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United States House of Representatives
Committee on Energy and Commerce

Hearing on Building a 100 Percent Clean Economy: Advanced Nuclear Technology's Role in a Decarbonized Future

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Thank you, Chairman Pallone, Ranking Member Walden and members of the Committee. My name is Chris Levesque, and I am the Chief Executive Officer of TerraPower, an advanced nuclear technology company.

Including the past 5 years at TerraPower, I have spent my entire career working in nuclear energy, beginning with my service in the US Navy on submarines. I have also had the opportunity to work on civilian nuclear projects in the US and internationally. These experiences greatly inform my comments today, as well as my belief that the US must retain its leadership in nuclear energy technology.

In 2006, our company's founders - Bill Gates and Nathan Myhrvold – began looking for a technological solution to the dual challenges of the growing global demand for energy and the rising threat of climate change. The answer, they discovered, is advanced nuclear technology.

The mission of advanced nuclear energy companies like TerraPower is to improve nuclear energy technology on a number of fronts, using the capabilities offered by 21st century technologies and digital modeling previously unavailable. These technologies move well beyond our country's 20th century fleet of light water reactors, including safety improvements, reductions in the risk of weapons proliferation, minimization of waste production, more efficient use of uranium supplies and lower costs. We believe that we, as an American company, have a duty to innovate in clean energy. No other country has the capacity for innovation, and the freedom to think innovatively, like the United States. We benefit from the investments made by past Congresses, and the work of the engineers and scientists who have gone before us. TerraPower's goal is to provide a commercial product that provides reliable, zero-carbon, cost-effective electric and thermal energy solutions that can be deployed in the United States and abroad.

Advanced Nuclear Technology and a 100% Emissions Free Economy

Nuclear energy is essential to combating global climate change. The United Nations' Intergovernmental Panel on Climate Change (IPCC) provides a number of pathways to keep global emissions below 1.5 degrees Celsius. None of those pathways allow for a reduction of the share of global power provided by nuclear, and the high economic growth scenario – the one that lifts billions out of poverty –calls for global nuclear power demand to increase by five times current levels.[1]

I cannot emphasize enough the scale of the challenge we are diligently working to meet. Clean electrification is essential for eradicating poverty for billions around the world in a sustainable way. On a recent trip to India, I was encouraged to learn that 26 million households and all 600,000 villages for the first time have electricity. I was equally discouraged to learn that most of that energy demand is being met by coal, and today coal is still 80 percent of world's primary energy source. This is not only unsustainable, but it is outright dangerous for the health of our planet.

[1] https://www.iph/site/assets/uploads/sites/2/2019/02/SR15_Chapter2_Low_Res.pdf

Today, many states and utilities that have committed themselves to eliminating emissions from the power sector have plans that rely on a combination of carbon-free resources that includes nuclear power. Like wind and solar, nuclear power is carbon-free and can be a key tool in efforts to reduce emissions and pollution. And like coal and natural gas, nuclear power can provide power 24 hours a day and 7 days a week. But unlike coal and natural gas, nuclear neither emits carbon dioxide or other air pollutants, nor does it require continual delivery of commodities to produce power. The result is always-available, carbon free power that does not require a natural gas pipeline or a coal train to operate. No other form of power has all of these attributes.

We also know that we need to decarbonize the power sector quickly. Nuclear is the only option that can scale fast enough to address the urgency of the need. We saw the benefits of rapid deployment from 1969 to 1990 when the U.S. built more than 100 nuclear plants. Rapid build and heavy investment in research and development were primary contributors to the stable, emissions-free power that cleared pollution from our cities and fueled growth.

In addition, as the Committee knows, getting to a 100 percent carbon free future will require us to eliminate emissions in more difficult to decarbonize sectors of the economy like industry. We will have to develop strategies to produce chemicals, cement, metals and other products without burning fossil fuels. Advanced nuclear technologies like ours can provide reliable, very high temperature heat for industrial processes. Our designs can provide heat of 700 degrees Celsius without emitting any carbon dioxide or methane.

