Testimony for the Record
Nuclear Energy Institute
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I am Maria Korsnick, President and Chief Executive Officer of the Nuclear Energy Institute (NEI). I appreciate the opportunity to testify this morning and thank the subcommittee for continuing to focus on nuclear energy – and specifically on the role of advanced nuclear technology in reaching our decarbonization goals.

It is undeniable that we are moving to a clean energy future: the public demands it, and businesses – including utilities – are making commitments to reduce and eliminate carbon emissions. The United Nations IPCC has indicated that the choices we make today – to bring the changes and technologies needed – are critical.

At the heart of a clean energy system will be an electric grid that is overwhelmingly carbon-free. It is reasonable to begin the task of decarbonizing by focusing on the power sector. This is the segment of the energy economy that has the most mature technologies that will be capable of displacing emitting sources. A low-carbon power sector will enable emission reductions in other sectors by making electrification a more attractive option.

States and utilities have recognized the need to decarbonize the energy sector. States like California, New Mexico, Colorado, New York, and Washington have all set goals to require 100 percent clean and reliable energy by 2050 or earlier, with more on the way. Dozens of utilities are demonstrating leadership on decarbonization through significant emission-reduction pledges, and many more utilities are already well positioned for a low-carbon future by virtue of their existing nuclear generation.

Nuclear Supports Carbon Goals
In the U.S., nuclear energy already generates most of our nation's clean energy by producing over 800 billion kilowatt hours of emissions-free energy every year. The current nuclear fleet is making our air cleaner and our planet safer – in 2018 alone operation of the fleet avoided emissions of over 500 million metric tons of carbon dioxide and over ½ million short tons of other pollutants. Nuclear plants run 24 hours a day, 7 days a week producing power with unmatched reliability and have the added benefit of having all their fuel on site for 18-24 months. Nuclear plants are hardened facilities that are protected from physical and cyber threats, helping to ensure we have a resilient electricity system in the face of potential disruptions.

Looking at today's energy mix and at our goals for further decarbonization, it's clear that we need nuclear alongside other clean sources of energy such as wind, solar, and hydropower. We need these technologies to complement each other, not work against each other. Electric utilities are recognizing that nuclear power will be essential to meeting their carbon reduction

commitments. For example, Duke energy has announced that it will seek to renew the operating licenses of the 11 reactors it operates at six nuclear stations in the Carolinas for an additional 20 years and that their nuclear fleet plays an important role in the company's efforts to lower carbon emissions.[1] Electric utilities are looking for firm, dispatchable, carbon-fee solutions to complement wind and solar and meet their decarbonization pledges – recognizing that second license renewal for the current fleet and advanced technologies are integral to meeting these goals. The first-ever second license renewal application was recently approved – extending a plant's operation out to 80 years. Another renewal is on the verge of being granted, and many more are on the horizon. These investments by U.S. nuclear plant operators have huge decarbonization benefits; renewing the operating licenses of the existing 96 U.S. nuclear power reactors will avoid many billion metric tons of carbon from being added into the atmosphere.[2]

As another example, Dominion recently announced aggressive carbon reduction goals for 2050. In announcing its goals, Dominion remarked that "reducing emissions as fast as possible and achieving net zero emissions requires immediate and direct action. That is why the company is moving to extend licenses for its zero-carbon nuclear generation fleet, promoting customer energy efficiency programs, and investing in wind and solar power, lower-carbon natural gas, and carbon-beneficial renewable natural gas. Over the long term, achieving this goal will also require supportive legislative and regulatory policies, technological advancements and broader investments across the economy. This includes support for the testing and deployment of such technologies as large-scale energy storage, hydrogen, advanced nuclear and carbon capture, all of which have the potential to significantly reduce greenhouse gas emissions." [3]

Next year (2021) Southern Company will bring the nation's first AP1000 light water reactor – Vogtle 3 in Georgia – online; and the year after that, the second AP1000 Vogtle 4 (2022) will begin operation. When finished, these facilities will generate enough carbon-free electricity to power a million homes and businesses.

Power companies are also moving forward with plans to build a next generation of nuclear reactors. For example, Utah Associated Municipal Power Systems (UAMPS), which does not currently utilize nuclear power, states that "the electrical utility industry is in the midst of transformation due to the proliferation of new technologies, changing lifestyles, and new regulations targeting fossil fuels. UAMPS' Carbon Free Power Project encompasses three interconnected parts designed to help members cope with these changes and ensure that UAMPS' future energy supply is safe, clean, secure, stable and adequate for an energy-hungry, growing population. The CFPP provides tools for Energy Efficiency, embraces Distributed Generation (like rooftop solar) with wise rate structures, and is investigating Small Modular

[1] See https://news.duke-energy.com/releases/duke-energy-will-seek-to-renew-nuclear-plant-licenses-to-support-its-carbon-reduction-goals

[2] Emissions avoided are calculated using regional and national fossil fuel emissions rates from the U.S. Environmental Protection Agency (https://www.epa.gov/emc/emc-continuous-emission-monitoring-systems) and 2018 plant generation data from the U.S. Energy Information Administration (https://www.eia.gov/nuclear/generation/)

[3] See https://news.dominionenergy.com/2020-02-11-Dominion-Energy-Sets-New-Goal-of-Net-Zero-Emissions-by-2050

Nuclear Reactor technology to provide future baseload supply."[4] UAMPS is planning to construct the NuScale power reactor on the Idaho National Laboratory site.

