy through the application of the ERO Reliability Assessment Process.[5] Projections in this assessment are not predictions of what will happen; they are based on information supplied in July 2024 about known system changes with updates incorporated prior to publication. This *2024 LTRA* assessment period includes projections for 2025–2034; however, some figures and tables examine data and information for the 2024 year. NERC's standardized data reporting and instructions were developed through stakeholder processes to promote data consistency across all the reporting entities that are further explained in the **Demand Assumptions and Resource Categories** section of this report. Reliability impacts related to cyber and physical security risks are not specifically addressed in this assessment; it is primarily focused on resource adequacy and operating reliability. NERC leads a multi-faceted approach through NERC's Electricity Information Sharing and Analysis Center (E-ISAC) to promote mechanisms to address physical and cyber security risks, including exercises and information-sharing efforts with the electric industry.

The LTRA data used for this assessment creates a reference case dataset that includes projected on-peak demand and system energy needs, demand response (DR), resource capacity, and transmission projects. Data from each Regional Entity is also collected and used to identify notable trends and emerging issues. This bottom-up approach captures virtually all electricity supplied in the United States, Canada, and a portion of Baja California, Mexico. NERC's reliability assessments are developed to inform industry, policymakers, and regulators as well as to aid NERC in achieving its mission to ensure the reliability of the North American BPS.

[1] NERC Rules of Procedure - Section 803

[2] Section 39.11(b) of FERC's regulations states the following: "The Electric Reliability Organization shall conduct assessments of the adequacy of the Bulk-Power System in North America and report its findings to the Commission, the Secretary of Energy, each Regional Entity, and each Regional Advisory Body annually or more frequently if so ordered by the Commission."

[3] Title 18, § 39.11 of the Code of Federal Regulations

[4] BPS reliability, as defined in the How NERC Defines BPS Reliability section of this report, does not include the reliability of the lower-voltage distribution systems that account for 80% of all electricity supply interruptions to end-use customers.

[5] ERO Reliability Assessment Process Document

Assumptions

In this *2024 LTRA*, the baseline information on future electricity supply and demand is based on several assumptions:[6]

- Supply and demand projections are based on industry forecasts submitted and validated in July 2024. Any subsequent demand forecast or resource plan changes may not be fully represented; however, updated data submitted throughout the report drafting time frame have been included where appropriate.

- Peak demand is based on average peak weather conditions and assumed forecast economic activity at the time of submittal. Weather variability is discussed in each Regional Entity's self-assessment.

- Generation and transmission equipment will perform at historical availability levels.

- Future generation and transmission facilities are commissioned and in service as planned, planned outages take place as scheduled, and retirements take place as proposed.

- Demand reductions expected from dispatchable and controllable DR programs will yield the forecast results if they are called on.

- Other peak demand-side management programs, such as energy efficiency (EE) and price-responsive DR, are reflected in the forecasts of total internal demand.

Reading this Report

This report is compiled into two major parts:

1. **A reliability assessment of the North American BPS with the following goals:**

   a. Evaluate industry preparations that are in place to meet projections and maintain reliability

   b. Identify trends in demand, supply, reserve margins, and probabilistic resource adequacy metrics

   c. Identify emerging reliability issues

   d. Focus the industry, policymakers, and the general public's attention on BPS reliability issues

   e. Make recommendations based on an independent NERC reliability assessment process

2. **A regional reliability assessment that contains the following:**

   a. A 10-year data dashboard

   b. Summary assessments for each assessment area

   c. A focus on specific issues identified through industry data and emerging issues

   d. A description of regional planning processes and methods used to ensure reliability

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[6] Forecasts cannot precisely predict the future. Instead, many forecasts report probabilities with a range of possible outcomes. For example, each regional demand projection is assumed to represent the expected midpoint of possible future outcomes. This means that a future year's actual demand may deviate from the projection due to the inherent variability of the key factors that drive electrical use, such as weather. In the case of the NERC regional projections, there is a 50% probability that actual demand will be higher than the forecast midpoint and a 50% probability that it will be lower (50/50 forecast).

Executive Summary

In the *2024 LTRA*, NERC finds that most of the North American BPS faces mounting resource adequacy challenges over the next 10 years as surging demand growth continues and thermal generators announce plans for retirement. New solar PV, battery, and hybrid resources continue to flood interconnection queues, but completion rates are lagging behind the need for new generation. Furthermore, the performance of these replacement resources is more variable and weather-dependent than the generators they are replacing. As a result, less overall capacity (dispatchable capacity in particular) is being added to the system than what was projected and needed to meet future demand. **The trends point to critical reliability challenges facing the industry: satisfying escalating energy growth, managing generator retirements, and accelerating resource and transmission development.**

This *2024 LTRA* is the ERO's independent assessment and comprehensive report on the adequacy of planned BPS resources to reliably meet the electricity demand across North America over the next 10 years; it also identifies reliability trends, emerging issues, and potential risks that could impact the long-term reliability, resilience, and security of the BPS. The findings presented here are vitally important to understanding the reliability risks to the North American BPS as it is currently planned and being influenced by government policies, regulations, consumer preferences, and economic factors. Summaries of the report sections are provided below.

Capacity and Energy Risk Assessment

The **Capacity and Energy Risk Assessment** section of this report identifies potential future electricity supply shortfalls under normal and extreme weather conditions. NERC's evaluation of resource adequacy in the LTRA considers both the capacity of the resources and the capability of resources to convert inputs (e.g., fuel, wind, and solar irradiance) into electrical energy. NERC used both a probabilistic assessment and a reserve margin analysis to assess the risk of future electricity supply shortfalls. Both are forward-looking snapshots of resource adequacy that are tied to industry forecasts of electricity supplies, demand, and transmission development.

Areas categorized as **High Risk** fall below established resource adequacy criteria in the next five years. High-risk areas are likely to experience a shortfall in electricity supplies at the peak of an average summer or winter season. Extreme weather, producing wide-area heat waves or deep-freeze events, poses an even greater threat to reliability. **Elevated-Risk** areas meet resource adequacy criteria, but analysis indicates that extreme weather conditions are likely to cause a shortfall in area reserves. **Normal-Risk** areas are expected to have sufficient resources under a broad range of assessed conditions. The results of the risk assessment are depicted in **Figure 1.**

High Risk: shortfalls may occur at normal peak conditions

Elevated Risk: shortfalls may occur in extreme conditions

Normal Risk: low likelihood of electricity supply shortfall
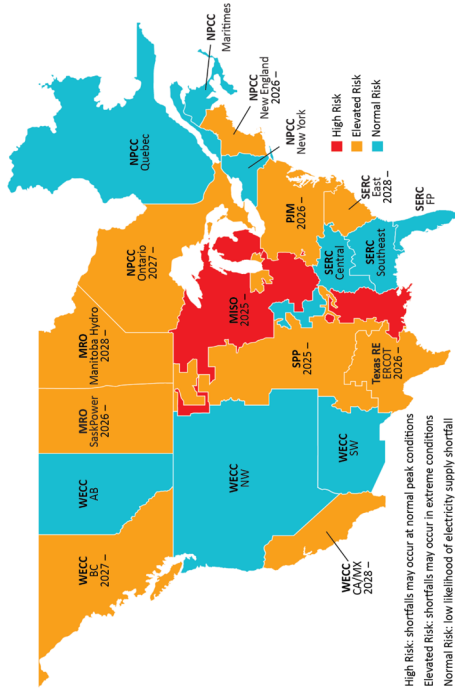
Figure 1: Risk Area Summary 2025–2029

Regional Assessments Dashboards

The **Regional Assessments Dashboards** section contains dashboards and summaries for each of the 20 assessment areas, developed from data and narrative information collected by NERC from the six Regional Entities. Probabilistic Assessments (ProbA) are presented that identify energy risk periods and describe the contributing demand and resource factors.

Table 1: Capacity and Energy Risk Assessment Area Summary

Area	Risk Level	Years	Risk Summary
MISO	High	2025 -	Resource additions are not keeping up with generator retirements and demand growth. Reserve margins fall below Reference Margin Levels (RML) in winter and summer.
Manitoba	Elevated	2028 -	Potential resource shortfalls in low-hydro conditions, driven by rising demand.
SaskPower	Elevated	2026 -	Risk of insufficient generation during fall and spring when more generators are off-line for maintenance.
Southwest Power Pool (SPP)	Elevated	2025 -	Potential energy shortfalls during peak summer and winter conditions arise from low wind conditions and natural gas fuel risk.
New England	Elevated	2026 -	Strong demand growth and persistent winter natural gas infrastructure limitations pose risks of supply shortfalls in extreme winter conditions.
Ontario	Elevated	2027 -	Reserve margins fall below RMLs as nuclear units undergo refurbishment and some current resource contracts expire. Demand growth is also adding to resource procurement needs.
PJM	Elevated	2026 -	Resource additions are not keeping up with generator retirements and demand growth. Winter seasons replace summer as the higher-risk periods due to generator performance and fuel supply issues.
SERC-East	Elevated	2028 -	Demand growth and planned generator retirements contribute to growing energy risks. Load is at risk in extreme winter conditions that cause demand to soar while supplies are threatened by generator performance, fuel issues, and inability to obtain emergency transfers.
ERCOT	Elevated	2026 -	Surging load growth is driving resource adequacy concerns as the share of dispatchable resources in the mix struggles to keep pace. Extreme winter weather has the potential to cause the most severe load-loss events.
California-Mexico	Elevated	2028 -	Demand growth and planned generator retirements can result in supply shortfalls during wide-area heat events that limit the supply of energy available for import.
British Columbia	Elevated	2027 -	Drought and extreme cold temperatures in winter can result in periods of insufficient operating reserves when neighboring areas are unable to provide excess energy.

Risk from Additional Generator Retirements

Plans for generator retirements continue at similar pace and scale to levels reported in the 2023 LTRA. Confirmed generator retirements (52 GW by 2029 and 78 GW over the 10-year period) are accounted for in the Capacity and Energy Risk Assessment above. Economic, policy, and regulatory factors spur further fossil-fired generators to retire in the 10-year horizon. Announced retirements, which include many generators that have not begun formal deactivation processes with planning entities, total 115 GW over the 10-year period. The effect of all retirements on the assessment area Planning Reserve Margins (PRM) can be seen in **Figure 2**. On-peak reserve margins fall below RMLs; the levels required by jurisdictional resource adequacy requirements) in the next 10 years in almost every assessment area, signaling an accelerating need for more resources.
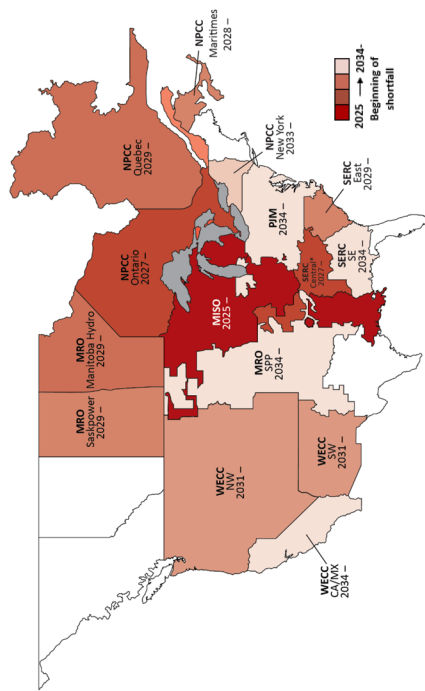
Figure 2: Projected Reserve Margin Shortfall Areas

Changing Resource Mix and Reliability Implications

New resource additions continue at a rapid pace. Solar PV remains the overwhelmingly predominant generation type being added to the BPS followed by battery and hybrid resources, natural-gas-fired generators, and wind turbines. New resource additions fell short of industry's projections from the 2023 LTRA with the notable exception of batteries, which added more nameplate capacity than was reported in development last year.

As older fossil-fired generators retire and are replaced by more solar PV and wind resources, the resource mix is becoming increasingly variable and weather-dependent. Solar PV, wind, and other variable energy resources (VER) contribute some fraction of their nameplate capacity output to serving demand based on the energy-producing inputs (e.g., solar irradiance, wind speed). The new resources also have different physical and operating characteristics from the generators that they are replacing, affecting the essential reliability services (ERS) that the resource mix provides. As generators are deactivated and replaced by new types of resources, ERS must still be maintained for the grid to operate reliably.

Natural-gas-fired generators are a vital BPS resource. They provide ERSs by ramping up and down to balance a more variable resource mix and are a dispatchable electricity supply for winter and times when wind and solar resources are less capable of serving demand. Natural gas pipeline capacity additions over the past seven years are trending downward, and some areas could experience insufficient pipeline capacity for electric generation during peak periods.

Trends and Reliability Implications

Demand and transmission trends affect long-term reliability and the sufficiency of electricity supplies. A summary for each is provided below and further discussed within the **Demand Trends and Implications** and **Transmission Development and Interregional Transfer Capability** sections.

Demand Trends

Electricity peak demand and energy growth forecasts over the 10-year assessment period continue to climb; demand growth is now higher than at any point in the past two decades. Increasing amounts of large commercial and industrial loads are connecting rapidly to the BPS. The size and speed with which data centers (including crypto and AI) can be constructed and connect to the grid presents unique challenges for demand forecasting and planning for system behavior. Additionally, the continued adoption of electric vehicles and heat pumps is a substantial driver for demand around North America. The aggregated BPS-wide projections for both winter and summer have increased massively over the 10-year period:

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- The aggregated assessment area summer peak demand forecast is expected to rise by 15% for the 10-year period: 132 GW this LTRA up from over 80 GW in the *2023 LTRA*.

- The aggregated assessment area winter peak demand forecast is expected to rise over almost 18% for the 10-year period: 149 GW this LTRA up from almost 92 GW in the *2023 LTRA*.

Transmission Trends

For the first time in recent years, transmission projections reported for the LTRA reflect a significant increase in transmission development. This year's cumulative level of 28,275 miles of transmission (>100 kV) in various stages of development for the next 10 years is substantially higher than the *2023 LTRA* 10-year projections (18,675 miles) and is above the average of the past five years of NERC's LTRA reporting on average (18,900 miles of transmission planning projects in each 10-year period published in the last five LTRAs). Transmission in construction has yet to increase substantially; rather, the large increase in transmission projects is seen in planning stages of development.

New transmission projects are being driven to support new generation and enhance reliability. Transmission development continues to be affected by siting and permitting challenges. Of the 1,160 projects that are under construction or in planning for the next 10 years, 68 projects totaling 1,230 miles of new transmission are delayed by siting and permitting issues, according to data collected for the LTRA. Questions of cost allocation and recovery can also challenge transmission development when the benefits apply to more than one area, as often occurs with projects that enhance interregional transfer capability.

In NERC's separate Interregional Transfer Capability Study (ITCS), which was performed to meet requirements contained in the Fiscal Responsibility Act of 2023, NERC found that an additional 35 GW of transfer capability across the United States would strengthen energy adequacy under extreme conditions. Increasing transfer capability between neighboring transmission systems has the potential to alleviate energy shortfalls in some areas identified in this LTRA's **Capacity and Energy Risk Assessment.** Conversely, when resource plans are developed that address these same energy shortfalls, such as through resource additions, demand-side management initiatives, or changes to generator retirement plans, the need for increased transfer capability will also change. Planners have options for reducing energy adequacy risks from extreme weather. Selecting the best course of action will depend on weighing these options against various engineering, economic, policy, reliability, and resilience objectives.

