Prepared Statement

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and its Subcommittee on Energy

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

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Chairman Rush, Ranking Member Upton, and Members of the Subcommittee, thank you for the opportunity to be here today to discuss the imperatives of climate change and the promise of advanced nuclear technology in decarbonizing America's energy sector. I am Joseph Hezir, a Principal at the Energy Futures Initiative, Inc. From 2013-2017, I served as Chief Financial Officer of the U.S. Department of Energy and Senior Policy Advisor to the Secretary of Energy.

The Energy Futures Initiative

My testimony today draws from the work of the Energy Futures Initiative (EFI), an organization founded in 2017 by former Secretary of Energy Ernest J. Moniz, along with Melanie Kenderdine, founding Director of the Department of Energy (DOE) Office of Energy Policy and Systems Analysis and myself.

EFI's mission focuses on data-driven analysis to explore the ways technology and policy innovation create clean energy jobs, expand the economy, enhance national and global energy security, and addresses the imperatives of climate change.

To fulfill this mission, EFI produces reports for policymakers and the public that offer new insights into and recommendations on emerging energy issues. To have maximum impact, EFI identifies solutions that are effective, realistic, and sufficiently robust for adoption in these uncertain times. In three years, EFI has published 13 reports:

- The U.S. Nuclear Energy Enterprise: A Key National Security Enabler (August 2017)
- Leveraging the DOE Loan Programs: Using $39 Billion in Existing Authority to Help Modernize the Nation's Energy Infrastructure (March 2018)
- The 2018 and 2019 U.S. Energy and Employment Reports (March 2019 & June 2018), with the National Association of State Energy Officials

- Promising Blockchain Applications for Energy: Separating the Signal from the Noise (July 2018)
- Advancing Large Scale Carbon Management: Expansion of the 45Q Tax Credit (May 2018)
- Investing in Natural Gas for Africans: Doing Good and Doing Well (November 2018)
- Advancing the Landscape of Clean Energy Innovation (February 2019), with IHS Markit
- More Funding Needed for Carbon Removal Technologies (April 2019), with the Bipartisan Policy Center
- Optionality, Flexibility & Innovation: Pathways for Deep Decarbonization in California (May 2019)
- The Green Real Deal: A Framework for Achieving a Deeply Decarbonized Economy (August 2019)
- Clearing the Air: A Federal RD&D Initiative and Management Plan for Carbon Dioxide Removal Technologies (September 2019)
- Regional Clean Energy Innovation (February 2020) (with the University of Maryland)

All EFI reports are available to the public at: **https://energyfuturesinitiative.org/efi-reports**.

The Green *Real* Deal Framework for Advanced Nuclear Energy Technologies

The Green New Deal Resolution has drawn critical national attention to two aspirational goals: (1) the need to address the climate change crisis on an urgent basis and (2) the necessity to transition to a clean economy built by and in service to communities of all sizes and compositions: rural and urban, white collar and working class.

To translate these two aspirational goals of the Green New Deal into practice, EFI published in August 2019 ***The Green Real Deal (GRD): A Framework for Achieving a Deeply Decarbonized Economy.*** This paper described a comprehensive strategy for the deep decarbonization of U.S. energy systems by mid-century in ways that minimize costs, maximize economic opportunities and promote social equity.