The Economic Case for Investing in Advanced Nuclear

These attributes are good for the environment, but also present substantial economic opportunity for our country. Most Americans either live in states with emissions targets or are served by utilities who have put forth ambitious emissions goals. This includes our home state of Washington, in which our power provider, Energy Northwest, has offered a plan to meet our state's mandate to eliminate carbon emissions from the grid with a combination of wind, solar, hydro, existing nuclear, and next generation nuclear.

More and more corporations also are committing to bold climate goals, including two powerhouse global companies headquartered in our home state—Microsoft and Amazon. Microsoft has promised to become carbon negative by 2030, removing more carbon than it emits, and by 2050 it has vowed to erase a volume of carbon equal to all of the greenhouse warming gas that the company has emitted since launching in 1975. Amazon has pledged to reduce its carbon footprint by investing in electric vehicles, reforestation projects and to achieve net zero annual carbon emissions by 2040.

Outside of the United States, every potential export market in the world has signed onto the Paris Climate Agreement. To meet the Paris goals, those countries will need energy sources with attributes like advanced nuclear. We are excited about the domestic market for our products, but it's hard to overstate the potential of the global market for firm, carbon free energy technologies.

Given that, it should not be surprising that other countries are working to develop advanced nuclear technology. Countries like China and Russia are actively supporting the development of advanced reactors with significant direct investment by government into state-supported companies. This direct government support helps these countries establish a valuable export product, but the sale of a reactor also brings important national security benefits for those governments. Some of these state-supported companies sell their reactors with a multi-decade contract to provide fuel, operations and maintenance services, and waste services. This creates a multi-decade strategic partnership between the country selling nuclear reactors, and the country purchasing that technology. Russia, for example, is currently offering these "Build, Own, Operate" contracts in Europe and the Middle East.[2] Those contracts will enable Russia to increase its influence in those regions.

And finally, the investment in nuclear technology yields applications that go beyond energy. Because of the technical expertise we've gained from working to build reactors, TerraPower is working with Oak Ridge National Laboratory to separate life-saving medical isotopes from cold war era nuclear waste currently stored in Tennessee. These isotopes can be used to attack cancer cells without damaging surrounding tissue and could lead the way to dramatic improvements in our ability to treat cancer.

Civil nuclear technology was invented in the United States, and every advanced nuclear technology under development across the globe was invented in the United States. Our nation should benefit from that investment, both in terms of the technology we can deploy to meet our domestic clean power needs, and in terms of the economic and national security opportunity for American companies to sell their products around the world.

What is Advanced Nuclear, or "Generation IV?"

Light water reactors have served us very well, but new designs can improve fuel cycles, proliferation, safety, and the cost of light water technologies. TerraPower's designs are walk away safe, and use natural forces like gravity and air cooling, not human intervention, to keep the reactor safe when faced with unplanned events. Our plants can run on natural or depleted uranium and can reduce waste over conventional designs by nearly 80 percent. Because they do not require enrichment, and because they burn up more of the fuel in the reactor core, they significantly reduce the risk of proliferation. These improvements make our reactors safer, cheaper, and able to operate with lower volumes of waste.

In the nuclear industry, safety is always our first and highest priority. Almost every meeting in our industry, regardless as to the topic, begins with a discussion about safety. Safety is deeply ingrained in the nuclear industry's culture. As a result of this safety culture, nuclear power has

[2] https://www.belfercenter.org/publication/russian-nuclear-energy-proposal-offer-you-cant-refuse

consistently proven to be the safest way to make electricity. America's nuclear reactors have a tremendous record in terms of operating safely.

Advanced designs build on that success. Advanced reactors offer next-generation safety benefits that permit new applications and expand the potential to use nuclear energy for more than electricity production. This new technology will not require active safety systems, eliminating the need for diesel engines, multiple back-up systems and human intervention under emergency scenarios. Our designs avoid high pressure and rely on the natural laws of physics to maintain the safety of the plant without needing operator intervention or auxiliary power, using air and the properties of natural convection, rather than water, as the ultimate heat sink. Safety features in the selection of fuels and coolants provide for enhanced versatility and permit more flexible siting, with a much more compact site and a smaller emergency planning zone within the site boundary. If you were to put these reactors through the Fukushima test, there would be no accident. A fast reactor would have shut itself down independently, indefinitely.

