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

MAY 21, 2024

Opening

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

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

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

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

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

About Micron

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

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

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

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

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

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

Micron's planned investments

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Conclusion

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

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