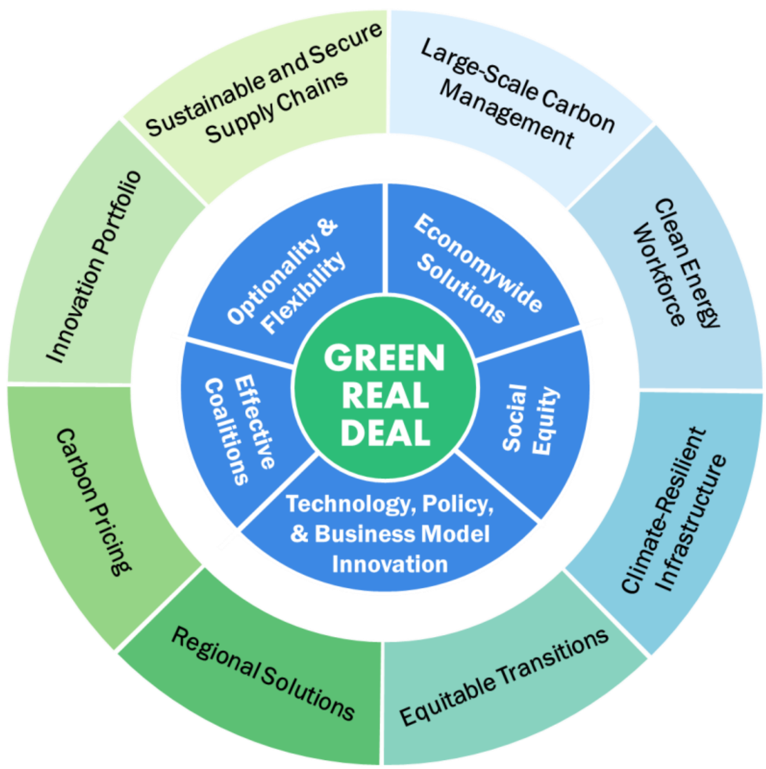
Building on the goals for emissions reduction laid out in the 2015 Paris Agreement, the ***Green Real Deal*** targets deep decarbonization by midcentury. Following the subsequent release of the 2019 IPCC report, global consensus is building around the need for emissions reductions of 40 percent by 2030, and net-zero emissions by midcentury. In practice, achieving these targets requires that we implement multiple pathways to economywide decarbonization, and deploy at scale breakthrough technologies that are only now in their infancy.

A key aspect of a net-zero emissions goal by midcentury is the term "net." As noted in the September 2019 EFI Report ***Clearing the Air: Technological Carbon Dioxide Removal RD&D Initiative,*** "Net-zero carbon dioxide emissions is not credibly achievable by midcentury without major contributions form negative-carbon technologies." Thus, the objective of today's hearing, "Building a 100 Percent Clean Economy" needs to be cognizant that emissions-free technologies such as advanced nuclear energy will be necessary but not sufficient to meeting this goal.

The ***Green Real Deal*** presents a framework starting from five broad-based principles and organized around eight high-level elements. The principles include:

- ✓ Technology, Business Model, and Policy Innovations are Essential
- ✓ Broad and Inclusive Coalitions Must be Built
- ✓ Social Equity is Essential for Success
- ✓ All GHG Emitting Sectors Must be Addressed in Climate Solutions (this includes large scale carbon management)
- ✓ Optionality and Flexibility are Needed for Technologies, Policies and Investments

A graphical representation of the ***Green Real Deal*** Framework is shown below.



At the heart of the ***Green Real Deal*** is an emphasis on an "all-of-the-above" approach to reducing greenhouse gas emissions: rapid action on climate change must be borne of practicality, not ideology. The Midwest presents different opportunities and challenges for emissions reductions than the Southeast, and a just and equitable low-carbon future demands optionality, flexibility, and innovation of policymakers.

In our analysis, advanced nuclear reactors consistently rank among the technologies that most enable that optionality and flexibility.

Advanced Nuclear Energy Technologies Have High Breakthrough Potential

EFI, in collaboration with IHS-Markit, conducted a detailed assessment of the current U.S. energy innovation ecosystem. In February 2019, the two organizations released a final report titled ***Advancing the Landscape of Clean Energy Innovation,*** addressing the need for expanded and accelerated investment in the research, development, demonstration, and deployment of advanced energy technologies.

The study sought to identify technologies that promise to overcome the largest obstacles on the path to economy-wide, deep decarbonization, including:

- The question of clean electric power generation,
- Difficult-to-decarbonize sectors of the economy such as heavy industry and transportation, and
- The need for decentralized and distributed energy technologies