The ITCS provides foundational insights that facilitate stakeholder analysis and actions; it is not a transmission plan. In the future, NERC will extend the study beyond the congressional mandate to include transfer capabilities from the United States to Canada and among Canadian provinces.

Emerging Issues

The **Emerging Issues** section discusses developments and trends that have the potential to substantially change future long-term demand and resource projections, resource availability, and reliable operations of the BPS. Topics include data centers and large industrial loads, battery energy storage systems, electric vehicles and load, and energy drought. NERC's RSTC has formed new task forces where needed to address emerging issues.

Recommendations

To address the energy and capacity risks identified in this LTRA, NERC recommends the following priority actions:

1. **Integrated Resource Planners, market operators, and regulators: Carefully manage generator deactivations.** Independent System Operator/Regional Transmission Organizations (ISO/RTOs) should evaluate mechanisms and process enhancements for obtaining information on expected generator retirements that would support early identification of reliability risks. State and provincial regulators and ISO/RTOs need to have mechanisms they can employ to extend the service of generators seeking to retire when they are needed for reliability, including the management of energy shortfall risks. Regulatory and policy-setting organizations must use their full suite of tools to manage the pace of retirements and ensure that replacement infrastructure can be developed and placed in service.

2. **NERC and Regional Entities: Improve the LTRA by incorporating new analysis and criteria to inform stakeholders of future reliability risks.** NERC increased the frequency of the ProbA from biennial to annual and included unserved energy and load-loss metrics as the basis for risk analysis in this year's LTRA. To be more effective in using energy criteria and outputs of probabilistic analysis, NERC must specify consistent methods and assumptions for assessment areas to follow in preparing the annual ProbA. NERC and the Regional Entities, in consultation with the RSTC, should also continue to enhance NERC's LTRA to assess ERSs in the future system and the potential impact of new and evolving electricity market practices, regulations, or legislation on resource adequacy. Finally, NERC should work with the Regional Entities to perform wide-area energy analysis with modeled interregional transfer capability. Wide-area energy analysis will support the evaluation of extreme weather and regional fuel supply issues on an interconnection level.

3. **Regulators and Policymakers: Streamline siting and permitting processes to remove barriers to resource and transmission development.** As ISO/RTOs continue looking for opportunities to speed transmission planning processes, delays from siting and permitting activities will need to be reduced. These are the most common causes for delayed transmission projects. Support from regulators and policymakers at the federal, state, and provincial levels is urgently needed.

4. **Regulators, electric industry, and gas industry member organizations: Implement a framework for addressing the operating and planning needs of the interconnected natural gas-electric energy system.** Various initiatives were launched in the past year to address the reliability needs that arise from the complexity of interconnecting natural gas and electric infrastructure. Voluntary actions taken by the natural gas industry in response to the North American Energy Standards Board (NAESB) Forum report are a positive step toward improving winter readiness. The National Association of Regulatory Utility Commissioners (NARUC) launched its Gas-Electric Alignment for Reliability (GEAR) task force this year and recently created the Natural Gas Readiness Forum. For its part, NERC continues to collaborate extensively with industry and policymakers. NERC has enhanced its Reliability Standards requiring generators to prepare for winter extremes, implement training, and establish communication protocols between generators and grid operators. Current standards projects encompass extreme weather planning and energy assurance requirements. NERC will continue to provide full support to initiatives aimed at achieving a reliable interconnected energy system and urges regulators and policymakers to support needed avenues of coordination between the two sectors.

5. **Regional transmission organizations, independent system operators, and FERC: Continue to ensure essential reliability services are maintained.** The changing composition of the North American resource mix calls for more robust planning approaches to ensure adequate ERSs.[7] Retiring conventional generation is being replaced with large amounts of wind and solar; planning considerations must adapt with more attention to ERSs. As replacement resources are interconnected, these new resources should be capable of supporting voltage, frequency, ramping, and dispatchability. Many technologies can contribute to ERSs, including variable energy resources; however, policies and market mechanisms need to reflect these requirements to ensure these services are provided and maintained. Regional transmission organizations, independent system operators, and FERC have taken steps in this direction, and these positive steps must continue.

In addition to these priorities, NERC recommends continued progress in areas identified previously in NERC's LTRA and other assessment reports. All recommendations are listed in the **Recommendations and ERO Actions Summary** section.

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[7] Essential Reliability Services: https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/ERS%20Abstract%20Report%20Final.pdf

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The Budgetary Cost of the Inflation Reduction Act's Energy Subsidies

IRA Energy Tax Credits Could Cost $4.7 Trillion by 2050

BY TRAVIS FISHER AND JOSHUA LOUCKS

EXECUTIVE SUMMARY

The Inflation Reduction Act (IRA) became law on August 16, 2022. Despite its name, the act was mostly designed to decarbonize the US economy by providing subsidies to producers of clean energy and consumers of low-carbon-emitting preferred products such as electric vehicles.

A contentious point of debate surrounding the passage of the IRA was its budgetary impact—how much liability American taxpayers would have to take on to subsidize clean energy. Various governmental and nongovernmental organizations estimated fiscal costs that turned out to be too low and that they later revised upward.

Using a transparent budget scoring methodology, we estimate that the energy subsidies in the act will cost between $936 billion and $1.97 trillion over the next 10 years, and between $2.04 trillion and $4.67 trillion by 2050. This estimate is substantial because several of the IRA's largest subsidies are uncapped.

When Congress passed the IRA, the Congressional Budget Office (CBO) and the Joint Committee on Taxation (JCT) estimated the energy-related IRA subsidies would cost about $370 billion. An analysis by Goldman Sachs later estimated the IRA's 10-year cost would be $1.2 trillion.

However, the IRA's energy subsidies are multiple times larger than initial estimates, and they expose American taxpayers to potentially unlimited liability. Congress should repeal all the energy subsidies in the IRA. At a minimum, Congress should cap total spending on energy subsidies and require budget experts at the CBO, JCT, and other government organizations to publish transparent and updated estimates of the IRA's long-term costs.

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INTRODUCTION

The Inflation Reduction Act (IRA) became law on August 16, 2022. Despite its name, the act was mostly designed to expedite the decarbonization of the US economy by providing subsidies to producers of low-emission energy and some consumers of low-carbon-emitting products such as electric vehicles. A contentious point of debate surrounding the passage of the IRA was the various estimates of its budgetary impact—how much liability American taxpayers would have to take on to subsidize clean energy. Various governmental and nongovernmental organizations estimated fiscal costs that turned out to be too low and that they later revised upward.

In this paper we aim to explain the energy spending in the IRA and demonstrate that it is highly variable, uncapped, and has been underestimated; provide a transparent and replicable method for scoring the IRA in the upcoming 10-year budget window; estimate a range of total spending (total taxpayer liability) through 2050; highlight the major spending drivers; and advocate for full legislative repeal of the IRA while noting significant reforms that could be made to the IRS guidance and regulations dealing with IRA implementation.

Table 1 summarizes the upper- and lower-bound estimates of energy spending in the IRA, both for the coming 10-year budget window and for a longer budget window stretching to 2050. It also shows the effect of applying a 3 percent discount rate to the spending in the 2050 budget window, which is to reduce the net present value of the stream of IRA spending by approximately 30 percent.

History of the Inflation Reduction Act

The most salient goal of the IRA was not to reduce inflation—it was to accelerate the decarbonization of the US economy. In July 2024, President Joe Biden wrote that his administration had passed "the most important climate legislation in the history of the world."[1] Biden is correct if we judge the significance of legislation by the amount of government spending it enables—there is not a single piece of legislation or other government action that commits more public spending to address climate change than the IRA.[2]

Biden signed the IRA into law on August 16, 2022, following party-line votes in the House and the Senate, to pass the bill through the budget reconciliation process.[3] Advancing as a budget reconciliation measure meant the IRA could pass on a simple majority in the Senate instead of requiring a filibuster-proof majority of 60 Senate votes.[4] By the same token, the IRA can be repealed as part of a budget reconciliation package.

The final version of the IRA was the culmination of a long process of shaping the climate portion of Biden's Build Back Better agenda.[5] An earlier iteration of climate-related spending was approved by the House Energy and Commerce Committee in 2021 as the Clean Electricity Performance Program—scored at approximately $150 billion of the $3.5 trillion Build Back Better package—but this early proposal failed to gain political traction.[6] The IRA ultimately moved forward with the energy subsidies analyzed in this paper and some provisions unrelated to climate, such as price caps on medication.[7]

Table 2 summarizes the various energy-related subsidies in the IRA and shows the expiration dates for each, as well as the locations of each provision in the IRA statute and the IRS code.

TOTAL IRA SPENDING IS DIFFICULT TO ESTIMATE

Other estimates of IRA spending range from about $350 billion to more than $1 trillion. When Congress passed the IRA, the Congressional Budget Office (CBO) and the Joint Committee on Taxation (JCT) estimated that its energy-related subsidy provisions would cost between $369 billion and $383 billion over the 10-year budget window. In contrast, several third-party estimates suggested that costs could exceed three times those projected by the CBO and the JCT.[8] The wide range in estimates is a result of the open-ended nature of many of the IRA's energy subsidies, which are highly sensitive to factors such as industry growth, market adoption, and technological advancements.

Each provision in Table 2 represents a different category of spending that contributes to the ultimate cost of the IRA, and the forecast range of annual spending in each category is wide. Furthermore, the length of the budget window has a significant effect on the analysis. Many of the IRA's subsidy provisions expire in 2032, such as the tax credits for electric vehicles (EVs) and existing nuclear power plants. However,

Table 1

Cato's estimate of energy spending in the Inflation Reduction Act

Scoring window	2025–2034	2025–2050
Upper bound	$1.97 trillion	$4.67 trillion
Discounting 2050 total at 3%		$3.26 trillion
Lower bound	$936 billion	$2.04 trillion
Discounting 2050 total at 3%		$1.47 trillion

Sources: Authors' calculations; "Annual Energy Outlook 2023," US Energy Information Administration, March 2023; and Pieter Gagnon et al., "2023 Standard Scenarios Report: A US Electricity Sector Outlook," National Renewable Energy Laboratory, revised January 2024.
Note: Please contact the authors to request a copy of the underlying datasets we used and to see our calculations.

Table 2

Energy subsidy provisions in the Inflation Reduction Act: expiration dates and key details

Provisions	Expiration date	Notes	IRA section(s)	Internal Revenue Code section(s)
Clean vehicle credits	2032		Sec. 13401, 13402, 13403, 13404	Sec. 25E, 30C, 30D, 45W
Residential clean energy credit	2034	Storage portion begins phaseout in 2032 and ends in 2035	Sec. 13302	Sec. 25D
Energy efficient home credit	2032		Sec. 13304	Sec. 45L
Clean hydrogen production credit	2042	Construction must begin by 2032, credit extends for the first 10 years of life	Sec. 13204	Sec. 45V
Credit for carbon sequestration	2044	Facility must be developed by 2032, credit extends for 12 years beyond the development date	Sec. 13104	Sec. 45Q
Production tax credit for electricity from renewables	2024	Rolls into the PTC under section 13701 beginning in 2025	Sec. 13101	Sec. 45
Clean fuel production credit	2028		Sec. 13704	Sec. 45Z
Nuclear production credit	2032		Sec. 13105	Sec. 45U, 45J
Clean electricity production tax credit	Contingent expiration date	Expires when GHG emissions for electricity are below 25% of 2022 levels	Sec. 13701	Sec. 45Y
Clean electricity investment tax credit	Contingent expiration date	Expires when GHG emissions for electricity are below 25% of 2022 levels	Sec. 13702	Sec. 48E
Advanced energy project credit	Expires upon fund exhaustion	Expires once the $10 billion in allocated funds are exhausted	Sec. 13501	Sec. 48C
Advanced manufacturing production credit	No full expiration	Phaseout begins in 2030, fully phased out after 2032 for most provisions; no phaseout for applicable critical materials (as defined under Sec. 45X(b)(3)(C))	Sec. 13502	Sec. 45X

Source: 117th Congress, Inflation Reduction Act of 2022, Pub. L. No. 117-169, 136 Stat. 1818, August 16, 2022.

3

some of the IRA's largest subsidies phase down only when the level of greenhouse gas (GHG) emissions from the electricity sector falls to 25 percent of the 2022 baseline.[9]

The electricity sector is highly unlikely to reduce the GHG emissions by 75 percent from 2022 levels in the next 10 years, especially if electricity demand continues to grow.[10] Further, the IRA promotes electrification—as with EVs—which will contribute to increased electricity demand, thus making the GHG target more difficult to reach. Figure 1 illustrates GHG projections from the Energy Information Administration (EIA), which show that electricity sector emissions will remain far above the IRA's target of 25 percent of the 2022 level through 2050, even in the scenario that assumes a "high uptake" of IRA subsidies.[11]

Major Spending Drivers

Some of the costliest provisions of the IRA are the production tax credit (PTC) and the investment tax credit (ITC) for clean electricity production under IRS code sections 45Y and 48E, respectively, and the advanced manufacturing tax credit under IRS code section 45X. In the case of the 45Y production tax credit, the owner of a power plant that qualifies for clean electricity credits will receive an inflation-adjusted payment per unit of clean electricity produced. In 2023, the going rate for the PTC was $27.50 per megawatt-hour. The section 48E investment tax credit reimburses a percentage—typically 30 percent—of the

up-front investment cost of a power plant that produces clean electricity or an electricity storage facility, such as a battery or pumped storage hydroelectric facility. Starting in 2025, a clean electricity production facility will have the option of choosing either the section 45Y production tax credit or the section 48E investment tax credit, but not both. The section 45Y and 48E credits in the IRA will likely cost taxpayers between $70 billion and $180 billion per year in the years just before the GHG target is met.[12]

The section 45X tax credit for advanced manufacturing includes an uncapped production tax credit for critical minerals. Under section 45X(c)(6) of the IRS code (section 13502 of the IRA), the federal government will indefinitely subsidize 50 different "critical minerals." This includes high-volume production minerals such as aluminum, lithium, nickel, and cobalt. These subsidies, particularly in the context of rising demand for lithium-ion batteries used for EVs and energy storage, risk creating a compounding effect, where multiple subsidies stack across the supply chain. For example, in a "solar plus storage" context, taxpayers not only subsidize the solar energy production through the PTC, but also the battery through the ITC and the minerals that go into that battery via section 45X(c)(6). Recent guidance on section 48E added another layer of taxpayer liability, as some transmission upgrades for new sources will also be subsidized by the ITC.

Given recent trends—including growing demand for electricity and the looming Trump administration reversal of power plant regulations issued by the Environmental

Figure 1

Electricity sector emissions
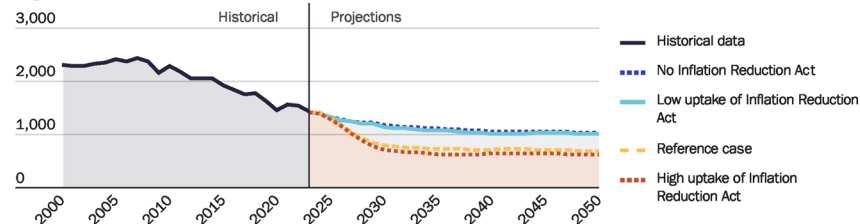
CO_2 emissions, million metric tons

Sources: Authors' calculations; "Annual Energy Outlook 2023: Reference Case Projection Tables, Table 18," US Energy Information Administration, March 2023; and "US Energy-Related Carbon Dioxide Emissions, 2023," US Energy Information Administration, April 2024.
Note: Please contact the authors to request a copy of the underlying datasets we used and to see our calculations.

