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Statement of the Honorable Ernest J. Moniz
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Committee on Energy and Natural Resources
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Chairman Murkowski, Ranking Member Manchin and Members of the Senate Committee on Energy and Natural Resources, thank you for the opportunity to appear before you today to discuss the future of energy innovation in the United States.

It was my pleasure to appear multiple times before this Committee during the time I had the honor of serving as the 13th U.S. Secretary of Energy. Throughout my time of service, I found that Members of the Committee from both sides of the aisle came together on numerous occasions to support U.S. energy innovation. I hope that the 116th Congress will continue this tradition.

Much of my career has focused on energy innovation. At MIT, I established the MIT Energy Initiative, which had a significant focus on innovation in a carbon-constrained environment and engaged all of MIT's Schools. As Secretary of Energy, I made clean energy innovation a cornerstone of the Department's initiatives and policy. And now, at the Energy Futures Initiative, clean energy innovation is a pillar of our policy analysis. EFI has produced policy papers on important elements of energy innovation, including the national security foundation for the commercial nuclear energy sector; implementation of the 45Q tax credit program for carbon capture, utilization and storage; expanding the DOE Loan programs to leverage increased innovation in energy infrastructures; and application of blockchain technology to management of energy systems and services.

Importance of Energy Innovation

Energy innovation is the essence of America's security and strength. Our ability to innovate is at the heart of American economic success and optimism. Innovation drives job creation, contributes to national security, addresses complex societal challenges and improves our quality of life.

For the past seven decades, the United States has been the global leader in technology and energy innovation. Central to U.S. leadership in innovation is our unparalleled innovation ecosystem which includes the Federal, state, local and tribal governments; national laboratories; research universities; the private sector; nonprofits and philanthropies.

The U.S. is undergoing rapid change in the global competitive environment, challenging America's preeminent position but also offering immense opportunity for shaping the inevitable low-carbon global energy future. The science is clear, and the data are compelling—climate change is a major threat to our planet and to our way of life, and the clock is ticking. Nations in denial of climate change as a critical driver of an accelerated clean energy transformation will be left behind.

Accelerating this transformation won't be easy: the U.S. energy system has considerable inertia and risk aversion, since the industry is highly capitalized and must provide essential services all the time. This creates an inherent tension between the energy incumbents and the technology disruptors that must instead be harnessed to advance innovation, with incumbents and disruptors each playing an essential role.

Accelerating the Pace of Energy Innovation

It is in this context that the Energy Futures Initiative and IHS Markit undertook a joint study of the U.S. energy innovation landscape, commissioned by Breakthrough Energy. Yesterday we released the final report, *Advancing the Landscape of Clean Energy Innovation.* Breakthrough Energy asked my colleague and friend Dan Yergin and me to co-chair the study, drawing on our complementary private sector and public sector perspectives on the current U.S. clean energy innovation landscape, with the goal of defining a strategic path forward of national scope. The Executive Summary of the report is attached for inclusion in the hearing record.

Clean energy innovation supports multiple national goals: economic competitiveness, environmental responsibility, energy security and national security. The report describes today's U.S. ecosystem of clean energy innovation from the perspectives of technological potential, investment patterns, institutional roles and public policy. *Advancing the Landscape of Clean Energy Innovation* provides recommendations for accelerating our progress toward a clean energy economy.

Our study was comprehensive in scope, addressing technologies with breakthrough potential; the role of regional clean energy ecosystems; mobilizing increased private sector investment in energy innovation; and the respective roles of federal, state, local and tribal governments. Based on our assessment of the strengths and weaknesses of the clean energy ecosystem, we developed 18 major recommendations for making the ecosystem more effective.

A key finding is the need for increased, and better targeted, public and private sector investment in energy innovation across all stages of the innovation spectrum from fundamental research through commercial scale demonstrations. The study team developed a methodology and set of criteria to examine current and proposed energy technologies for their breakthrough potential. The report examined more than 100 cutting edge energy technologies, focusing on the candidates with significant breakthrough potential, including: advanced energy storage technologies; advanced nuclear reactor technologies; new approaches to decarbonization of industrial processes; electricity systems

modernization with a focus on the role of grid modernization in enabling smart communities; and large-scale carbon dioxide utilization and management, including new approaches for carbon dioxide removal from the environment where emissions are not otherwise averted or mitigated.

Several groups, including the American Energy Innovation Council made up of large American company CEOs, have argued for tripling federal clean energy investment. This is important, but more than increased funding is needed. The federal energy innovation portfolio—indeed the portfolio across the entire innovation chain—needs to be "all of the above" to match the time scales and geographies and to emphasize optionality. History shows that we achieve better results when flexible innovation pathways are favored over planned, prescriptive outcomes.

The report recommends that the private sector allocate increased investment from the tax savings created by the Tax Cut and Jobs Act to energy innovation, with a particular focus on testing facilities for product demonstration. The analysis also makes clear that disciplined public-private partnership is needed across the innovation value chain to demonstration and initial commercial deployment of critical technologies. The report also recommends a stronger role for strategic philanthropic investors in alignment with government and industry.