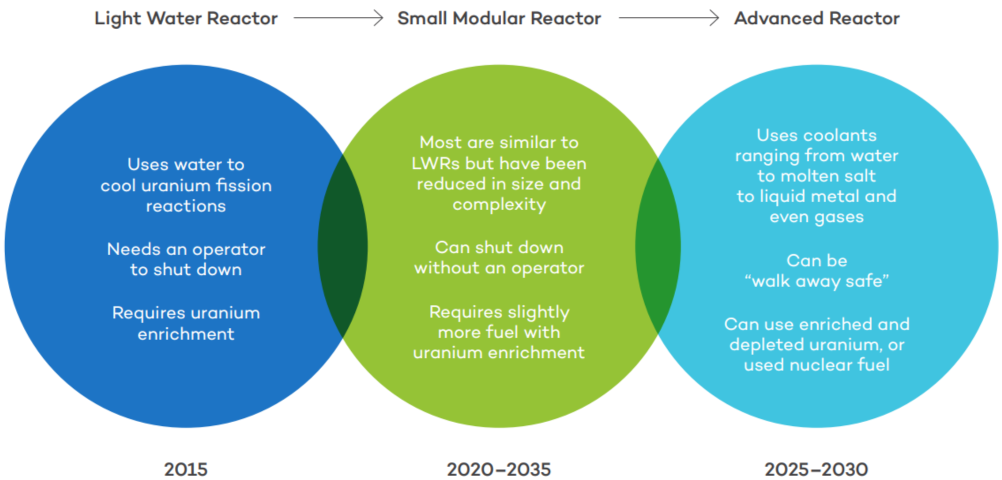
The study developed a set of four criteria for identifying and evaluating energy technology breakthrough priorities:

- ***Technical Merit***, including energy or environmental performance, especially greenhouse gas emission reductions;
- ***Market Viability***, including manufacturability at scale with adequate and secure supply chains, a viable cost-benefit ratio for providers, consumers and the general economy;
- ***Compatibility***, including potential to interface with a wide variety of existing energy infrastructures, including interoperability, flexibility and extensibility; and
- ***Consumer value***, taking into consideration potential consumer preference issues.

This analysis-based approach identified advanced nuclear energy technologies as one of five critical technologies with high breakthrough potential. (The other four technology areas included storage and battery technologies, technology applications of buildings and industry, electricity grid modernization and smart cities and large-scale carbon management technologies.

The hallmarks of advanced nuclear power technologies include simpler design and construction, passive safety features such as the ability to shut down or even operate automatically, increased efficiency and the ability to use a greater variety of nuclear fuels, including spent nuclear fuel from older reactors. These technologies can be packaged into small, modular reactors (SMRs) and used to produce process heat – making advanced reactors suitable for a large number of industrial applications, other than ones requiring extremely high heat, that otherwise may have limited alternatives to utilize clean energy supplies.

The innovations spanning for current commercial nuclear power technologies through advanced nuclear energy technologies are illustrated in the graphic below.



Nuclear technologies are evolving beyond light water reactors to encompass both small modular reactors and numerous advanced reactor concepts.

Source: Energy Futures Initiative (EFI), 2017, compiled using data from Third Way, 2015

Advanced nuclear reactor technologies provide reliable, constant, zero-carbon electricity wherever they are located – in contrast to renewable intermittent generating technologies such as wind and solar, or geographically-limited energy sources such as geothermal and hydroelectric. Advanced nuclear energy technologies have potentially a national market footprint; nuclear technology is climate resilient and modular-sized reactors can be closely matched to small, including rural, markets.

The report notes that several companies have pursued advanced reactor concepts with private capital, largely leveraged from past DOE funded research and development in high temperature gas and molten salt reactor technologies. DOE is currently cost sharing activities to develop designs for advanced reactor technologies (including high-temperature and fast reactors) and is supporting licensing activities for SMRs employing light water technology. The DOE SMR Licensing Technical Support Program works with industry partners, research institutions, the national laboratories, and academia to advance the certification, licensing, and siting of domestic advanced SMR designs, and to reduce economic, technical, and regulatory barriers to their deployment. Standardized manufactured designs will simplify the licensing process. The United States is not alone in this pursuit: several countries are supporting R&D on advanced nuclear reactor concepts, establishing the Generation IV International Forum (GIF) in 2001.

A versatile suite of technologies, less capital-intensive designs and smaller size all lower the barrier to entry for prospective operators and promise to fundamentally change the dynamics of financing for nuclear power generation. This promise, however, has not yet been brought to fruition. Additional investment is needed for the demonstration of performance and safety characteristics, fuels qualification, and cost validation. Additionally, the elements of the current regulatory framework, established over a long history and focused on licensing of large, gigawatt-scale light water reactors, must be reconsidered. Elements of the Nuclear Regulatory Commission's licensing process for older-generation, large scale light water reactors may not be appropriate for advanced modular-scale reactor concepts.