This growing appreciation for the role of firm, dispatchable, carbon-free nuclear generation comes as the electricity sector in the United States continues to undergo significant transformation. The U.S. Energy Information Administration (EIA) forecasts the retirement of 140 gigawatts of capacity by 2040 in the U.S.[5] In addition, the EIA estimates that demand for electricity in the U.S. will expand by almost 15 percent during that time. Ensuring that advanced reactors are available to the market by the early 2030s is essential to ensuring a secure, resilient, and affordable electricity sector well into the future to meet domestic and global energy needs. This is a challenging task but one that is necessary if the U.S. is to maintain the reliable electricity service Americans now enjoy and meet its clean air commitments.

Of course, focusing only on the need for carbon reduction and additional electricity in the U.S. in the upcoming decades would mistakenly overlook the likelihood of and the need for a significant increase in electricity demand and carbon reduction worldwide. There are still nearly 1 billion people in the world without access to electricity.[6] Providing them with a reliable clean source of electricity will significantly raise their standard of living. Therefore, it is imperative that new U.S. advanced reactors be available soon for both domestic and international deployment.

Electricity Market Challenges

In many parts of the U.S., nuclear plants are facing the prospect of early closure. In markets where their non-emitting attribute is not valued, the flood of natural gas unleashed by fracking has made economic survival a difficult proposition.

Policies that do not fully account for the value of nuclear energy's carbon-free generation will fail to address the forces driving nuclear plants to early closure. Allowing nuclear plants to close will undermine the progress otherwise being made in reaching the emissions reductions needed, when they are needed, to achieve our nation's environmental goals in an affordable manner. Making progress on reducing carbon emissions begins with preserving non-emitting sources.

Unfortunately, by 2025, eight additional nuclear reactors have announced plans to close prematurely (and several more may soon follow). That means less reliable clean energy and fewer jobs in Pennsylvania, Iowa, New York, Michigan, and California. Today, those eight reactors help avoid more than 39 million metric tons of carbon dioxide each year. Shutting those plants is the equivalent of putting more than 8 million vehicles on the road. This gap in electricity production will likely be filled by what is available in most cases, fossil fuels.

Advanced Nuclear Innovation

As we look ahead to the future of nuclear energy, I'm pleased to note that both the government and the private sector are taking meaningful steps to better position the U.S. to deliver innovative new nuclear technologies to the global marketplace. The U.S. leads the world in innovative and entrepreneurial companies. NEI's members include approximately 20 advanced reactor

[4] Utah Associated Municipal Power Systems (UAMPS) – Carbon Free Power Project www.uamps.com
[5] U.S. Energy Information Administration – 2019 Annual Energy Outlook: Table A8.
[6] International Energy Agency - 2018 World Energy Outlook: Electricity Access Database

developers with one or more designs being developed. These companies are developing designs with coolants including water, liquid metal, high temperature gas, and molten salt.

The designs range in size from a few megawatts electric (micro-reactors) to a few hundred megawatts electric (small modular reactor or SMR) to the 1,000+-megawatt-class reactors. Advanced nuclear reactor designs have many potential technological advantages (e.g., passive cooling even in the absence of an external energy supply; some designs operate at or near atmospheric pressure, which reduces the likelihood of a rapid loss of coolant; and extended operations between refueling and the potential consumption of nuclear waste as fuel, reducing disposal issues). As a result, the nuclear power of the future will enable not only electricity production at large central facilities, but also provide resilient and reliable energy to remote locations that are currently using diesel. It will enable the replacement of retiring coal facilities utilizing the existing infrastructure and in doing so preserve jobs in the local community. Increased electrification with advanced nuclear technologies could also spur decarbonization in other sectors such as manufacturing, chemical processing, and particularly in transportation – electric cars make a lot more sense if they are charged with carbon-free nuclear energy.

NEI supports a nuclear future that includes the existing fleet with second license renewals, additional large light water reactors (LWRs) and advanced reactors, including advanced water-cooled small modular reactors and non-light water reactors. Evolutionary LWR designs are already commercially available, with the two AP1000 units that will come online in 2021 and 2022. Advanced water-cooled SMRs are expected to be available by the mid-2020s and larger advanced non-LWRs are expected to be available in the late 2020s or early 2030s while micro-reactor technology is expected to be commercially available in the mid-2020s.