Protection Agency (EPA)—the decarbonization of the grid is likely to slow, or perhaps stall, in terms of total emissions.[13] As one significant data point, the most recent capacity auction for electricity generation resources in the PJM Interconnection, which is the wholesale electricity market covering 13 states in the mid-Atlantic region and the District of Columbia, retained every GHG-emitting power plant that offered capacity.[14] In other regions with faster-growing deployment of renewable resources, such as Texas, decarbonization of the electricity sector has been modest, in part because reductions in the GHG intensity of electricity generation are being offset by increased electricity use overall.[15]

If the growth in nationwide electricity consumption continues, many of the existing GHG-emitting power plants will be needed for reliability—and this is true independent of their profitability. If supply shortfalls are imminent, grid operators will not allow fossil-fueled power plants (mostly coal and natural gas) to close in the near term.[16] Finally, a reversal of the EPA's power plant GHG rule would allow for a variety of natural gas–fired power plants to be built to meet rising electricity demand, further increasing GHG emissions and lengthening the term of subsidies as currently designed in the IRA.[17]

Initial Estimates of the IRA's 10-Year Budget Cost

The one-page summary of the budget impacts of the IRA circulated by Senate Democrats in July 2022 said the Energy Security and Climate Change section of the IRA would cost $369 billion, but it did not itemize the wide-ranging set of provisions.[18] In August 2022, the CBO and the JCT released an itemized estimate that revised the 10-year cost of the IRA's energy-related provisions to approximately $383 billion, due to minor adjustments.[19] These estimates are challenging to deconstruct and replicate because the agencies do not publish replication codes or detailed methodologies. However, third-party estimates from the same period align with the initial CBO and JCT estimates. Researchers using the Penn Wharton Budget Model found that the climate and energy provisions of the IRA would cost $384 billion in August 2022.[20] Also, that same month, the nonpartisan Tax Foundation estimated there to be $352 billion in expanded tax credits in the IRA.[21]

Updated Estimates of the IRA's 10-Year Budget Cost

Although the various initial estimates of IRA spending all clustered around the original score of roughly $370 billion, the CBO and others have since updated their estimates multiple times. As summarized in a February 2024 article by the Tax Foundation, the CBO and the JCT found that "the IRA credits appear to cost approximately $786 billion over the new budget window (2024–2033)."[22] The updated amount is more than double the original CBO and JCT estimate.

Estimates by private firms, think tanks, and researchers are even higher. The updated Penn Wharton Budget Model estimated the IRA's climate and energy provisions will cost just over $1 trillion by 2032.[23] The Brookings Institution found that the 10-year cost could be roughly $800 billion—again, more than twice the CBO's original estimate.[24] A widely circulated report by Goldman Sachs estimated the 10-year cost would be $1.2 trillion, more than triple the CBO's original estimate and 50 percent larger than the CBO's revision.[25] Figure 2 summarizes the findings of these groups as well as Cato's upper- and lower-bound estimates for the upcoming 10-year budget window.

There have been several regulatory changes since the IRA became law that might contribute to the discrepancies in estimates over time. On March 20, 2024, the EPA finalized tighter tailpipe emissions standards that were projected to increase EV sales by raising the relative price of cars with internal combustion engines, which would boost consumer use of the IRA's clean vehicle credit. Those regulations could have contributed to the increase in the cost of the clean vehicle provision from the CBO/JCT's estimate of $14 billion in 2022 to $73 billion in February 2024.[26] The future of the EPA regulations is uncertain, and so is the future of market demand for EVs without the regulations or credits. Figure 2 shows much lower spending on the EV tax credit in the Cato estimates than the Penn Wharton and Goldman Sachs estimates, partly because we expect slower growth in the US EV market due to factors such as consumer demand and other market constraints.

The JCT estimated that changes to regulations—including updated guidance by the IRS—are likely to double initial cost projections for some credits. Goldman Sachs determined that most of the disparities between initial and

later cost projections are "driven by higher estimates for all categories, especially our significantly higher estimates for advanced manufacturing tax credits (45X) and EV tax credits."[27] Overall, the 10-year spending estimates have shifted from the initial range of less than $400 billion to a new range of $1 trillion or more.

Early Data from Tax Returns

Although IRA spending projections are inherently uncertain, new information from the IRS shows that the actual subsidies included in tax filings have surpassed initial projections. For example, the Treasury Department recently highlighted the rapid uptake of the residential clean energy credit and the energy-efficient home-improvement credit. These two credits cost $8.4 billion in 2023, but initial estimates were a fraction of that.[28]

The residential clean energy credit was estimated to cost $459 million in 2023, with a total cost of $22 billion by 2031.[29] The IRS data show an actual cost to taxpayers of $6.3 billion in 2023, roughly $4 billion of which is attributable to the IRA (as the original credit would have still been in effect until the end of 2023).[30] At this pace, the total cost would exceed $200 billion by 2032.

Figure 2

Comparing third-party estimates of the IRA's fiscal costs to the government's

10-year cost estimates of the IRA's energy and climate-related provisions
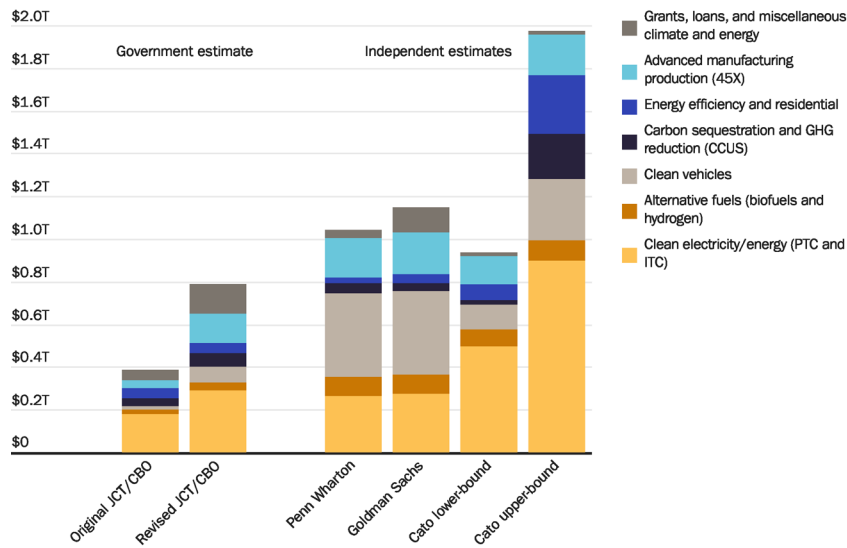
Source: Authors' calculations; "Annual Energy Outlook 2023," US Energy Information Administration, March 2023; and Pieter Gagnon et al., "2023 Standard Scenarios Report: A US Electricity Sector Outlook," National Renewable Energy Laboratory, revised January 2024; and "Estimated Budget Effects of the Revenue Provisions of Title I—Committee on Finance of an Amendment in the Nature of a Substitute H. R. 5376," Joint Committee on Taxation, August 9, 2022; and "The Budget and Economic Outlook: 2024–2034," Congressional Budget Office, February 2024; Michele Della Vigna et al., "Carbonomics: The Third American Energy Revolution," Goldman Sachs, March 22, 2023; and Alex Arnon et al., "Senate Passed Inflation Reduction Act: Estimates of Budgetary and Macroeconomic Effects," University of Pennsylvania Wharton Budget Model, August 12, 2022.

Note: Please contact the authors to request a copy of the underlying datasets we used and to see our calculations. PTC = Production Tax Credit; 45X = Internal Revenue Code section that establishes the Advanced Manufacturing Production Credit; ITC = Investment Tax Credit; and CCUS = carbon capture, utilization, and storage.

Actual costs for the energy-efficient home-improvement credit in 2023 were $2.1 billion.[31] This is nearly eight times the original estimate of $273 million for 2023 and exceeds the initially estimated 10-year total of $2 billion.[32] The sharp growth of these two credits shows how initial, and even revised, estimates have been off by billions of dollars, not only collectively but for many of the individual provisions within the IRA.

Estimates of the IRA's Cost Beyond the 10-Year Budget Window

Few modelers have attempted to estimate what the IRA might cost beyond a 10-year window. One such estimate comes from Wood Mackenzie, an energy transition analytics company. Two Wood Mackenzie analysts estimated that the clean electricity portions of the IRA—the PTC and the ITC for clean electricity generation and storage—will cost nearly $3 trillion by 2060.[33] Wood Mackenzie has since identified issues, namely interconnection delays and slow expansion of transmission capacity, that could push the phasedown year for the PTC and the ITC even later because they would delay hitting the 75 percent reduction goal.[34]

HOW WE APPROACH OUR COST ESTIMATES

We create a simple model to estimate a range of spending on the energy subsidies in the IRA. Using projections published by the EIA and the National Renewable Energy Laboratory (NREL), we take levels of deployment for each subsidized technology and estimate the cumulative amounts of the various tax credits in the IRA. This methodology is then applied to all subsidized technologies and investments (electricity generation resources, energy storage, EVs, etc.).

Because there are many moving parts in the IRA framework, we make educated guesses about the type of subsidy a given project developer is likely to select, as well as the magnitude of the subsidy. For example, developers of offshore wind facilities may select the ITC rather than the PTC, so we estimate the offshore wind subsidies in the IRA by multiplying the amount of offshore wind investment by the subsidy level. The range established in the statute goes from 6 percent to at least 50 percent of the cost of the project. We assume a

30 percent ITC. Our estimated offshore wind subsidy for each year, then, based on EIA and NREL projections, is 30 percent of the estimated investment in offshore wind facilities.

We repeat this estimate for each year out to 2050, using projected deployment levels from both the EIA's Annual Energy Outlook and NREL's modeling of state goals for offshore wind. In this case, NREL's projection is significantly higher than the EIA's, so the subsidy estimate that relies on the NREL projection is much higher than the EIA-based estimate. In most cases, the EIA's estimate for subsidy-eligible technologies is lower than NREL's estimate, and the difference in deployment levels between the EIA and NREL provides the lower and upper bound, respectively, for the annual subsidy estimates.

What this paper does not do. We do not offer a mid-point estimate for the total cost of the IRA, either over the 10-year budget window or out to 2050, because there are too many uncertainties involved; our estimates would be based on arbitrary assumptions, and we want to avoid the false appearance of precision. Further, although IRA spending will likely continue beyond 2050, we do not make any spending projections beyond 2050 because the number of variables—including changes to energy technology or broader economic conditions—would push our analysis further toward the realm of pure guesswork. Finally, we do not use capacity expansion models; contributions from these models would be unlikely to contradict our findings.[35] Our goal is to present an IRA spending estimate that is generally accessible, transparent, and replicable using basic spreadsheet software.[36]

Full versus partial credits. Estimates of the IRA's fiscal impact hinge, in part, on whether the full credits are attainable, which depends on variables such as supply-chain decisions made by private companies. For example, some of the ITCs range from 6 percent of the total investment to 50 percent or more, depending on factors such as labor requirements and domestic sourcing of materials. As noted before, to simplify our estimates, we model all ITCs at 30 percent, which is consistent with long-standing levels of the solar ITC.[37] As another example, the tax credit for purchasing an EV depends on production decisions made by automakers and the income level of the household purchasing the EV.[38] In our lower- and upper-bound estimates, we model partial and full EV credits, respectively.

Election of the ITC or the PTC. Developers of new or expanded low-GHG electricity generation resources can choose between an up-front ITC of typically 30 percent or a 10-year stream of PTC payments (the 2023 value of the PTC was $27.50 per megawatt-hour of electricity generation).[39] To model the choice between the ITC and the PTC in our estimates, we assumed that developers of offshore wind and new nuclear resources will elect the ITC, and other energy-generation resources will choose the PTC. Although that assumption may not always be true in all regions or for all years, we believe it will yield accurate results. In addition, the ITC/PTC distinction may not significantly alter the total cost of the IRA by 2050. However, it does change the timing of subsidy payments because spending will occur earlier if more developers choose the ITC and later if more developers choose the PTC and, hence, could impact the discounted values of IRA spending. Notably, for some technologies such as energy storage, which includes everything from batteries to pumped hydroelectric generation resources, the ITC is the only category of IRA subsidy available.

IRS guidance. Many of the cost estimates depend on ongoing changes and clarifications to the implementation guidelines issued by the IRS. For example, owners of some existing low-GHG electricity generators can take advantage of the IRS's so-called 80/20 rule by "repowering," meaning retrofitting facilities that are already in service.[40] In the context of energy tax credits, this rule states that the IRS will treat a retrofitted electricity generation or storage unit as if it were new, and thus it would be eligible for tax credits for new resources if the value of the new components is at least 80 percent of the total market value of the refurbished facility.

We assume that a gradually increasing portion of existing hydroelectric facilities, starting at zero in 2024 and increasing to 25 percent of all hydroelectric generation units by 2050 in our upper-bound estimates, will take advantage of the 80/20 rule.[41] We also assume in our upper-bound estimates that all owners of wind and solar resources will repower and requalify for the PTC when they are eligible to do so.[42] In contrast, our lower-bound estimates assume that no repowering of wind and solar resources takes place.

Data sources and sensitivity analysis. We rely on data from forecasts published by government sources, namely the EIA and NREL. Our assumptions and analysis are informed, in part, by previous work by private and academic researchers, such as Wood Mackenzie, Goldman Sachs, and Princeton University's REPEAT Project.[43] We note that the forecasts we rely on are inherently uncertain and produce large differences in spending estimates.

A major difference between our lower-bound estimate of IRA spending by 2050 and our upper-bound estimate is driven by the difference between the EIA's relatively lower projection of solar generation and NREL's relatively higher projection. Similarly, deployment levels of new or repowered nuclear energy represent about a $600 billion difference between lower- and upper-bound estimates, or zero new deployment versus 200 gigawatts (GW) by 2050, respectively.

The 200 GW upper bound for new nuclear deployment comes from the Biden administration's stated goals and the authors' judgments about possible deployment levels for new nuclear under a high-load growth scenario. For our upper-bound estimates of tax credits for offshore wind and EVs, we also go beyond government projections and substitute relevant policy goals, such as states' offshore wind mandates and the previous administration's goal of EVs being 50 percent of new vehicles sold by 2032.

Figures 3 and 4 show the share of total IRA spending by subsidy category in our lower-bound and upper-bound scenarios, respectively. Note the large difference in ITC payments, which reflects the much higher deployment levels of new nuclear and offshore wind resources in our upper-bound estimate.