We also know that our potential customers are very concerned about the cost of nuclear. We are too, and advanced reactors are specifically designed to reduce cost. Because of our passive safety designs, advanced reactors have fewer needs for multiple, redundant safety systems. Advanced reactors operate at higher temperatures, and burn more of the fuel, yielding more electricity and lower costs per kilowatt-hour for the same plant size. Our reactor designs require less maintenance and fuel, and some have the potential to make up to 30 times more energy out of each ton uranium used to provide carbon free power. Our reactors can run on depleted uranium - waste product from enrichment that is currently managed by the U.S. Government. These attributes result in substantial savings over light water designs.

And finally, we know that America's energy system is going through tremendous change. Tomorrow's grid will rely heavily on wind and solar. Our technology is specifically designed to integrate into a grid with high levels of variable renewable penetration. In fact, we are currently working with Southern Company and Oak Ridge National Laboratory to use the high temperature heat from our reactors to power molten salt system that can store tremendous amounts of energy, levels of magnitude larger than the energy stored by typical battery storage facilities. That energy can be used to power the grid at peak demand when the wind isn't blowing, or the sun isn't shining. We view our technology as a key enabler of wind and solar technologies, and part of the fastest way to get to the 100 percent clean energy future envisioned by the Committee.

U.S. nuclear technologies and research and development capabilities are envied around the world, and the U.S. enjoys close political and commercial relationships with many countries forged over decades through the construction of U.S.-origin nuclear plants. Exports of U.S. nuclear technology allow the U.S. to set global standards for nuclear security, safety and nonproliferation. New designs will enable advanced nuclear to fit seamlessly into systems with high penetrations of variable renewable sources. U.S. nuclear innovators, including TerraPower, have advanced their technology readiness levels sufficiently for demonstration and offer substantial advances in economics, safety and proliferation resistance. Now is the time to build

on the momentum of these innovators, demonstrate advanced reactors, and deploy this important tool in the fight against climate change.

The Role of the Federal Government

Unlike many of our foreign competitors, America's advanced nuclear industry is made up of private companies backed by private investors who partner with our national laboratories, research universities, and agencies, like the U.S. Department of Energy, to develop domestic advanced nuclear technology.

Clean energy technologies have long benefited from partnering with the federal government to make it through the "valley of death" that new technologies face initially. Wind and solar are no exceptions and would not have taken off without subsidies, power-purchasing targets and government funding for research and development activities. The result is clean technology innovations with reduced costs and faster development and deployment timelines than previously imagined.

Without question, the most important step Congress can take to get cost competitive advanced nuclear reactor designs to market is to continue to push for public private partnerships to demonstrate advanced nuclear technology. We are willing and able to make substantial private investment to demonstrate our technology, but we need partnership with national laboratories, the Department of Energy, and the Nuclear Regulatory Commission to demonstrate our designs. Because our designs are novel and cutting edge, it will be virtually impossible to find capital to build a commercial reactor without demonstrating the coolants, fuels, and components of our reactors.

As such, we are excited that the FY2020 Appropriations Bill provides $230 million for demonstration of advanced nuclear reactors, including two designs to be demonstrated in the next 5-7 years at a 50/50 cost share. Given the step change in improvements in areas including fuel cycles, waste, safety and cost possible by Generation IV designs, we hope that at *least* one of those reactors is truly advanced, and moves beyond conventional light water designs. We look forward to working with the Committee and DOE to demonstrate our technology as part of this program.