The majority of the companies within the advanced reactor industry are privately funded and all have a strong commitment to the development of safe, secure, and economically viable reactors. Private-public partnerships, in different forms, have benefitted many of these companies, enabling them to leverage their own resources and thereby accelerate development of their technologies. These companies are rapidly developing their technology and continuing to achieve significant milestones. The Tennessee Valley Authority recently received the nation's first early site permit for a small modular reactor at its Clinch River site. NuScale is expected to receive a design certification from the NRC for its SMR this year – the first approval for an SMR. The NRC is expecting Oklo to submit, in the near-term, an application for the first advanced non-water cooled micro-reactor. GE-Hitachi is actively engaged with NRC on its innovative SMR design. Kairos, TerraPower, Terrestrial Energy, and X-energy are all at different levels of engagement with NRC, and Southern Company is teaming with TerraPower on molten salt reactor technology. And there is more work being done by many other advanced reactor companies.

Private-Public Partnerships

Recently, Congress took a big step forward by approving $1.5 billion in appropriations for the Department of Energy's (DOE) Office of Nuclear Energy – that's a 12.5 percent increase in the coming year, and the most funding in decades. Within this appropriation, Congress provided the first year of funding for an Advanced Reactor Demonstration Program. This program will fund, through cost-share awards, two demonstrations with a goal to be operational in 5 to 7 years, and

will fund 2-5 other projects to facilitate successful future demonstrations. In addition to the financial assistance, this show of government confidence in advanced reactor technology will spur capital investment for commercialization. Lastly, demonstrations will spur domestic and international sales of U.S. reactors by providing an opportunity for the potential customers to "kick the tires" before purchasing. And if those new nuclear technologies can achieve the goal of being competitive with natural gas in the U.S., those technologies will be highly sought after in the global market.

The Nuclear Energy Leadership Act Is Vital

The bipartisan Nuclear Energy Leadership Act (NELA) is a vital piece of legislation that will help enable the development, demonstration, and deployment of advanced nuclear power systems and position the U.S. industry for both domestic and international expansion. We are pleased that the majority's CLEAN Future Act discussion draft includes NELA provisions, including a pilot program that would incentivize new technology deployment through federal power purchase agreements.

As recognized by NELA, a robust and vibrant advanced nuclear power industry requires:

- Innovative ideas and technology through private sector development
- An efficient and effective regulatory structure for licensing advanced reactors
- Research and development infrastructure
- Access to fuel
- Market demand
- A committed and vibrant workforce

In order for the advanced reactor community to be successful, the Nuclear Regulatory Commission's (NRC) regulatory structure for licensing advanced reactors must be efficient and effective and the companies must have access to the necessary research infrastructure. The Nuclear Energy Innovation Capabilities Act and the Nuclear Energy Innovation and Modernization Act, both of which have been signed into law, will help address these issues.

NELA is the key to addressing the workforce, access to fuel, and market demand issues as well as reinforcing the need for a robust R&D infrastructure. NELA's policies will address market demand by providing a pathway to demonstration for multiple designs and establishing policies that enable the long-term valuation of power from these reactors. Once passed, the bipartisan Nuclear Energy Leadership Act will help ensure that our nation's advanced reactor program thrives in the coming decade.

NELA authorizes a long-term DOE program to support demonstrations of advanced reactor technologies through private-public partnerships, the first year of which was recently funded in FY20 appropriations. NELA sets aggressive goals for demonstrations which are necessary to position advanced nuclear as a deployable resource in the next decade. Demonstrating advanced nuclear technologies will also open other market possibilities including hydrogen production and process heat generation with carbon-free energy. Introducing nuclear power into these sectors will be instrumental to achieve decarbonization of the broader energy sector in the U.S. and worldwide.

Although the U.S. led the world into the age of nuclear energy, we have lost ground to other countries with substantial, state-funded advanced reactor programs. The United States is no longer the dominant supplier of nuclear reactors; we are in a race against other countries to capture a growing international market share. NELA's implementation and the advanced reactor demonstration program funded in FY20 appropriations are critical to positioning the United States for the future both domestically and internationally and will help the United States regain its position as global leader in nuclear energy. To avoid being left behind, we must focus on regulatory reform, R&D infrastructure, and development and deployment of new technologies. Positive things are happening in all of these areas, but more must be done; NELA is instrumental in this effort.

Decarbonizing the Broader Energy Sector

There is a growing consensus that including nuclear energy is the most cost-effective way to quickly transition a clean electricity system. Recognizing that the electricity sector accounts for far less than half of the carbon dioxide emissions from U.S. energy use, any effort to decarbonize energy use will require efforts that go far beyond the electricity sector.