In each estimate, our goal is to establish a sound framework for analyzing IRA spending—within the 10-year budget window as well as through 2050—and to advance a transparent and accurate framework for others to build on.[44]
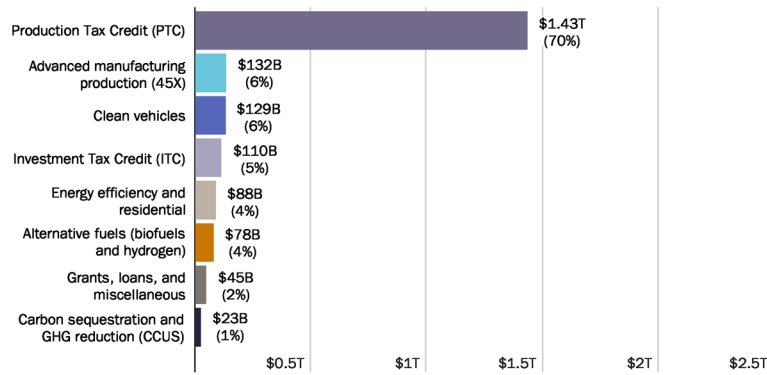
Expiration dates for IRA subsidies. A difficult element to predict is the end date for the energy subsidy provisions that expire only when the electricity sector meets certain GHG targets. To repeat, the PTCs and the ITCs phase down only when the level of GHG emissions from the electricity sector falls to 25 percent of the 2022 level. The required reduction will likely not occur by 2050 because there will be significant growth in electricity demand, making a target based on a GHG level (rather than a GHG intensity) more difficult to reach. This is consistent with NREL modeling.[45]

Although the phasedown year is not easy to forecast, a shorter subsidy window is unlikely to materially change the cost of the IRA between now and 2050 because hitting the

Figure 3

Spending breakdown in Cato's 2050 lower-bound estimate

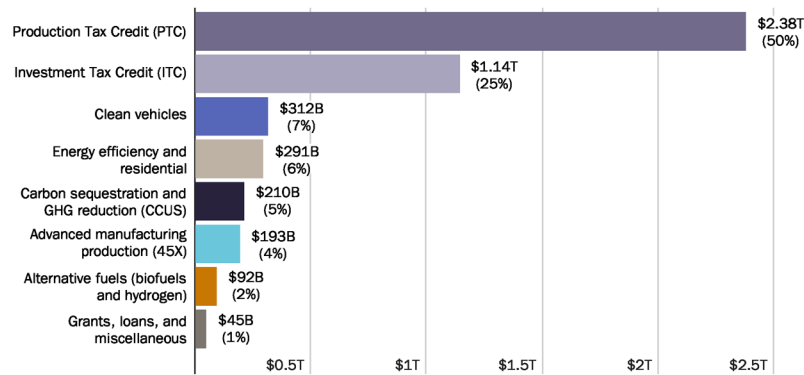Lower-bound cost estimate of energy and climate-related provisions

Category	Value
Production Tax Credit (PTC)	$1.43T (70%)
Advanced manufacturing production (45X)	$132B (6%)
Clean vehicles	$129B (6%)
Investment Tax Credit (ITC)	$110B (5%)
Energy efficiency and residential	$88B (4%)
Alternative fuels (biofuels and hydrogen)	$78B (4%)
Grants, loans, and miscellaneous	$45B (2%)
Carbon sequestration and GHG reduction (CCUS)	$23B (1%)

$0.5T $1T $1.5T $2T $2.5T

Sources: Authors' calculations; "Annual Energy Outlook 2023," US Energy Information Administration, March 2023; and Pieter Gagnon et al., "2023 Standard Scenarios Report: A US Electricity Sector Outlook," National Renewable Energy Laboratory, revised January 2024.
Notes: Please contact the authors to request a copy of the underlying datasets we used and to see our calculations. PTC = Production Tax Credit; 45X = Internal Revenue Code section that establishes the Advanced Manufacturing Production Credit; ITC = Investment Tax Credit; and CCUS = carbon capture, utilization, and storage.

Figure 4

Spending breakdown in Cato's 2050 upper-bound estimate

Upper-bound cost estimate of energy and climate-related provisions

Category	Value
Production Tax Credit (PTC)	$2.38T (50%)
Investment Tax Credit (ITC)	$1.14T (25%)
Clean vehicles	$312B (7%)
Energy efficiency and residential	$291B (6%)
Carbon sequestration and GHG reduction (CCUS)	$210B (5%)
Advanced manufacturing production (45X)	$193B (4%)
Alternative fuels (biofuels and hydrogen)	$92B (2%)
Grants, loans, and miscellaneous	$45B (1%)

$0.5T $1T $1.5T $2T $2.5T

Sources: Authors' calculations; "Annual Energy Outlook 2023," US Energy Information Administration, March 2023; and Pieter Gagnon et al., "2023 Standard Scenarios Report: A US Electricity Sector Outlook," National Renewable Energy Laboratory, revised January 2024.
Notes: Please contact the authors to request a copy of the underlying datasets we used and to see our calculations. PTC = Production Tax Credit; 45X = Internal Revenue Code section that establishes the Advanced Manufacturing Production Credit; ITC = Investment Tax Credit; and CCUS = carbon capture, utilization, and storage.

GHG target implies aggressive deployment of subsidized resources.[46] In other words, IRA subsidies will be significant even if the GHG targets are achieved well before 2050.

Methodology Specific to the 10-Year Budget Window Estimates

Among the provisions that expire in 2032, we provide our own estimate for some of the tax credits, including the EV credit and the residential clean energy credit. For other provisions, we rely on the CBO, JCT, and other estimates for the contribution of those provisions to total spending. For example, we rely exclusively on external estimates for the total 10-year cost of subsidies for hydrogen production, biofuels, carbon capture, and the manufacturing tax credit. Figure 5 illustrates our upper-bound 10-year estimate broken down by subsidy type.

Methodology Specific to Estimating Beyond the 10-Year Budget Window

Our estimates of the long-term cost of the PTC and the ITC follow the methodology of projecting the amount of subsidized activity, such as eligible clean energy production

for the PTC and the eligible clean energy investment for the ITC, and then applying an estimated subsidy. We assume developers of all new onshore wind, solar, geothermal, and hydroelectricity production will claim the standard value of the PTC, which was $27.50 per megawatt-hour in 2023. If new projects elect the ITC rather than the PTC, that will shift projected spending to earlier years because ITC subsidies are paid up front, whereas PTC payments are spread over 10 years but may not substantially change total costs.

Figure 6 breaks down IRA spending by year and shows the contribution of each type of subsidy. Note that the total spending rises relatively steadily for every year from 2033 through the end of the projection. By 2050, the annual cost of the IRA's energy subsidies reaches $180 billion, which is nearly half the original CBO/JCT score of $369 billion.

We assume developers of all new offshore wind and new nuclear facilities will choose to receive the ITC. Projected levels of investment in offshore wind in each year through 2050 vary significantly—the EIA's Annual Energy Outlook shows little investment (23 GW), whereas NREL modeling of state policies mandating offshore shows high investment (112 GW).[47] To convert installed gigawatts to investment spending, we use the EIA's base overnight construction cost of offshore wind (with no adder applied) of $5,338 per

Figure 5

10-year cost estimate approaching $2 trillion

Our 10-year upper-bound cost estimate of energy and climate-related provisions
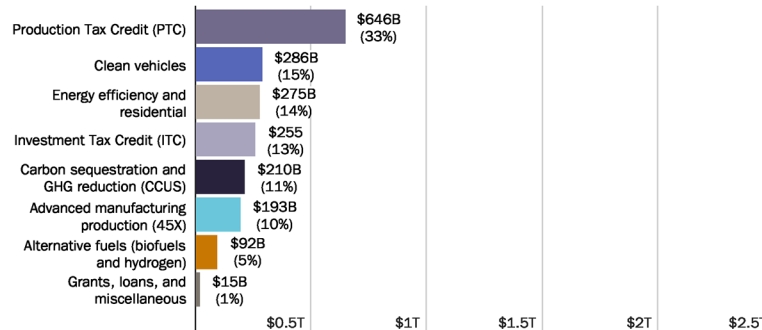
Sources: Authors' calculations; "Annual Energy Outlook 2023," US Energy Information Administration, March 2023; and Pieter Gagnon et al., "2023 Standard Scenarios Report: A US Electricity Sector Outlook," National Renewable Energy Laboratory, revised January 2024.

Notes: Please contact the authors to request a copy of the underlying datasets we used and to see our calculations. PTC = Production Tax Credit; 45X = Internal Revenue Code section that establishes the Advanced Manufacturing Production Credit; ITC = Investment Tax Credit; and CCUS = carbon capture, utilization, and storage.

kilowatt.[48] To derive tax credit spending amounts, we apply a 30 percent ITC to the level of new investment in each year.

New energy storage projects are eligible for only the ITC. The arithmetic for quantifying tax credits under a 30 percent ITC for energy storage is calculated the same way as for offshore wind, with the credit applied to a percentage of the capital investment in eligible projects. Hence the level of the tax credit is based on the project's up-front cost. However, each input for our energy storage projections—total installed capacity and cost per unit—features variability that is difficult to capture in a simple model. We found the EIA's projection

of new storage deployment to be implausibly low, even for a lower bound, so we rely instead on the REPEAT Project for a lower-bound estimate of energy storage investment and on NREL for the upper bound. Our estimates account only for the capital costs of battery storage and not total system costs, as formulated by NREL.[49] Opting to use total system costs would increase the ITC costs by approximately $80 billion by 2050, depending on the cost scenario used.[50]

To the best of our knowledge, no one has attempted to estimate the long-term cost of the advanced manufacturing (45X) credit for critical mineral production. The critical

Figure 6

Production Tax Credit and Investment Tax Credit alone could cost over $3 trillion by 2050

Cumulative estimated cost of the PTC and ITC
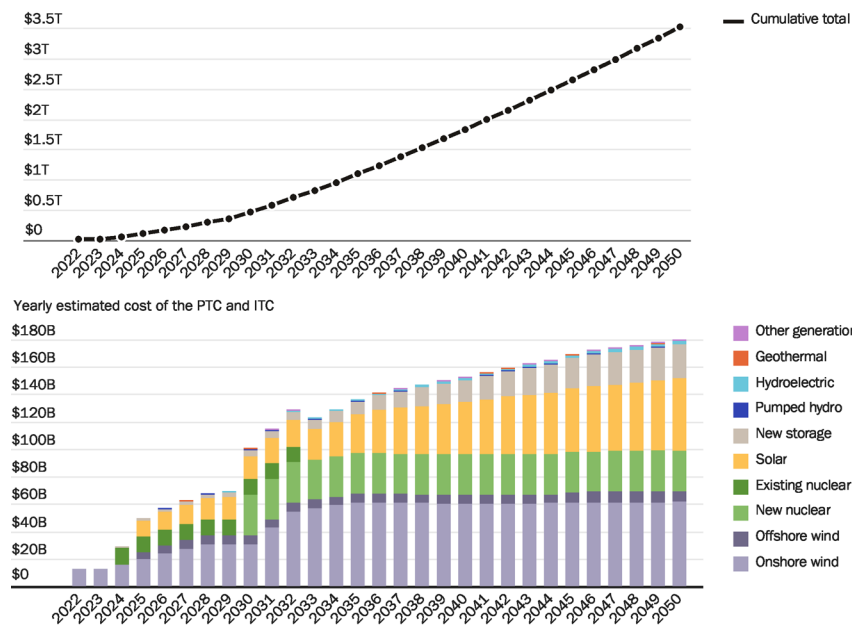
Yearly estimated cost of the PTC and ITC

Source: Authors' calculations; "Annual Energy Outlook 2023," US Energy Information Administration, March 2023; and Pieter Gagnon et al., "2023 Standard Scenarios Report: A US Electricity Sector Outlook," National Renewable Energy Laboratory, revised January 2024; and REPEAT Project (Rapid Energy Policy Evaluation and Analysis Toolkit), Princeton University; and Ryan Sweezey, "The Indefinite Inflation Reduction Act: Will Tax Credits for Renewables Be Around for Decades?," Wood Mackenzie, March 2023.

Notes: Please contact the authors to request a copy of the underlying datasets we used and to see our calculations. PTC = Production Tax Credit; ITC = Investment Tax Credit.

mineral provision within section 45X has no expiration date and applies to approximately 50 critical minerals, including some minerals whose domestic production could rise sharply, such as lithium.[51] Similarly, the Electric Power Research Institute estimates that the production tax credits for clean hydrogen (45V) could cost between $385 billion and $756 billion by 2050.[52] These high-end figures are not reflected in our own estimates, but we note them here to illustrate the open-ended nature of IRA spending.

FINDINGS

Within the upcoming 10-year budget window (2025–2034), we estimate the IRA spending will range between $936 billion under a set of lower-bound assumptions and $1.97 trillion under a set of upper-bound assumptions. By 2050, total IRA spending could range between $2.04 trillion and $4.67 trillion. Table 3 shows Cato's estimated total spending on IRA energy subsidies through the upcoming 10-year budget scoring window, as well as through 2050, including present values of IRA spending through 2050 using discount rates of 0, 3 percent, and 7 percent.

The original CBO/JCT 10-year score significantly underestimated the subsidy payments authorized by the IRA, but third-party estimates of the IRA's 10-year budget score—such as the Goldman Sachs estimate of $1.2 trillion—fall comfortably between our lower- and upper-bound estimates for the upcoming 10-year budget window.

Our estimates also reflect total spending through 2050, calculated using present values of projected 2050 spending levels with discount rates of 0, 3 percent, and 7 percent. For example, applying a 3 percent discount rate to upper-bound spending yields a present value of $3.26 trillion, which is approximately 30 percent lower than the undiscounted total of $4.67 trillion. Although we recognize that spending

beyond the 10-year budget window is unlikely to be scored as part of budget reconciliation legislation, it is an important consideration as policymakers weigh reform or repeal.[53]

We also note the possibility of applying a longer-term scoring window to match tax cuts with spending cuts beyond the typical 10-year budget window. Because IRA spending on the PTC and the ITC is likely to continue to increase throughout the 2040s, extending the budget window for a reconciliation package beyond the typical 10 years will increase the amount of offsets made available by IRA repeal.

POLICY RECOMMENDATIONS

The federal government passed the largest climate bill in history, vastly underestimated the costs, and subjected taxpayers to unlimited liability. We recommend full repeal of the IRA's energy subsidies. If full repeal is not possible, Congress should limit taxpayer liability by capping the dollar value of subsidies, putting an expiration date on the subsidies regardless of emissions levels, or both. For example, Congress could limit the level of IRA subsidies to the August 2022 CBO and JCT score of $383 billion.

Disparities in cost estimates highlight the need for policymakers to require budget experts at the CBO, JCT, and other government research organizations to publish transparent estimates of the IRA's long-term costs.[54] Given the size and volatility of IRA cost estimates—initial estimates of roughly $370 billion over 10 years have grown to $4.67 trillion by 2050—the forward-looking budget reconciliation score for IRA repeal should be fully transparent and replicable by outside researchers.