Advanced Nuclear Energy Technologies Provide Optionality and Flexibility to Meet Midcentury Clean Economy Goals

As discussed in EFI's comprehensive study of decarbonization for the state of California, titled ***Optionality, Flexibility and Innovation***, current technology options are available to expand deployment of end use energy efficiency improvements, move toward electrifying transportation and physical infrastructure (for both commercial and residential buildings), and continue to expand deployment of renewable electricity on a scale that can achieve the target of 40 percent reduction in emissions by 2030 as established by the state. Moving beyond 2030 to more ambitious targets by midcentury is less clear. As stated in the report:

> "Achieving deep decarbonization in the midcentury timeframe will depend on innovation, including clean energy technologies that cut across sectors. Meeting emission reductions goals while managing their costs will require a strong focus on, and commitment to, technology optionality, flexibility and innovation."

Advanced nuclear energy technologies can play an essential role in contributing to the optionality, flexibility and innovation needed to meet midcentury clean energy goals. Successful development and demonstration of these technologies over the course of this decade will position the technology to play an important role as the energy sector moves toward a 100 percent clean economy by midcentury.

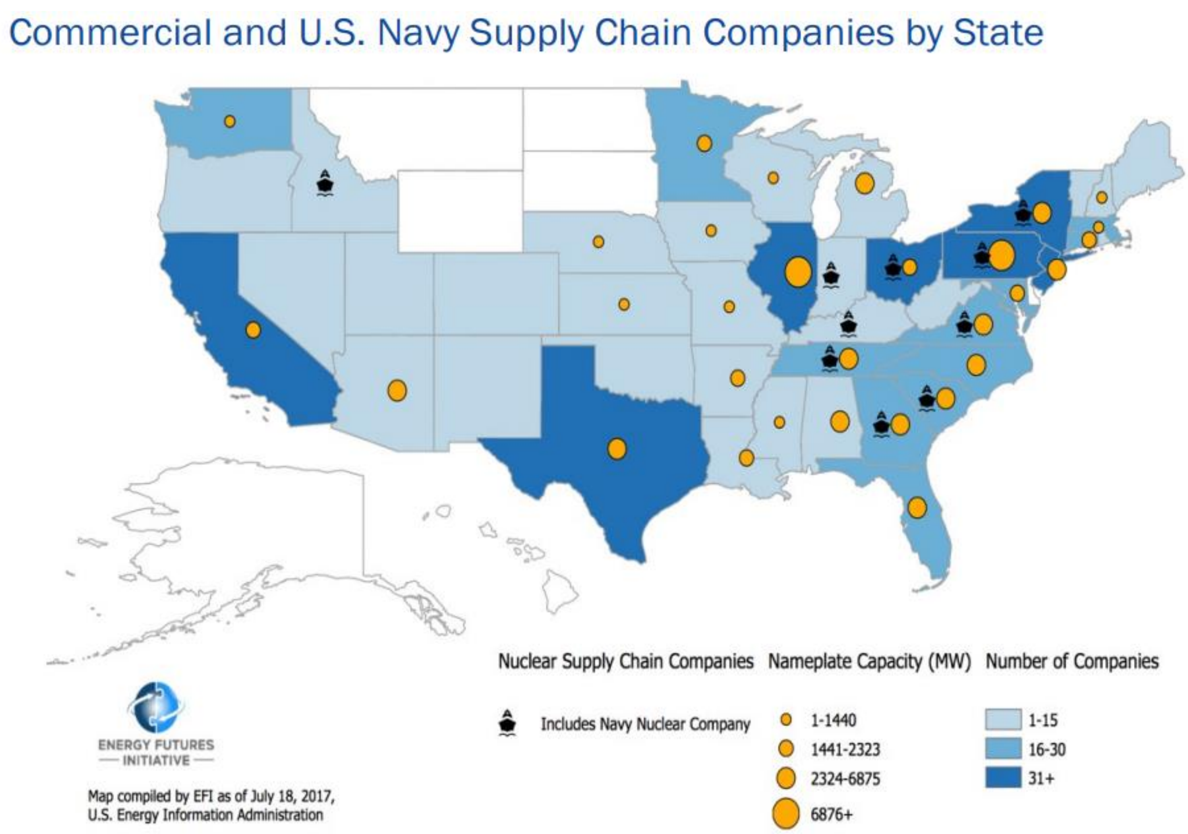
The National Security Imperative for Advanced Nuclear Energy Technologies