We also strongly support H.R. 3306, the Nuclear Energy Leadership Act (NELA). This legislation presents a vision and execution strategy with specific targets and milestones to advance the nuclear industry, including, advanced reactor research goals, authorization of the VTR, along with high-assay, low-enriched uranium for research and the demonstration of several advanced nuclear reactors. We appreciate that a number of members of this committee have joined as co-sponsors of this important bill and we hope Congress will move to pass NELA expeditiously.

NELA builds on much of the work already done by this Committee. The Nuclear Energy Innovation Capabilities Act (NEICA) laid the groundwork for advanced nuclear innovation at America's national laboratories, including the need for a fast neutron source that has become

the Versatile Test Reactor (VTR). The VTR will provide a user facility for innovators providing both a fast neutron source and heat for coolant loops to test materials, fuels and new coolants. TerraPower is working with GE-Hitachi to develop the reactor to power the VTR, and we think this can be done in a way that both creates this important user facility while demonstrating advanced technologies like a sodium cooled fast reactor. If we can reach an agreement with DOE, we will bring private investment into the VTR. This could be a win-win for the United States, and we will continue to engage with the Department to make this project a reality.

In addition, TerraPower appreciates the work of both this committee and the Nuclear Regulatory Commission (NRC) to prepare for the licensing of advanced nuclear technology. The enactment of the Nuclear Energy Innovation and Modernization Act (NEIMA) will provide significant help, and we are grateful for your leadership and work on that legislation. We look forward to continuing to work with the NRC on implementing NEIMA and licensing advanced reactors. Ensuring that the NRC has the resources to evaluate advanced reactor designs is critical if we're going to bring these products to market in time to make a 100 percent clean economy a reality.

And finally, we are deeply grateful for the work the Committee is doing on legislation like the Clean Future Act that sets the ambitious goals necessary to prevent the worst effects of climate change. Our company was founded on the premise that we must end both global energy poverty and climate change. This will require bold goals coupled with practical plans to achieve those goals. Advanced nuclear can pair with other carbon free sources of energy to decarbonize our grid. Our high temperature heat can help decarbonize the industrial sector. And we can help scale the grid to meet the increasing demand for electricity from the transportation sector. To be sure, meeting a goal of zero emissions by 2050 is ambitious. We wholeheartedly believe that America is up for this challenge, and TerraPower is ready to play a key role in making a 100 percent emissions free future a reality.

Conclusion

The Committee has recognized that America and the world are transitioning to a future that requires forms of energy that do not produce emissions. The country that owns the advanced nuclear transition will be a leader in the global nuclear market and fulfill the international goals of deploying clean energy, supporting energy security, lifting millions out of energy poverty, and driving economic growth. The advanced nuclear industry is critical to providing the safe, emissions-free, firm power the world will require over the coming century.

We know America can lead in nuclear innovation. In 1957, the Shippingport Atomic Power Station - the world's first full-scale commercial nuclear power plant, came online in Pennsylvania. Shippingport was the cornerstone for commercial light water reactor technology and led to the construction of hundreds of reactors around the world employing US born technology. In the coming decades, many new countries will employ nuclear energy for the first time to meet their growth needs. China and Russia stand poised to supply these countries with their technology. The US needs to be ready with ours. It is time to repeat the story of Shippingport, this time with next generation technology that can help bring clean power to the

United States and around the world. This must happen if we are to meet the goal of a 100 percent clean economy.

On behalf of TerraPower's one hundred and fifty employees working to make that goal a reality, thank you for the opportunity to appear before the Committee

Additional Information

American Energy Innovation Council Report – Energy Innovation: Fueling America's Economic Engine[3]

Third Way Report on Advanced Nuclear Industry [4]

TerraPower Co-founder and Vice Chairman Nathan Myhrvold Op-Ed on Nuclear Energy Innovation[5]

[3] http://americanenergyinnovation.org/wp-content/uploads/2018/11/Energy-Innovation-Fueling-Americas-Economic-Engine.pdf
[4] https://www.thirdway.org/graphic/keeping-up-with-the-advanced-nuclear-industry
[5] https://www.intellectualventures.com/buzz/insights/why-we-need-innovative-nuclear-energy