Finally, in addition to legislative reform or repeal of IRA spending, the Trump administration should limit the availability of IRA subsidies by unwinding the series of IRS guidance documents that have vastly expanded the cost of

Table 3

Cato's estimate of energy spending in the Inflation Reduction Act

	10-year score	2050 score (no discount)	2050 score (3% discount rate)	2050 score (7% discount rate)
Upper bound	$1.97 trillion	$4.67 trillion	$3.26 trillion	$2.2 trillion
Lower bound	$936 billion	$2.04 trillion	$1.47 trillion	$1.03 trillion

Sources: Authors' calculations; "Annual Energy Outlook 2023," US Energy Information Administration, March 2023; and Pieter Gagnon et al., "2023 Standard Scenarios Report: A US Electricity Sector Outlook," National Renewable Energy Laboratory, revised January 2024.
Note: Please contact the authors to request a copy of the underlying datasets we used and to see our calculations.

the IRA. In addition to the repowering issue outlined above, in December 2024, the IRS extended the section 48E ITC to include components of the transmission system—an action contemplated by Congress that was expressly removed from the climate portion of the Build Back Better agenda.[55] Such IRS guidance is inappropriate; it could fail judicial review and is remediable by the executive branch.

CONCLUSION

The IRA was passed to decarbonize the US economy, and the CBO and the JCT estimated it would cost less than $400 billion over 10 years. Using the methods described above, we estimate far larger costs of up to $1.97 trillion over 10 years and $4.7 trillion by 2050. The American people and our elected representatives cannot make informed decisions about the IRA without an accurate assessment of its cost, and we should not have had to wait two years to understand the IRA's impact on the budget.

Further, Congress should stop issuing blank-check subsidies with no expiration date. The massive cash transfer from taxpayers to private firms under the guise of environmentalism creates an overwhelming and undue burden on taxpayers who continue to pay for fiscally irresponsible federal spending. By nearly any metric, the IRA is a flawed policy that should be repealed.

APPENDIX

There are significant problems with applying a strict cost-benefit analysis to the IRA. We note that many economists view cost-benefit studies as central to analyzing climate policy, however, and we offer a cost-benefit framework to those economists. In the case of the IRA, both the benefits and the costs are highly uncertain. The uncertainties on the cost side are the subject of this paper. The range of potential benefits is also wide because there is a large range of plausible estimates of the social cost of carbon dioxide (SCC), which is the most readily available estimate of the social benefit of carbon dioxide (CO_2) reduction. The SCC that was estimated by the EPA during President Barack Obama's administration was about $50 per ton, and the EPA's most recently proposed SCC is $190 per ton of CO_2, both of which were estimated using a global scope. In addition to debates about the correct scope to use when estimating the SCC (global versus domestic), there are also valid debates about the appropriate discount rates.[56]

As shown in Figure 7, the EIA's reference case projects that

Figure 7

All-sector emissions
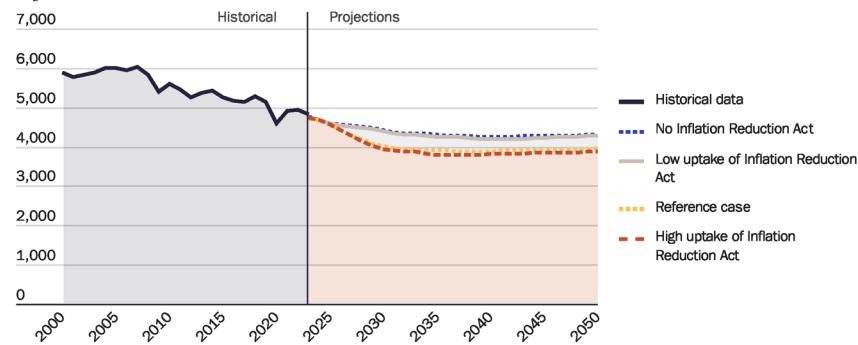
CO_2 emissions, million metric tons

Sources: Authors' calculations; "Annual Energy Outlook 2023: Reference Case Projection Tables, Table 18," US Energy Information Administration, March 2023; and "US Energy-Related Carbon Dioxide Emissions, 2023," US Energy Information Administration, April 2024.
Note: Please contact the authors to request a copy of the underlying datasets we used and to see our calculations.

all-sector CO_2 emissions in the United States will decrease by 0.7 percent annually through 2050. In comparison, in the absence of the IRA, emissions would decline by 0.4 percent annually. In terms of tons of CO_2 rather than percentages, the EIA projects that the IRA will reduce CO_2 emissions by 9.122 billion metric tons by 2050 relative to the no-IRA case.

Applying our lower-bound and upper-bound estimates of the cost of the IRA by 2050, we estimate that the CO_2 abatement cost of the IRA is between $224 and $535 per ton. Different assumptions about the cost of the IRA, its impact on CO_2 emissions levels, and the social cost of CO_2 would yield different results.

NOTES

1. "Read the Letter That Biden Wrote to Say That He Would No Longer Seek Reelection," Associated Press, July 21, 2024.

2. The European Green Deal is likely in second place at about 400 billion euros, but that amount significantly trails the full cost of the IRA, as discussed in this brief. "The European Green Deal: A Growth Strategy That Protects the Climate," European Commission, October 14, 2024.

3. "Roll Call Vote 117th Congress—2nd Session," US Senate, August 7, 2022; and "Roll Call 420 | Bill Number: H.R. 5376," US House of Representatives Clerk, August 12, 2022.

4. Jonathan L. Ramseur, "Inflation Reduction Act of 2022 (IRA): Provisions Related to Climate Change," Congressional Research Service, Report R47262, updated October 26, 2023.

5. Coral Davenport and Lisa Friedman, "'Build Back Better' Hit a Wall, but Climate Action Could Move Forward," *New York Times*, January 20, 2022.

6. Jason Plautz, "House Committee Approves $150B Clean Electricity Performance Program," *Utility Dive*, September 13, 2021; and Ashley J. Lawson, "The Clean Energy Performance Program (CEPP): In Brief," Congressional Research Service, Report R46934, October 7, 2021.

7. Michael F. Cannon, "Medicare Is Not Taxing or Coercing Merck, Just Reducing Its Government Subsidies," *Cato at Liberty* (blog), Cato Institute, June 9, 2023.

8. "Summary: The Inflation Reduction Act of 2022," Senate Democrats, July 27, 2022. The initial estimate of $369 billion excluded certain provisions while also including the Superfund reinstatement under section 13601 of the IRA, which increased credited revenues by approximately $12 billion. The CBO's September 7, 2022, cost estimate states: "JCT estimates that enacting section 13601 will increase revenues credited to the Hazardous Substance Superfund." See "Summary: Estimated Budgetary Effects of Public Law 117-169, to Provide for Reconciliation Pursuant to Title II of S. Con. Res. 14," Congressional Budget Office, September 7, 2022, p. 15.

9. Using 2022 as the baseline rather than a year in the peak-emissions era of 2005–2008 makes a 75 percent reduction much more difficult and places it out of reach in the near term. See "U.S. Energy-Related Carbon Dioxide, 2023," US Energy Information Administration, April 2024.

10. John D. Wilson and Zach Zimmerman, "The Era of Flat Power Demand Is Over," Grid Strategies, December 2023.

11. "AEO2023 Issues in Focus: Inflation Reduction Act Cases in the AEO2023," US Energy Information Administration, March 2023. Twenty-five percent of 1.685 billion metric tons of CO_2 is approximately 0.421 billion metric tons. See Travis Fisher, "New IRS Guidance Makes the Inflation Reduction Act's Energy Subsidies Harder to Eliminate," *Cato at Liberty* (blog), Cato Institute, May 31, 2024.

12. To request a copy of the underlying datasets that we used and to see our calculations, please contact the authors. See row 90 of the lower-bound and upper-bound sheets in our formula workbook.

13. John D. Wilson and Zach Zimmerman, "The Era of Flat Power Demand Is Over," Grid Strategies, December 2023.

14. According to the PJM Interconnection's after-auction report, it appears that every megawatt of coal, oil, and gas offered in the 2025/2026 auction cleared. See "2025/2026 Base Residual Auction Report," *PJM Interconnection*, July 30, 2024, table 6.

15. Electricity-related emissions in Texas are flat or slightly increasing because CO_2 intensity reductions are being offset by load growth. See "Energy-Related CO_2 Emission Data Tables," US Energy Information Administration, October 29, 2024.

16. Mark Takahashi, "PJM Board Response," *PJM Interconnection*, letter to advocates, September 19, 2024.

17. David Jordan, "Trump Vows EPA Rollbacks as Climate Becomes Hot Campaign Issue," *Roll Call*, August 29, 2024.

18. "Joint Statement from Leader Schumer and Senator Manchin Announcing Agreement to Add the Inflation Reduction Act of 2022 to the FY2022 Budget Reconciliation Bill and Vote in Senate Next Week," Senate Democrats, July 27, 2022; and "Summary: The Inflation Reduction Act of 2022," Senate Democrats, July 27, 2022.

19. "Summary: Estimated Budgetary Effects of Public Law 117-169, to Provide for Reconciliation Pursuant to Title II of S. Con. Res. 14," Congressional Budget Office, September 7, 2022; and "Estimated Budget Effects of the Revenue Provisions of Title I—Committee on Finance of an Amendment in the Nature of a Substitute H.R. 5376," Joint Committee on Taxation, August 9, 2022.

20. Jon Huntley et al., "Senate Passed Inflation Reduction Act: Estimates of Budgetary and Macroeconomic Effects," University of Pennsylvania Wharton Budget Model, August 12, 2022.

21. Alex Durante et al., "Details & Analysis of the Inflation Reduction Act Tax Provisions," Tax Foundation, August 10, 2022.

22. William McBride and Alex Muresianu, "Major Takeaways from CBO's Updated Long-Term Outlook," Tax Foundation, February 13, 2024.

23. "Update: Budgetary Cost of Climate and Energy Provisions in the Inflation Reduction Act," University of Pennsylvania Wharton Budget Model, April 27, 2023.

24. John Bistline et al., "Economic Implication of the Climate Provisions of the Inflation Reduction Act," Brookings Papers on Economic Activity, March 29, 2023.

25. "The US Is Poised for an Energy Revolution," Goldman Sachs, April 17, 2023.

26. "Estimated Budget Effects of the Revenue Provisions of Title I—Committee on Finance of an Amendment in the Nature of a Substitute H.R. 5376," Joint Committee on Taxation, August 9, 2022; and "The Budget and Economic Outlook: 2024 to 2034," Congressional Budget Office, February 2024.

27. Michele Della Vigna et al., "Carbonomics: The Third American Energy Revolution," Goldman Sachs, March 22, 2023.

28. Laura Feiveson and Matthew Ashenfarb, "The Inflation Reduction Act: Saving American Households Money While Reducing Climate Change and Air Pollution," US Department of the Treasury, August 7, 2024.

29. "Summary: Estimated Budgetary Effects of Public Law 117-169, to Provide for Reconciliation Pursuant to Title II of S. Con. Res. 14," Congressional Budget Office, September 7, 2022.

30. "SOI Tax Stats—Clean Energy Tax Credit Statistics," Internal Revenue Service, 2023.

31. Laura Feiveson and Matthew Ashenfarb, "The Inflation Reduction Act: Saving American Households Money While Reducing Climate Change and Air Pollution," US Department of the Treasury, August 7, 2024.

32. "Summary: Estimated Budgetary Effects of Public Law 117-169, to Provide for Reconciliation Pursuant to Title II of S. Con. Res. 14," Congressional Budget Office, September 7, 2022.

33. Ryan Sweezey and Robert Whaley, "The Inflation Reduction Act One Year On," Wood Mackenzie, August 4, 2023.

34. David Brown, "Hitting the Brakes: How the Energy Transition Could Decelerate in the US," Wood Mackenzie, May 2024.

35. Erin Boyd, "Power Sector Modeling 101," US Department of Energy.

36. Further research in this area could incorporate sensitivity analyses based on different scenarios that we did not analyze, including different rates of demand growth or cost-reducing breakthroughs in certain technologies. For example, if the component costs for solar photovoltaics continue to be reduced, deployment levels of solar will be higher than if costs level off (all else being equal). Recent technological advancements in geothermal power plants could also encourage faster wide-scale deployment of that technology. Significant expansion of the transmission system would also accelerate IRA subsidies. There are too many degrees of freedom in the modeling of IRA spending to capture all the relevant pieces in a snapshot.

37. "Solar Investment Tax Credit (ITC)," Solar Energy Industries Association, 2024.

38. Donald J. Marples and Nicholas E. Buffie, "Clean Vehicle Tax Credits," Congressional Research Service, updated December 26, 2024.

39. Energy storage resources are eligible for the investment tax credit only. Amish Shah et al., "IRS Releases 2023 Section 45 Production Tax Credit Amounts," Holland & Knight, June 21, 2023.

40. Emma Penrod, "Repowering Will Represent Nearly Half

of All New Wind Capacity in 2024: Enverus," *Utility Dive*, February 22, 2024.

41. Michael Purdie, "How Existing Hydropower Could Benefit from the Inflation Reduction Act," National Hydropower Association, January 8, 2024.

42. Isaac Orr and Mitch Rolling, "The Death of a Wind Farm," *Thinking Minnesota*, Spring 2023.

43. "Data Driven Energy & Climate Policy Evaluation," REPEAT Project (Rapid Energy Policy Evaluation and Analysis Toolkit), Princeton University.

44. To request a copy of the underlying datasets that we used and to see our calculations, please contact the authors.

45. Cy McGeady, "Strategic Perspectives on U.S. Electric Demand Growth," Center for Strategic and International Studies, May 20, 2024. "We assume the tax credits will not phase out before 2050, based on 13 of 17 current policies scenarios in NREL's 2023 Standard Scenarios never reaching the Inflation Reduction Act of 2022's emissions reduction targets." See "Financial Cases and Methods," National Renewable Energy Laboratory, 2024; and Pieter Gagnon et al., "2023 Standard Scenarios Report: A U.S. Electricity Sector Outlook," National Renewable Energy Laboratory, revised January 2024.

46. Short of a catastrophic event that would destroy demand for electricity in the United States, the amount of new, low–greenhouse gas (GHG) electricity production that would be required to reach the Inflation Reduction Act's GHG targets would inevitably yield large subsidy payments.

47. The EIA tends to underestimate growth in new and emerging technologies, largely due to its conservative assumptions about market adoption and innovation, compared to organizations like NREL. This is why we incorporate both EIA and NREL projections in our cost

estimates for greater balance.

48. "Cost and Performance Characteristics of New Generating Technologies, *Annual Energy Outlook 2023*," US Energy Information Administration, March 2023.

49. The formula to calculate total system costs according to NREL: Total cost ($/kWh) = energy cost ($/kWh) + power cost ($/kW) / duration (hr).

50. For a fuller discussion of battery cost estimates, see Wesley Cole and Akash Karmakar, "Cost Projections for Utility-Scale Battery Storage: 2023 Update," National Renewable Energy Laboratory, June 2023.

51. We note that unanticipated discoveries of critical mineral deposits in the United States could significantly increase IRA spending under section 45X. See Seth Amgott, "Unlocking Arkansas' Hidden Treasure: USGS Uses Machine Learning to Show Large Lithium Potential in the Smackover Formation," US Geological Survey, October 21, 2024.

52. "Impacts of IRA's 45V Clean Hydrogen Production Tax Credit," Low-Carbon Resources Initiative White Paper, Electric Power Research Institute, November 3, 2023.

53. Andrew R. Garbarino et al., "FINAL Credits Letter," letter to US House of Representatives Speaker Mike Johnson, August 6, 2024.