A 2016 report by the Joint Institute for Strategic Energy Analysis at the National Renewable Energy Laboratory[7] examined the possibility of replacing fossil-fuel combustion in industry with small modular nuclear reactors, solar thermal, and geothermal energy sources. The report found that SMRs are an option to supply both process heat as well as hydrogen production for feedstock use. For example, to supply heat to industry and hydrogen as feedstock to refineries, steel production, and plastic materials and resins production, the report found that 850 SMRs (rated at 150 MW thermal) would be necessary. Another potential application for nuclear in hydrogen production would be to serve petroleum refineries, which use 9,130 metric tonnes/day of hydrogen. All of the refinery merchant hydrogen demand could be met by 309 light-water SMR modules.

Decarbonizing the transportation sector will of course require moving away from fossil fuels – including gasoline, diesel and natural gas – and increasing the use of low-carbon fuels. The greatest potential for decarbonizing the transportation sector comes from using electricity or hydrogen generated from zero-carbon sources like nuclear reactors, wind turbines, and solar panels. Use of net-zero sources, such as biofuels and ammonia that can be generated using energy resources with low life-cycle carbon emissions, could be included depending on the decarbonization goals. Given that nuclear energy provides nearly 20 percent of U.S. electricity and more than half of America's carbon-free electricity, it can play a significant role in providing the carbon-free electricity needed to power a growing fleet of electric vehicles.

The growing amounts of hydrogen and ammonia that will be needed to decarbonize modes of transportation that are not readily electrified should be produced with zero-carbon resources to maximize the carbon reduction. Last year DOE's H2@Scale program[8] awarded a grant to demonstrate hydrogen production at a commercial nuclear power plant in the Midwest, and DOE's Office of Nuclear Energy is working with operators of three commercial nuclear power plants to demonstrate hydrogen production in nuclear power plants in different regions of the

[7] See https://www.nrel.gov/docs/fy17osti/66763.pdf
[8] See https://www.energy.gov/eere/fuelcells/h2scale

U.S.[9] Projects such as these should be continued and expanded to ensure we have a broad range of carbon-free technologies from which to produce the necessary quantities of hydrogen to decarbonize heavy transport modes. Advanced nuclear energy systems could be an important source of hydrogen and process heat for the production of ammonia as well as for other decarbonized transport fuels such as aviation fuels.

U.S. National Security Interests Are At Stake

From the dawn of nuclear energy, a dominant position in civilian nuclear power enabled the United States to advance multiple national-security interests. Leadership in nuclear energy allowed the United States to promote the highest global standards for nuclear safety, security and nonproliferation; to protect our friends and allies against energy insecurity and adverse foreign influences; to maintain a healthy domestic supply chain for our nuclear Navy and major DOE programs; and to promote environmental goals through generation of the majority of our nation's carbon-free power, among other critical interests.

In recent decades, Russia and China – guided by strategic goals and backed by strong state support – have displaced the United States as the global leader in nuclear energy. The future of global nuclear leadership is at a crossroads. The lower cost, lower power, inherent safety and wider applications of advanced reactor designs make nuclear power a practical option for many more countries than use nuclear power today. The supplier will forge a special relationship with these counties over the century-long life of its nuclear program – from site characterization to regulatory development, training, engineering and construction, operations and maintenance, security services and finally decommissioning. More broadly, the dominant global supplier will exert considerable influence on nuclear policies and practices.

If the U.S. is to maintain its leadership in global nuclear safety, security and nonproliferation; if we are to continue helping our friends and allies against foreign leverage through energy supply; if we are to maintain the domestic supply chain that supplies not just our plants but also our nuclear Navy; and if we are to maintain our nation's majority of carbon-free power, then we must lead in the development and commercialization of advanced nuclear reactors.

On a positive note, I'm pleased to recognize the efforts by Congress to restore the functionality of the Export-Import Bank. To compete successfully in the international marketplace, U.S. suppliers must be able to offer competitive financing to potential customers. Other countries' nuclear energy suppliers are backed by national export credit agencies or directly by their governments. A functional and competitive Ex-Im Bank is a must if we hope to win our fair share of this trillion-dollar global market, and the recent seven-year reauthorization of the bank's charter was an important victory for U.S. suppliers.

Conclusion

The industry is grateful for the bipartisan Congressional commitment to carbon-free nuclear energy that resulted in the enactment of NEICA and NEIMA. We appreciate and applaud the continued bipartisan support that inspired NELA. With this continued support and the dedication of the industry, I am confident the U.S. will be the world leader in nuclear technology and

[9] See http://world-nuclear-news.org/Articles/US-DOE-awards-funds-to-support-industry-innovation

generation and that nuclear power will remain a dominant source of carbon-free energy for decades to come.

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