The report highlights the need for the federal energy innovation research portfolio to be better managed for performance, regardless of the appropriated amounts. A key focus is the Department of Energy, which in FY 2016 administered three-quarters of Federal investment in clean energy innovation. Other agencies with significant clean energy innovation budgets include the Department of Defense (DOD), the Department of Transportation (DOT), and the Department of Agriculture (USDA); portfolios at these agencies are mission-focused, as opposed to being broadly based across all energy sectors.

The report notes that DOE's applied energy research programs are currently organized around a fuel-centric framework that has its origins in the 1970s, a structure that inherently skews its programs and budgets. The current structure also lacks clear direction for supporting all stages of the innovation process from fundamental research through commercial demonstration. A federal system that is focused solely on discovery and invention leaves the door open to other countries to translate the fruits of this research into new products, industries and jobs that are based offshore.

During my tenure as Secretary, I advanced clean energy innovation as the cornerstone of our national energy policy. We combined the science and applied energy R&D portfolios under a single Under Secretary to enable more seamless translation of fundamental science into new energy technologies. We incorporated innovation into the two installments of the Quadrennial Energy Review, a government-wide effort that integrated the energy-related interests of 22 federal agencies. Congressional action on many of the energy infrastructure recommendations demonstrated the broad appeal of analytically grounded policy development. We also updated the Quadrennial Technology Review. We placed particular focus on the role of the DOE National Laboratory system. We created a Laboratory Policy Council to engage the Laboratories in a stronger strategic relationship with Departmental policies and

programs, established a Laboratory Operations Board to promote more efficient and effective laboratory operations, created the Office of Technology Transitions to accelerate the transfer of new technologies to the private sector and produced the first State of the National Laboratories report. We analyzed the importance of regional innovation systems and our last budget request sought funding for regional structures.

On the international scale, DOE led efforts to revamp and modernize the G-7/EU Energy Security Principles, which provided a focus on the importance of clean energy to energy security. DOE also was in the forefront of the establishment of Mission Innovation, an initiative supported by 23 countries plus the European Commission to double the level of public investment in energy technology innovation over five years.

The report builds on this foundation and expands the focus to all levels of government to align key policies, players and programs in ways that both enhance and accelerate clean energy innovation. At the federal level, the report notes that the fuels-based organizational structure of DOE, which has been in existence since 1979, is not optimized for modern energy systems and needs. It tends to lead to budget allocations by fuel, resulting in gaps and budget distortions, rather than prioritization by innovation potential.

A good case in point is DOE funding for RD&D on advanced grid-scale energy storage technologies. The budget requests for energy storage R&D in each of the past two fiscal years was only $8 million for this key technology area. Congress increased the grid-scale energy storage budget in the electricity office significantly, to $41 million in FY 2018 and $46 million in FY 2019; yet it remains underweighted within a $5 billion total DOE energy RD&D investment portfolio when one considers the needs all the way to seasonal storage. A serious gap currently exists for carbon dioxide removal RD&D (including biological sequestration), which has no obvious organizational home within the current DOE organizational structure, and consequently is not funded at a level commensurate with its need and long-term potential.

The report's assessment of the current landscape in the energy innovation space was not limited to DOE or the federal government. States, cities and tribal governments play a very important role in the energy innovation process, particularly as supporters of initial commercial adoption of new energy technologies and products. It recommends increased focus on identifying and spreading the use of best practices among the states, and closer alignment of federal and state financial incentives to maximize effectiveness. Expanded policy innovation in state electricity and natural gas regulatory practices also could play an important role in accelerating energy innovation.

The report also notes the importance of nurturing energy innovation ecosystems at a regional scale. Energy resources, expertise and markets vary significantly by region of the country, and many of the issues facing the energy sector can be better managed by strategies tailored to each region's specific needs. Many energy innovation clusters have emerged in the U.S. and are evolving into fully-integrated

innovation ecosystems, and federal policies and programs should be cognizant of these developments and seek to nurture further evolution. The DOE National Laboratories and other federally-funded research institutes, working with universities, can play a major role in catalyzing regional energy innovation ecosystems.

A key finding underpinning the work of the study team was the emergence of new technologies outside the energy arena that can enable further innovation in energy applications. Technological developments in digitalization, big data analytics, advanced computing, smart systems, additive manufacturing and robotics have opened the door to a potential new wave of innovation in the energy economy. Combined with socio-economic trends in urbanization and flattening of energy demand, they point to new opportunities for energy innovation, for the emergence of new companies and whole new industries in the energy sector, creation of new and better jobs, new consumer services, more cost-effective energy use and a deeply decarbonized 21st century energy economy.

Conclusion

All of this work points to the need for, and ability of the U.S. to sustain its preeminence in clean energy technology innovation but requires far-sighted and sustained action to better align the policies, players and programs that are the key building blocks of our national energy innovation ecosystem.

It is my pleasure—once again—to appear before this important Committee. I have always found that Senators from both sides of the aisle work together to support US energy innovation.

Chairman Murkowski, Ranking Member Manchin and Members of the Senate Committee on Energy and Natural Resources, thank you for the opportunity to appear before you today to discuss the future of energy innovation in the United States. I look forward to your questions.

Attachment: *Advancing the Landscape of Clean Energy Innovation*, Executive Summary, February 2019