54. Alex Muresianu and William McBride, "Major Takeaways from CBO's Updated Long-Term Outlook," Tax Foundation, February 13, 2024.

55. See Department of the Treasury, "Definition of Energy Property and Rules Applicable to the Energy Credit," Internal Revenue Service, 26 CFR Part 1, pp. 214–16.

56. Travis Fisher, "The Political Economy of EPA's Updated Social Cost of Carbon," *Cato at Liberty* (blog), Cato Institute, February 28, 2024.

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CITATION

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The Honorable Brett Guthrie
Chairman, House Committee on Energy & Commerce
2125 Rayburn House Office Building
45 Independence Avenue SW
Washington, D.C. 20515

The Honorable Frank Pallone
Ranking Member, House Committee on Energy & Commerce
2125 Rayburn House Office Building
45 Independence Avenue SW
Washington, D.C. 20515

Re: Full Committee Hearing – *Converting Energy into Intelligence: The Future of AI Technology, Human Discovery, and American Global Competitiveness*

Dear Chairman Guthrie and Ranking Member Pallone,

As Executive Director of SAFE's Center for Grid Security, I commend the House Energy & Commerce Committee for holding this timely hearing on the intersection of energy, artificial intelligence (AI), and American competitiveness. Ensuring the United States maintains its global lead in these areas requires more than innovation—it demands action to modernize and expand our energy infrastructure at the speed of national urgency.

AI is reshaping warfare, industrial productivity, and global markets. As recognized by this Committee, AI's transformative power also comes with unprecedented energy demands. The nation's current generation and linear energy infrastructure, such as transmission lines and pipelines, is not equipped to support the scale, speed, or security these technologies require—particularly as they become critical to national defense and industrial output.

To support American leadership in AI, the Center for Grid Security urges the Committee to consider the following critical actions to strengthen our grid energy posture:

1. **Expand Transmission Infrastructure**

A secure, AI-capable grid requires a robust national transmission system that can move power flexibly and efficiently to remote locations where data centers are often located. Long distance lines, interregional connections, and grid-enhancing technologies must be rapidly deployed to meet the needs of industry, communities, and the military.

SAFE

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2. Accelerate Deployment of All Forms of Domestic Energy

From fossil fuels to clean energy, every form of American energy has a role to play in supporting AI and economic resilience. We must unlock new natural gas, advanced nuclear, solar, hydrogen, and battery storage projects—especially those located near major data center corridors and defense installations. To achieve this, we must avoid limiting our policy framework to picking winners and losers among the numerous generation technologies available to American power producers. Capitalizing on the full spectrum of abundant American energy resources will ensure we meet growing demand with the speed and scale required.

3. Prioritize AI's Strategic and Defense Energy Requirements

AI systems are powering decision-making, threat detection, cyber defense, and logistics across every branch of the military. A blackout or energy disruption could now jeopardize not just economic activity—but also mission readiness. Energy access for AI must be viewed as a national defense imperative.

4. Advance Comprehensive Permitting Reform

Outdated, overlapping, and uncertain permitting processes are among the greatest obstacles to building the energy future AI demands. Congress must modernize these processes to allow for timely review and construction of transmission lines, generation resources, and energy storage assets.

Without swift and bold action, the United States risks ceding energy and technological leadership to adversaries. But with pragmatic policy—grounded in security, speed, and dominance—we can build a grid that powers both prosperity and protection.

Thank you for your leadership, and for the opportunity to submit this letter for the record.

Sincerely,

Danielle Russo
Executive Director
Center for Grid Security, SAFE

Learn more about **LSEG**

Exclusive: Micron to impose tariff-related surcharge on some products from April 9, sources say

By **Reuters**

April 8, 2025 8:08 AM EDT · Updated 10 hours ago

SHANGHAI/TAIPEI, April 8 (Reuters) - U.S. memory chipmaker Micron Technology (MU.O) ⧉ has told U.S. customers it plans to impose a surcharge on some products from Wednesday to account for U.S. President Donald Trump's new tariffs, four sources familiar with the matter said.

Micron's overseas manufacturing sites are largely based in Asia, including China, Taiwan, Japan, Malaysia and Singapore.

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The company notified its customers in a letter that while Trump's announcement last week exempted semiconductors, which account for part of Micron's portfolio, the tariffs applied to memory modules and solid-state drives (SSDs), the sources said.

Those products, used to store data in various products from cars to laptops and data center servers, would now be subject to a surcharge, they said.

Micron did not immediately respond to a request for comment.

The notice to customers echoes comments the company made on March 21 on a post-earnings call, when its executives said it intended to pass along costs to customers in areas where tariffs had an impact.

It also comes shortly after Micron in late March notified customers of price rises due to an increase in "un-forecasted demand" for its products.

Trump's announcement last week jolted economies around the world, triggering retaliatory levies from China and sparking fears of a global trade war and recession.

It has also forced companies globally to assess whether they should absorb the tariffs or shift them on to customers.

U.S. customs agents began collecting Trump's unilateral 10% tariff on all imports from many countries on Saturday. Higher "reciprocal" tariff rates of 11% to 50% on individual countries are due to take effect on Wednesday at 12:01 a.m. EDT (0401 GMT).

An executive at an Asian NAND module manufacturer said they were taking a similar approach to Micron to tell U.S. customers they had to figure out the tariffs themselves.

"If they don't want to bear the taxes, we cannot ship the products. We cannot be held accountable for the decisions made by your government," the person said, declining to be named as they were not permitted to speak to the media.

"With this kind of tax rate, no company can generously say, 'I'll take on the burden'."

Reporting by Brenda Goh in Shanghai, Wen-Yee Lee in Taipei, Fanny Potkin in Singapore and Che Pan in Beijing; Editing by Miyoung Kim and Jan Harvey

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Why Trump's tariff and tax policies could derail efforts to boost US power supply

Despite the president's support for lower energy costs, his recent actions could cause electricity prices to soar.

BY: **CATHERINE MOREHOUSE** | 04/08/2025 05:00 AM EDT

President Donald Trump speaks to members of the media before boarding Marine One on the South Lawn of the White House on Thursday. Trump spoke a day after announcing sweeping new tariffs targeting goods imported to the U.S. on countries including China, Japan and India.| Andrew Harnik/Getty Images

President Donald Trump's tariffs and threatened repeals of clean energy tax credits could undermine efforts to build desperately needed power generation in the United States — and his own policy promises.

The president promised to lower energy prices and declared an "energy emergency" to make it easier to rapidly build new power plants, partly to meet rising demand from data centers and artificial intelligence. His gutting of Biden-era emissions regulations and exploring the possibility of building new plants alongside data centers are aligned with his goals.

But other Trump policies could work against his goals and cause electricity prices to soar. Trump's headline-making tariffs are likely to make it more difficult to secure the materials needed for new power plants and grid projects at affordable prices. And his plans to repeal tax credits are threatening the private sector investment required to bring more power onto the grid.

"Trump's declared an 'energy dominance' agenda, but his campaign promise to repeal tax credits and impose tariffs broadly creates significant uncertainty — if not direct risk — to power plant developers," said Timothy Fox, managing director of power sector coverage at research firm ClearView. "And as a consequence, these efforts could exacerbate the risk of resource inadequacy — but could also accelerate rising power prices throughout the U.S."

Grid operator and utility projections predict the U.S. will need 128 gigawatts more power capacity in the next five years alone. Trump sees preserving existing fossil fuel-fired power plants by reversing rules limiting their greenhouse gas emissions and undoing the core scientific finding that carbon dioxide pollution endangers human health and welfare that has supported federal climate policies for 15 years as part of the solution.

But the president's sweeping tariffs threaten to send prices for basic grid components like transformers skyrocketing, and will likely worsen the already clogged supply chain for gas turbines and other critical grid equipment.

"If [the tariffs] affect the price of bulk power system components — particularly transformers and switching equipment, etc. — that is going to be reflected in the price signal we're going to have to send to induce new generation," Manu Asthana, CEO of the PJM Interconnection, the largest grid operator in the country, said Wednesday at an Electric Power Supply Association event.

The White House did not respond to requests for comment.

For years, utilities have been warning about shortages for basic grid components like transformers, which are critical to transferring power from high-voltage lines to distribution centers that power homes and businesses.

Those shortages have been exacerbated by widespread grid damage caused by hurricanes and wildfires. Lead times for transformers spiked from around 50 weeks in 2021 to an average of 120 weeks last year, according to research firm Wood Mackenzie, and only about 20 percent of transformer needs can be met by a domestic supply chain.

The nation's largest gas turbine manufacturers have also already been grappling with a growing backlog of customers and tight supply chains amid increasing demand for gas plants to meet rising electricity loads.

GE Vernova's backlog for gas equipment will grow "considerably" this year even as it ramps up efforts to create more capacity, the company reported during its earnings call in January — well before Trump's tariffs announcements. Diversifying its turbine supply will help the manufacturer increase its shipment levels, which GE Vernova expects to reach 20 GW by 2027. But the manufacturer cautioned it won't be able to ramp up much more than that.

GE, the largest gas turbine company in the world, did not respond to a request for comment on how the tariffs will impact its supply chains.

Christian Bruch, CEO of Siemens Energy, another major manufacturer of gas turbines and critical electric components, said in a statement the company needs time to "diligently assess the potential impact on Siemens Energy."

"For the time being, it is unclear whether the tariffs will equally impact our competitors," he said. "Overall, regarding the US market, we remain optimistic and expect more opportunities than risks."

Utilities and electric manufacturing groups have urged more balance in the Trump administration's approach to tariffs in light of growing supply chain challenges.

"We would really like the administration to understand that as much as we want … some critical supply chains to move, that doesn't happen overnight," said Debra Phillips,

president and CEO of the National Electrical Manufacturers Association, on a press call Friday. "We need transition periods to bring some of those supply chains back, and we're prepared to be a partner in doing that."

Scott Aaronson, senior vice president of energy security and industry operations at utility trade group Edison Electric Institute, similarly urged striking a balance between pursuing energy dominance and energy security.

"Our industry must have access to the critical components, commodities, and equipment needed to operate the grid, as we work to meet growing customer demands for reliable, affordable, and resilient clean energy," he said in a statement.

Trump's commitment to rolling back Biden-era clean energy tax credits also threatens the financing for wind, solar and battery storage resources waiting to connect to the power grid and capital certainty for future commercial-scale carbon capture, advanced nuclear and geothermal projects.

"How are you going to raise capital for an expansion plan for a solar platform ... when every day you have a new headline about the [Inflation Reduction Act's] durability?" asked Josh Price, director of energy at analysis firm Capstone. "There's just a lot of uncertainty that also makes it really hard to commit to make investment decisions."

Gas is projected to meet just 46 GW of the projected 128 GW of new demand coming online in the next five years, creating a supply gap that the clean energy industry says can be met by the huge amount of renewables waiting to connect to the grid. There were 2.6 terawatts of resources in the queue as of 2023, according to the latest research from Lawrence Berkeley National Laboratory, the vast majority of which is solar, wind and storage.

Increasingly, utilities and grid operators are looking at squeezing more capacity out of existing nuclear and natural gas plants to get more power onto the grid at a faster pace. In PJM, an effort to fast-track certain power projects onto the grid yielded 47 proposals to increase capacity at existing power plants — half of the total projects proposed.

But those efforts are relatively small compared with the amount of power needed to meet rising demand from data centers, electrification and domestic manufacturing, according to Rich Powell, CEO of the Clean Energy Buyers Association, which represents some of the largest tech companies in the country. Without tax credits and finance certainty, the U.S. could lose gigawatts of projects that would otherwise connect to the grid.

"I keep coming back to the basic math. You've got all these sliver solutions. But then the thing that can probably deliver 50 to 100 gigawatts ... is all of these solar and wind

projects that are already in the queues," said Powell. "If we can just get them online, that would be the single biggest chunk" of power capacity that could connect to the grid.

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Responses to Questions for the Record for Dr. Eric Schmidt
for the hearing before the U.S. House Committee on Energy & Commerce
"Converting Energy into Intelligence: The Future of AI Technology,
Human Discovery, and American Global Competitiveness"
Wednesday, April 9, 2025 | 10:00 AM EST

The Honorable Mariannette Miller-Meeks, M.D.

1. In your written testimony, you stated that 'our goal should be to make energy so abundant that it is nearly free for our people and exportable to the world' and that AI development could require facilities demanding up to 10 gigawatts of power. You specifically mentioned fusion as a potential game-changing technology that should be declared a national priority. Could you elaborate on how fusion and other next-generation energy technologies could create the competitive advantage America needs in the AI race, and what specific federal investments would be required to accelerate these technologies to commercial scale before China achieves similar breakthroughs?

   Response:
   Fusion energy has the potential to be a transformative asset for America in maintaining AI leadership. As AI models become increasingly complex and are used throughout the economy, their energy demands will continue to grow, requiring the addition of many power plants' worth of electricity. Fusion offers a unique advantage: an abundant, safe, and near-limitless energy source that can deliver the firm power required to operate hyperscale AI data centers, factories, homes, businesses, and other critical infrastructure. Moving fusion from the lab to our grid would help offset higher domestic production costs and reinforce the United States as the global hub for AI innovation. For example, an estimated 10 gigawatts of power is needed for AI power growth in America. To reach that number of 10 GW, we would only need about 25 fusion power plants.

   The federal government should take bold, coordinated action to secure this advantage ahead of strategic competitors like China. This includes declaring fusion energy a national security priority, appointing senior leadership at the Department of Energy to oversee commercialization efforts, and supporting a one-time $10 billion investment in R&D facilities, pilot plant construction, and supply chain development. These investments would not only strengthen national security and energy resilience, but also catalyze public-private partnerships and ensure that the U.S. leads in both AI and the next-generation energy technologies that will power it.

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The Honorable Doris Matsui

1. AI is redefining our society, much as the internet did for the information age. And, while we should recognize the benefits of AI, we also need commonsense guardrails to protect against harms.

   AI-driven content may not be accurate, as models can hallucinate, presenting false and misleading information as fact. Biased algorithms can also deepen inequalities and hurt consumers.

   That's why I've championed legislation like the Algorithmic Justice and Online Platform Transparency Act to ban discriminatory algorithms and establish a safety and effectiveness standard.

   Dr. Schmidt, how can we reduce bias and guarantee the reliability of AI outputs?

   Response:
   AI systems are getting more accurate over time. Improving the reliability of AI systems requires a combination of technical rigor, transparent standards, targeted regulation, and self-governance. Developers must prioritize data governance, as well as robust testing and evaluation across contexts, to find and address potential problems before deployment. Continued investment in explainable AI, benchmarking, and independent red-teaming will also enhance model trustworthiness.

   Public-private efforts that bring government and industry together, including those led by the National Institute of Standards and Technology, can help establish clear standards for security, reliability, and transparency. Collaboration outside of government, such as through the private sector and nonprofit collaboration (e.g., ROOST), can help pool resources and ideas to find ways to mitigate critical harms. Lastly, focusing oversight on high-impact use cases, rather than regulating all AI equally, ensures that innovation and the security of AI consumers advance together.

2. Dr. Schmidt, in light of the increasing use of AI across various industries, how should government address concerns related to data privacy and security to protect consumers and businesses alike?

   Response:

The government should provide baseline data privacy safeguards and work with companies to develop clear standards for data governance. We especially need to protect children online. Policy changes like those in the Take It Down Act are a good start.