In 2017, EFI's first report, ***The U.S. Nuclear Energy Enterprise: A Key National Security Enabler***, addresses the national and global security reasons for investing in the next generation of commercial nuclear energy. The report documents the critical contributions of the domestic nuclear energy sector to enable the U.S. military meet specific defense priorities, including the global projection of U.S. military capability, as well as leadership and support for the implementation of U.S. nonproliferation policy.

The design and operation of United States Navy reactors includes a workforce trained in science and engineering, comprised of U.S. citizens who qualify for security clearances – as a result, there is strong overlap between the supply chains for the commercial nuclear energy sector and those required by the U.S. nuclear fleet. The operation, refueling, and servicing of reactors on eleven aircraft carriers and seventy submarines depend on the preservation of academic institutions, the DOE National Laboratories, and private industry for component parts, critical materials, and an educated workforce. As noted in the EFI March 2019 report, ***The 2019 U.S. Energy & Employment Report,*** a total of 72,146 persons are employed in commercial nuclear power industry and associated fuel supply chain industries; a large number received their nuclear training through service in the Nuclear Navy, and many in the supply chain support both commercial and national security applications.

The global nuclear energy market still operates U.S. technologies and designs, but the domestic nuclear sector is facing stiff state-sponsored international competition. Certain large nuclear energy technology components (e.g. large pressure vessels) can no longer be fabricated in the United States, and as more reactors in the U.S. may retire in the coming decades this trend could accelerate. To advance its collective energy security agenda and maintain its national security posture, the United States must continue to influence global nuclear priorities. This requires a robust domestic nuclear supply chain that can effectively compete in the global nuclear energy market, not only to capture a share of the benefits, but also to provide the leadership to ensure that nonproliferation and energy security objectives are not eroded.

The geographic interplay of the commercial and national security supply chains for nuclear energy is illustrated in the graphic below.



If investment in advanced nuclear technology promises benefits to national and global security, there are consequences for inaction. The U.S. military already lacks long-term domestic supply chains for nuclear fuel materials such as tritium and highly enriched uranium critical to the maintenance of the U.S. nuclear arsenal. Failing to invest in next generation nuclear technology will compromise important nuclear security capabilities or make them more costly. And if the United States cedes leadership in the commercial nuclear sector, it also erodes the authority of the Nuclear Regulatory Commission and the National Nuclear Security Organization to engage foreign organizations and government to advance nonproliferation objectives.

Moving Advanced Nuclear Energy Technologies from R&D through Demonstration and Deployment

The companies pursuing the development advanced nuclear energy technologies have been able to secure private sector financing for a range of planning, engineering design, testing and regulatory analysis activities. DOE cost-shared programs have provided limited public sector support. Private sector capital alone, however, may not be sufficient to carry these technologies from the research and development phases through to demonstration and deployment.

DOE currently provides cost sharing support for R&D, design studies and licensing support for advanced nuclear energy technologies. In addition, Congress has authorized production tax credits for initial commercial deployment of both existing and advance commercial nuclear power generation facilities. Congress is currently considering several additional legislative proposals to expand federal support for RD&D on nuclear energy technologies.

An additional important financial tool to support early commercial deployment of advanced nuclear energy technologies is the availability of credit support through the DOE Title XVII loan guarantee program, authorized by the Energy Policy Act of 2005. Loan guarantees issued through the DOE Loan Programs Office for the Vogtle nuclear power plant project was instrumental in enabling the construction of the first new nuclear power plant in the United States in more than thirty years.

The LPO has $39 billion in available Title XVII loan and loan guarantee authority – including $9 billion that could be used for advanced nuclear technology – that could be used to finance innovative energy infrastructure without new appropriations by Congress. In March 2018, EFI issued a Policy Paper, ***Leveraging the DOE Loan Program***, providing a series of recommendations for how this existing authority could be more effectively utilized to support modernization of energy infrastructures, including the domestic nuclear energy enterprise.

This concludes my prepared statement. I would be happy to answer any questions from the subcommittee.