This includes supporting the National Institute of Standards and Technology efforts to develop frameworks for secure data handling and advance privacy-enhancing technologies. At the same time, agencies should work with industry and nonprofits to promote responsible data stewardship, especially for sensitive sectors like healthcare and finance.

Focusing regulatory efforts on high-impact applications, especially those most likely to affect individuals' rights or safety, will help target protections where they are needed most without stifling innovation across the board.

3. AI and semiconductors, from memory and storage to photonic integrated circuits, play crucial roles in modern communication, including wireless networks, Wi-Fi technology, and advanced satellite systems.

   Dr. Schmidt, how would delaying CHIPS funding impact the ability to produce semiconductors used in communications and AI infrastructure in the United States?

   Response:
   From a national security perspective, the National Security Commission on AI recommended that America on-shore high-end chips manufacturing in order to compete with China. Strengthening domestic capacity for producing the advanced semiconductors that power AI and communications technologies, including wireless networks, Wi-Fi, satellite systems, and others, is essential to our global technological competitiveness.

   Delays in funding could slow the momentum needed to grow domestic manufacturing, which is a national security issue. Chips innovation in critical areas like memory, storage, photonics, and building the workforce to support it are necessary investments to achieve this strategy. Continued investment will help ensure that the United States remains a competitive and reliable leader in the semiconductor supply chain, supporting both national security and economic resilience.

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4. Dr. Schmidt, what strategies are being implemented to prepare the American workforce for the shifts brought about by AI, ensuring that workers are equipped with the necessary skills for emerging job roles?

Response:
Preparing the American workforce for shifts expected by AI starts with building a strong pipeline of talent from within the United States and by attracting the best minds globally.

We need to invest in AI education and training across all levels, from expanding STEM opportunities to supporting hands-on experience through apprenticeships and partnerships with industry. This also includes training federal workers, especially those in national security. They should have access to free AI training, such as the SCSP-Coursera course designed to equip public servants with relevant, flexible skills.

At the same time, the United States must remain the top destination for global talent. Too often, we train exceptional individuals at our universities only to send them home to become competitors. Retaining this talent is critical to our long-term competitiveness.

5. Dr. Schmidt, given the challenges SMEs face in adopting AI—such as high implementation costs and the need for specialized talent—what initiatives are planned to support these businesses in remaining competitive in an AI-driven market? How can we enable affordable access and level the playing field for SMEs?

Response:
To help level the playing field, more public-private partnerships driven by real programs, like Apollo, are needed to share AI tools, cloud platforms, and technical assistance. One additional opportunity is the National Science Foundation's National AI Research Resource, recommended by the National Security Commission on AI. These types of efforts can reduce barriers and give smaller companies the resources they need to compete and innovate in an AI-driven market. Inclusion of SMEs in the innovation ecosystem is good for all players.

6. Dr. Schmidt, how can collaborations between the government and private sector be structured to accelerate the development and deployment of AI innovations while maintaining fair competition and safeguarding public interests?

Response:

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Public-private partnerships are essential to accelerating AI innovation. The government can provide strategic direction and early-stage investment for AI applications while the private sector brings speed and technical expertise.

Structured around clear goals, these collaborations can focus on high-impact areas like national security, infrastructure, applied research, and workforce development, helping to grow innovation and maintain U.S. leadership in AI.

The Honorable Nanette Barragan

1. Dr. Schmidt, in March, I visited Space ISAC – Space Information Sharing and Analysis Center – in Colorado Springs. The Space ISAC team tracks and prevents cyber threats to space infrastructure. Their work keeps our satellites safe so that we can access the internet and use our phones.

   Your testimony mentions space as a strategic frontier in the AI race and calls for Technology Competitiveness Council in the White House. This Council, as you say, would develop national action plans, coordinate agency efforts, and ensure collaboration with private sector leaders.

   How could the Council partner with Space ISAC to develop AI tools that strengthen cybersecurity so that our internet or cell service is not impacted?

   Response:
   A Technology Competitiveness Council at the White House could serve as a strategic bridge between domain-specific efforts like those at Space ISAC and broader national AI and critical technology initiatives.

   The Council would provide strategic guidance within and across critical technology sectors, including AI, biotechnology, cybersecurity, space, and others, and would help align federal priorities and build collaborative partnerships with industry, academia, and others on the frontlines of tech innovation.

Submitted by Mr. Manish Bhatia, Executive Vice President of Global Operations
Micron Technology

Additional Questions for the Record

The Honorable Rick W. Allen

1. The National Ambient Air Quality Standards (NAAQS) implemented by the Biden-Harris Administration's EPA, for example, have proven to be a significant burden on the U.S. manufacturing base. These stringent regulations have made it difficult to permit and develop many of the facilities needed to support our next-generation industrial base. Whether it be PM2.5 or ozone, EPA needs to provide flexibility when it comes to allowing areas to reach attainment, and this should include discounting international emissions or wildfire emissions. I applaud Administrator Zeldin for Monday's decision to provide states more flexibility under section 179A of the Clean Air Act to demonstrate that they would achieve compliance with NAAQS requirements but for emissions coming from outside of the United States. As you also point out in your testimony, EPA's "reconsideration of the Particulate Matter National Ambient Air Quality Standards (PM 2.5) is positive as this rule, as currently implemented, limits opportunities for American manufacturing."
   a. Can you elaborate on the limitations that the Biden-Harris NAAQS for PM2.5 imposed on Micron?

MICRON RESPONSE:

Last year, the EPA reduced the fine particulate matter (PM 2.5) national standard, a key component to air emission standard permitting, by one-third (from 12 to 9.5), which directly impacts our permitting efforts in New York and Idaho. While we recognize that the PM standard is a critical, health-based standard and we fully support clean air policies, we encourage the EPA to review the rule to provide operational flexibility, either by: 1) providing an exemption for critical industries such as semiconductors; 2) reverting to the previous standard of 12; or 3) allowing states flexibility on how background/baseline concentration is calculated at the state level (i.e. how the states' calculation impacts the total allowable PM). Doing so would help speed up implementation of CHIPS investments and protect the environment through other applicable regulations.

The Honorable Russ Fulcher

1. You note in your testimony the importance of access to reliable, affordable, carbon-free electricity. As you note, the making of memory chips requires not just a robust amount of power, but also "consistent" and reliable power for fabs. And yet, between mandates on utilities and the challenge of getting transmission lines through the NEPA process and getting permitted can take decades. In your testimony, the worry is the U.S. won't meet the increase in projected demand of 128 GW over the next five years. And yet, on transmission, tell us about the challenges companies like Micron face when it comes to trying to align obtaining the additional power you need to meet demand for memory chips with the delays and uncertainties you receive from land management agencies on permitting?

MICRON RESPONSE:

Enhancing transmission infrastructure is critical for revitalizing domestic manufacturing. The U.S. government must ensure timely permitting of power generation and transmission facilities to meet electricity demand. Without substantial policy changes, the U.S. risks losing competitive advantages due to increasing electricity costs.

Micron is aware of the regulatory delays affecting the transmission of current generating capacity to businesses and consumers. With limited transmission infrastructure in the northwest, Micron views the Boardman to Hemingway (B2H) transmission line as an opportunity to deliver necessary electricity from Oregon to Idaho. This line could supply Idaho with up to 500 MW of affordable, reliable power from the Pacific Northwest during the summer months.

The B2H project, initiated in late 2006, remains unconstructed as a result of previous delays with federal permitting approval. For nearly 20 years, this potential generating capacity has been delayed in Oregon, with permitting costs now exceeding $220 million, while energy demands in Idaho continue to increase.

Such delays impact the ability to enhance U.S. manufacturing, support resilient businesses and growing communities, and achieve AI leadership objectives. These delays result in higher electricity costs, affecting the competitiveness of the United States as a destination for companies.

2. Please explain how Micron is showing it can lower its electricity consumption throughout its design, test, and production processes? You noted implementation of AI-based tools to lower energy use in your design, test, and production processes.

MICRON RESPONSE:

Micron Technology has internally deployed AI extensively through its manufacturing processes to ensure that Micron and its future expanded U.S. workforce remains at the cutting edge. In particular, this includes deployment of AI in image analytics, acoustic listening, and thermal imaging. As a result of these AI innovations, Micron has improved worker safety and kept its operations competitive: between 2016 and 2020, worker productivity rose 18%, time to resolve quality issues fell by 50%, time to market for new chips fell 50%, and product scrap production fell 22%. All these innovations help reduce power consumption as measured in per-chip terms. Reduction of product scrap helps ensure that energy is not wasted on products not destined for market.

More broadly, beyond AI we deploy a variety of energy efficiency processes to reduce our power consumption. As an example, last year, we reduced our Boise facility energy consumption by 19.5 million kilowatt hours, equivalent to the average annual consumption of over 1,700 households. We were able do this through an all-of-the-above approach: we eliminate energy consumption where feasible through process improvements and tool optimization, we recover energy through heat recapture and other innovations, and we optimize the energy we use through energy sensors and smart controls.

3. Micron does a lot of work with Idaho National Labs. This committee has done a lot of work to help nuclear energy get permitted and approved more quickly to be another reliable source of power. Tell us about your work with INL and how Micron could see more reliable

> sources of energy. Tell us about your work with INL, and things the federal government should continue to consider when it comes to Small Modular Reactors (SMRs) and other advanced nuclear programs?

MICRON RESPONSE:

For over 40 years, Micron's Memory Technical Center of Excellence (MTC) in Boise, Idaho, has anchored our R&D operations, and is the only full-flow memory and storage research site in the United States. Micron's hub and spoke model integrates expertise from R&D sites across the country, including Atlanta, Georgia for DRAM product design, Longmont, Colorado for test methodologies, Minneapolis, Minnesota for advanced controller development, California (Folsom & San Jose) for advanced architecture DRAM memory, and Richardson, Texas for bandwidth and energy efficiency improvements.

Additionally, Micron partners with the Department of Energy's National Labs, including Idaho National Lab (INL), the Pacific Northwest National Lab (PNNL), and Sandia National Lab. For example, our partnership with PNNL is addressing a major bottleneck in memory technology to increase problem-solving efficiency - near data computing to drastically reduce power consumption and increase performance. At Sandia, our partnership focuses on the development of high-bandwidth AI-optimized advanced memory technology and very large-scale memory systems to achieve a Peta-Scale Memory system to address rapidly changing AI and scientific applications.

Last month, I had the pleasure of meeting with senior INL leaders in Idaho Falls to discuss their extensive work on advanced nuclear technology, particularly SMRs. Their leadership in this field is extremely encouraging for the future of advanced nuclear technology development and ensuring U.S. leadership in remaining at the cutting-edge of nuclear power.

Accelerated permitting is essential to advance Small Modular Reactors (SMRs) and other advanced nuclear programs. The ADVANCE Act represents an initial step in reducing regulatory barriers to SMR deployment. However, with only one NRC-approved SMR design out of more than 80 designs using various fuel types, these approvals need to be expedited and made more cost-effective due to the lower expected power generating capacity compared to conventional reactors. Both China and Russia have operational SMRs, making it crucial for the U.S. to keep pace with SMR technology deployment, not just focusing on technological leadership. The manufacturing sector has shown strong interest, as has the power sector, indicating that federal government action is necessary.

This action includes supporting existing nuclear facilities in evaluating the feasibility of adding SMRs to utility-scale nuclear facilities in the United States. In January 2025, Constellation sought DOE permitting approval to construct an SMR at its Nine Mile Point nuclear station in upstate New York, near our expansion site. These permits should be reviewed promptly to demonstrate the proof-of-concept needed not only for expanded SMR siting in the United States but also for U.S. nuclear technology leaders to export their proven products to international markets.

The Honorable Nick Langworthy

1. The United States once produced nine percent of the world's memory chips. That was fifty years ago and today the U.S. only produces two percent. How can Micron, through projects like its facility under construction in Clay, New York, help get the United States up to twelve percent of the global share?

MICRON RESPONSE:

Over the next two decades, Micron's planned investments of over $140 billion in New York, Idaho, and Virginia will drive the U.S. to produce 12% of the global share of memory chips. However, building a fab in the United States takes twice as long as competing countries. Additionally, earlier estimates suggest that building advanced manufacturing fabs in the U.S. costs 35-45% more than building the same operations in Asia, and that gap has increased due to the inflation and lack of U.S. construction resources. Current U.S. incentives were established before inflationary pressures affected the entire country, and construction costs have surged by nearly 40% since 2020.

To reach the goal of substantially expanding the U.S. manufacturing share of the global supply of semiconductors, it is necessary to extend and increase the advanced manufacturing Investment Tax Credit (AMIC). Extending the AMIC by at least 4 years (it is currently set to expire next year) will ensure the construction of advanced manufacturing sites by providing the necessary timeline for planned projects to handle regulatory permitting and unanticipated governmental delays.

In addition to an AMIC extension, increasing the AMIC from 25% to 35% would give semiconductor manufacturers like Micron the stability needed to generate additional economic activity in the next four years, meet U.S. national security goals, and provide the confidence to make long-term investments in the U.S. by addressing the construction cost gap with Asia and level the playing field with other countries. The Building Advanced Semiconductors Investment Credit (BASIC) Act, led by Rep. Tenney (R-NY), would extend and increase the credit, and should be supported by members who wish to ensure America's technology leadership and manufacturing expansion. Further, Micron will need streamlined permitting regulations, continued investments in the semiconductor workforce for both operations and construction, and more access to affordable and abundant energy—as we testified.

2. We've seen bipartisan efforts in the past to streamline regulations, get rid of red tape, and clear the way for critical manufacturing projects. What still stands in the way as it relates to reforming the environmental review process? What has been left on the cutting room floor from past action that needs to be addressed this Congress?

MICRON RESPONSE:

From Micron's perspective, our company has completed an environmental review in a timely manner for its Boise expansion project and already has begun construction. In New York, Micron is currently undergoing both federal and state environmental reviews for its Clay, NY project.

Looking at the role of Congress, we are supportive of a process that ensures environmental protections but also streamlines review processes, especially for projects in states that already have robust environmental review processes in place where complying with state-level regulatory standards goes above and beyond the federal baseline. I would urge Congress to work swiftly to find

common sense reforms that will allow large-scale manufacturing projects to build in a timely fashion.

Looking forward, we are encouraged by recent action from EPA Administrator Zeldin to reconsider PM 2.5 as well as commitments to implementing wetland jurisdictional determinations in accordance with the U.S. Supreme Court's decision in Sacket v. EPA, 598 U.S. 651 (2023).

3. On April 9, 2025, I introduced the Infrastructure Project Acceleration Act (H.R. 2783), to help address these outstanding regulatory issues. My bill would allow projects in such states where the regulatory process is just as stringent as the federal process, to be exempt from NEPA review, among other regulatory reviews. This will shorten timelines, speed up projects, and help us get to where everyone here today believes we should be when it comes to American technological leadership. Is this bill something that would benefit projects like Micron's?

MICRON RESPONSE:

This bill goes to the core of the challenge we face expanding our operations in New York, addressing the same environmental concerns through overlapping and duplicative state- and federal-level regulations. Micron supports this bill as it would enable the build out of the semiconductor ecosystem in New York while maintaining environmental protections.

4. Focusing on the inflection point with meeting rising energy demand, how much energy and electricity do your facilities use? How has that changed over time?

MICRON RESPONSE:

A typical Micron fab uses around 400 megawatts of power, operating 24/7. This constant demand makes us a particularly good customer for utilities and helps maintain grid stability. But given that energy is a critical component of our operational costs, we work to ensure our energy consumption is as efficient as possible.

In Q4 2024, we saw a 15% reduction in our electricity intensity measured as electricity per gigabyte of production, from our CY2020 baseline. Last year, we reduced our Boise facility energy consumption by 19.5 million kilowatt hours, equivalent to the average annual consumption of over 1,700 households. We were able do this through an all-of-the-above approach: we eliminate energy consumption where feasible through process improvements and tool optimization, we recover energy through heat recapture and other innovations, and we optimize the energy we use through energy sensors and smart controls. Given how competitive our industry is, we must constantly stay ahead of the curve to make sure both our operations as well as the chips we manufacture are efficient as possible.

5. Looking specifically at the project being developed in Clay, New York, what role does natural gas play in powering this project?

MICRON RESPONSE:

As I discussed in my opening remarks, Micron supports an "all of the above" energy strategy that can keep prices affordable and reliable for our U.S. manufacturing expansion. This means expanding generating capacity across the board and permitting reform to update our transmission infrastructure and move it into the 21st century.

All of our U.S. sites have a blend of energy sources to fill our needs based on availability and what is most cost competitive. Each of our locations has a roughly 50/50 mix between natural gas and coal and carbon-free energy, so from our perspective expanding all energy sources makes sense to keep up with demand.

Looking at New York, state-wide the New York energy grid is around 15-20% hydro, 30-35% nuclear, 5-15% solar and wind, and 40-45% natural gas. For upstate New York, the generation mix is more concentrated in nuclear and hydropower (around 40% hydro and 43% nuclear), both significant competitive strengths for the region with abundant availability of both. However, natural gas plays a key role even in upstate New York, with approximately 7% of the region's power coming from natural gas in 2024.

The Honorable Doris Matsui

1. Mr. Bhatia, how can collaborations between the government and private sector be structured to accelerate the development and deployment of AI innovations while maintaining fair competition and safeguarding public interests?

MICRON RESPONSE:

As a semiconductor manufacturer, Micron has historically focused on deploying AI to optimize fab operations and ensure operational efficiency. Micron is recognized for its use of AI to remain competitive as the sole U.S. memory producer. Advanced manufacturing is crucial for success in the AI sector, yet the U.S. has not yet established a sustainable economic environment for this industry. To address this, it is essential for the U.S. government to enhance semiconductor incentives to foster a robust ecosystem and compete with other nations that have long invested in the semiconductor sector through supportive policies.

One significant measure is extending and increasing the Advanced Manufacturing Investment Credit (AMIC). Congresswoman Tenney proposed the BASIC Act, which aims to raise the AMIC value to 35% and extend its availability by four years. This, in combination with existing incentives, would help the U.S. stay competitive globally and ensure that we can expand U.S. semiconductor manufacturing. Enhancing the AMIC will accelerate investments in advanced manufacturing, generate jobs, stimulate economic growth, and establish a secure, leading-edge semiconductor ecosystem within the United States.

While advanced semiconductor manufacturing remains fundamental to AI progress, the growing complexity of large language models presents new challenges that necessitate memory-centric computing solutions. We recommend that Congress allocate additional funds for research and development partnerships with private industry to ensure microelectronics can keep pace with evolving AI technologies.

Semiconductors play a crucial role in enabling AI and should be a key focus of U.S. policy. As a semiconductor manufacturer, Micron continues to leverage AI to enhance fab operations and maintain competitiveness. Micron's AI applications include image analytics, acoustic listening, and thermal imaging, which improve manufacturing quality, efficiency, and accuracy while allowing engineers to focus on innovation. The company's AI initiatives also aim to enhance yield and quality through advanced AI systems. In expanding U.S. investments, Micron utilizes AI to optimize design and tool placement.

These AI advancements have contributed to improved worker safety and operational competitiveness at Micron: between 2016 and 2020, worker productivity increased by 18%, time to resolve quality issues decreased by 50%, time to market for new chips was reduced by 50%, and product scrap production fell by 22%. Such successes highlight the potential for greater collaboration between the government and the private sector to deploy AI in manufacturing, enhancing worker safety, reducing power and input consumption, and maximizing production. Micron's ability to utilize AI for manufacturing improvements supports its competitive edge and is expected to drive U.S. investment, potentially creating 80,000 jobs and furthering partnerships with the U.S. government.

Responses to Questions for the Record from April 9, 2025, hearing before the Committee on Energy and Commerce.

The Honorable David M. Turk, Distinguished Visiting Fellow, Center on Global Energy Policy, Columbia University.

<u>**The Honorable Doris Matsui**</u>

Q: AI is redefining our society, much as the internet did for the information age. And, while we should recognize the benefits of AI, we also need commonsense guardrails to protect against harms. AI-driven content may not be accurate, as models can hallucinate, presenting false and misleading information as fact. Biased algorithms can also deepen inequalities and hurt consumers. That's why I've championed legislation like the *Algorithmic Justice and Online Platform Transparency Act* to ban discriminatory algorithms and establish a safety and effectiveness standard. **Mr. Turk, how can we reduce bias and guarantee the reliability of AI outputs?**

A: AI is an incredibly powerful and transformative technology with widespread applications that can improve the lives of Americans across the country in fields from cancer research to advanced manufacturing. At the same time, I have found that the experts who are best versed in AI technology are also the ones who most forcefully advocate for effective guardrails against its excesses. There needs to be a bipartisan imperative to establish mandatory guardrails for AI and independent oversight to protect personal data and allow Americans to seek accountability. It is also crucial to implement safeguards to prevent AI models from spreading false information.

Q: Mr. Turk, in light of the increasing use of AI across various industries, how should government address concerns related to data privacy and security to protect consumers and businesses alike?

A: Government must lead the way on developing safeguards that prevent the abuse of AI, including to steal Americans' identities, feed them misinformation, and defraud their businesses. To that end, there needs to be urgent, bipartisan interest in legislation that would provide protections to Americans as well as interest in the promulgation of rules in the Executive Branch. The private sector is a crucial partner, of course, and it will be critical for government to work closely with the crop of innovative American companies that have placed the US in a dominant position with regard to this technology.

Q: America needs to lead in developing rules of the road for emerging technologies such as AI, so that they are trusted, secure, and reflect our democratic values. That's why I co-led the bipartisan, bicameral Promoting United States Leadership in Standards Act to strengthen U.S. leadership in international standards setting activities. This Congress, I will work to reintroduce and get this bill across the finish line. I'm deeply concerned that reckless cuts to our federal workforce and alienation of our allies will harm our ability to be the global technological leader. **Mr. Turk, why is it so critical to make sure our federal agencies have the experts and resources they need to advance U.S. AI innovation?**

A: The US government has enormous responsibility to help companies develop AI, to maintain the United States' dominant position with regard to developing the technology, and to support affordable and clean energy to power AI data centers. The US government cannot accomplish any of those tasks without a dedicated, motivated, and talented workforce. I very much share your concern that various actions by the Trump Administration have recklessly compromised this incredibly important capability.

Q: Mr. Turk, how can collaborations between the government and private sector be structured to accelerate the development and deployment of AI innovations while maintaining fair competition and safeguarding public interests?

A: It will be crucial to strike the right balance between giving American companies the space they need to innovate and preventing abuses of the technology that can harm all American consumers and businesses. The private sector's profit motive means that it will not necessarily always pursue technological progress that is in the interest of broader society. In addition to intensive public-private discussion and collaboration, the government should provide mandatory guardrails and ensure that red-teaming is required before new models can be accessed by the broader public.

The Honorable Nanette Barragan

Q: Deputy Secretary Turk, one of the challenges in our ability to expand data center infrastructure is the national shortage of power transformers, which are essential to deliver electricity to large facilities such as data centers. Utilities now face waiting times of 2 years or more for the delivery of transformers for energy projects. **Given this shortage, will President Trump's tariffs on steel make it even more expensive or difficult to supply the transformers we need to power our growing AI infrastructure?**

A: Yes. Power transformers are an absolutely critical part of our electricity infrastructure. The United States is facing huge increases in electricity demand, and the energy demands of AI will require the building of even more energy projects across the country. Tariffs will make the goods we need to build energy projects – including transformers – more expensive.

Q: Deputy Secretary Turk, President Trump recently signed an executive order that promotes coal as a fuel to power AI data centers—at the same time Republicans work to repeal clean energy investments. **Can you speak to what that would mean for Americans—especially when it comes to higher energy bills, more pollution, and the health impacts of keeping coal plants running just to meet rising demand from data centers?**

A: AI requires an enormous amount of electricity, and one of the crucial challenges we face as we work to maintain the US's dominant position with regard to this technology is finding sources of affordable energy to power it. Clean sources of power – particularly solar and storage – are now the quickest and most affordable ways to bring on new electricity supply over the near term. Maintaining – and even strengthening – tax incentives, loans, and grants like those in the

Inflation Reduction Act and Bipartisan Infrastructure Bill are absolutely crucial to continuing to quickly and affordably provide electricity supply solutions to American AI companies. We have seen several AI companies also announce plans and partnerships to advance additional clean, baseload solutions, including enhanced geothermal and nuclear energy. Coal production in our country has been displaced by cheaper and cleaner alternatives, driven primarily by market forces.

**Responses to Questions for the Record from April 9, 2025, Full Committee Hearing
Alexandr Wang, Founder and Chief Executive Officer, Scale AI**

<u>The Honorable Russ Fulcher</u>

1. We had a hearing a couple of months ago where we discussed the role of AI in manufacturing. One area that caught me out of that was how AI can help to drive more productivity, safety, and maintenance of products, people, and equipment.

    a. How can the U.S. employ AI to help in the energy saving and energy allocation areas in the production process?

Thank you for the question, as discussed in my testimony AI has a great number of use cases and it's imperative that we unleash AI to reap its benefits. In the energy sector itself, we have already seen a number of "low hanging fruit" use cases take shape and leveraging AI to better produce energy is a very strong one. To do so, AI could help provide better insights into the processes for production, where and how certain parts of the grid should be prioritized and much more.

    b. Do you envision more interactivity between operators and AI-based software at different points in the manufacturing process where quick shifting of additional power may be needed during testing of equipment or ramp ups in production? I am interested in understanding the need for building on our efforts to get more reliable sources of energy, such as advanced nuclear, to address the demand.

Thank you for the question. I think that this is very much something that the industry is currently working on and is an open question as we look to implement AI solutions. It's clear that we need to prioritize various forms of energy to meet the projected demands on the grid to have enough power. This is especially critical as we look at China's approach to energy and just this last month we saw them announce additional nuclear power plants which are expected to be online in the next few years. If we do not match or exceed China's intensity we risk ceding our global leadership in AI.

2. Plans such as Made in China 2025 have included investment in AI, semiconductor, quantum, 5G, and robotics are some of the industries the Chinese Communist Party (CCP) aims to monopolize. You noted in your testimony that China seeks to "widen its lead" on data collection and use, including running it through AI algorithms. Could you please explain your thoughts on creating and clarifying federal AI governance standards that can help reduce the "inconsistent definitions" you mention across the AI ecosystem so that companies can have rules that track with the unique challenges of their industries but are not obstacles to development and growth?

Thank you for the question. This is an important topic and as you mentioned China is racing ahead to work to become the global standard for AI. As part of our federal governance related to AI, Scale believes that it's important to clearly state one federal governance standard for AI. This year alone, we have already seen over 700 bills introduced at the state level and many of those bills have different definitions of the various actors within the AI ecosystem. The challenge with this becomes inconsistency at the state level and the likelihood of creating a system in which each state has very different compliance mechanisms. To help solve this potential situation, we strongly support the federal government setting clear definitions.

The Honorable Doris Matsui

1. America needs to lead in developing rules of the road for emerging technologies such as AI, so that they are trusted, secure, and reflect our democratic values. That's why I co-led the bipartisan, bicameral Promoting United States Leadership in Standards Act to strengthen U.S. leadership in international standards setting activities. This Congress, I will work to reintroduce and get this bill across the finish line. I'm deeply concerned that reckless cuts to our federal workforce and alienation of our allies will harm our ability to be the global technological leader.

   Mr. Wang, what are the consequences if the U.S. falls behind in setting global standards for AI technologies?

Thank you for that question. This is a very important topic and one that I believe is imperative for the United States to lead. Standard setting and measurement science is one of the best ways for the United States to export our technology to the world and Scale feels strongly that for AI, this is especially critical. The reason for this is that these standards will determine the process for which AI will be evaluated, measured, and developed and it's imperative that these follow western, democratic ideals.

2. Mr. Wang, why is it so critical to make sure our federal agencies have the experts and resources they need to advance U.S. AI innovation?

Thank you for the question, at a high level in order for AI to be unleashed by the U.S. Government, it requires people who understand how to leverage the technology and the resources necessary to implement AI. To date, we have seen AI challenge the Government's way of thinking in that it has to be acquired like software, but maintained like hardware. If we want to unleash AI, the Government must start to look more like a commercial program than a traditional Government procurement. This is why both resources and expertise are so important in order to both set the Government up for success and to be able to scale these AI programs.

3. Mr. Wang, what strategies are being implemented to prepare the American workforce for the shifts brought about by AI, ensuring that workers are equipped with the necessary skills for emerging job roles?

Thank you for that question and as I mentioned in my testimony, it's critical that we are setting up the workforce of the future to thrive in the United States. As part of this, it's critical that we teach AI skillets throughout K-12 education and then also are working with our Universities and Community Colleges to ensure that they are teaching the right skillsets. Scale has been proud to help develop this workforce through our flexible work opportunities. Last year alone, we paid out over $500 million globally and provided opportunities to ten of thousands of Americans. These skillsets are critical to U.S. leadership in AI.

4. Mr. Wang, how can collaborations between the government and private sector be structured to accelerate the development and deployment of AI innovations while maintaining fair

competition and safeguarding public interests?

Thank you for the question. United States leadership in AI relies on all levels of the AI ecosystem–industry, government and academia–working together to progress the technology. One strong example of this is the standard setting process which see all three layers coming together to better inform measurement science around items like evaluations. It's critical that industry and the government work together to first identify the areas where partnership makes sense and then begin to execute on them.

The Honorable Nanette Barragan

1. Mr. Wang, in your written testimony, you say that Congress and the Administration should "Resource and empower the National Institute of Standards and Technology (NIST)."

   The Trump Administration has already fired 70 probationary employees at NIST, which reports say is part of a larger plan to cut 20% of the Commerce Department's workforce.

   How do President Trump's cuts and firings threaten our leadership in A.I. innovation?

Thank you for that question, I feel very strongly that NIST has a critical role to play in developing the world's best standards and frameworks and ensuring that those can be exported to the world. In my testimony, I mention the importance of this work as well as leveraging the Global Network of AI Safety Institutes to do so. To date, we know that there are nearly 10 AI Safety Institutes around the world and the United States is currently serving as the Chair. This body serves as the best mechanism for us to export the standards and frameworks, which should be developed by NIST, to the world's leading AI countries.

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