Testimony for the Record

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Introduction

Chairman Murkowski, Ranking Member Manchin, and members of the Committee, thank you for the opportunity to discuss renewable energy, energy efficiency, and the Department of Energy's efforts to secure America's future through energy independence, scientific innovation, and national security.

As the Assistant Secretary of the Office of Energy Efficiency and Renewable Energy (EERE), I am responsible for overseeing a broad portfolio of renewable energy, energy efficiency, and transportation programs. The technologies in my portfolio advance America's economic growth and energy security while enhancing the reliability and resilience of the U.S. energy system. Knowledge generated by EERE research and development helps drive down the costs of new technologies, supporting the efforts of U.S. industries, businesses, and entrepreneurs in deploying innovative energy technologies. Affordable, reliable energy gives Americans a competitive edge needed to excel in the rapidly changing global energy economy.

We live in the most exciting time for energy technologies in the history of the world, with more competitive and affordable sources of energy than ever before. But affordable energy does not matter if we cannot integrate these new sources of generation into the energy system. This is why in addition to energy affordability, EERE is also focused on enhancing grid reliability and resilience through energy integration and storage.

To advance these priorities, since December 2018 EERE has issued over $935 million in competitive funding opportunities and selections, covering all sectors of the EERE portfolio. Described below, key examples include solar energy and systems integration, cybersecurity for energy-efficient manufacturing, energy-water desalination, bioenergy technologies, and vehicle technologies.

Solar Energy and Systems Integration

On March 26, DOE announced up to $130 million for transformative solar technologies.[1] The funding opportunity targets five research areas: photovoltaics (PV), concentrating solar-thermal power (CSP), soft costs reduction, innovations in manufacturing, and solar systems integration. These projects will make solar energy more affordable, reliable, and secure, while boosting domestic solar manufacturing and ensuring PV is more resilient to cyberattacks.

With more solar being added to our diverse generation portfolio, DOE is expanding its focus into new technologies to reliably integrate variable solar power into the electric grid. On March 25, DOE selected $36 million in Fiscal Year (FY) 2018 funding for research projects to strengthen the integration of solar on the electricity grid, especially at critical infrastructure sites.[2] Called

[1] https://www.energy.gov/articles/department-energy-announces-130-million-early-stage-solar-research-project
[2] https://www.energy.gov/eere/solar/advanced-systems-integration-solar-technologies-assist-situational-awareness-and

the Advanced Systems Integration for Solar Technologies (ASSIST), these projects will enable grid operators to rapidly detect physical and cyber-based abnormalities in the power system and utilize solar generation to recover quickly from power outages, in many cases without human control. The technology developed will be field-demonstrated to see if they could ultimately enhance power system resilience of some of our Nation's critical infrastructure.

Cybersecurity for Energy-Efficient Manufacturing

While Congressional report language called for funding the manufacturing institutes, the FY2020 Budget favors a transition away from the institute model because the mortgaging of future appropriations reduces budgetary flexibility. Instead, the Budget proposes a set of smaller and more directly managed, early-stage, R&D consortia activities. On March 26, DOE announced up to $70 million (subject to appropriations) to establish a new Clean Energy Manufacturing Innovation Institute focused on addressing cyber threats to more energy-efficient manufacturing.[3] The manufacturing and industrial sector consumes about 25% of the Nation's energy. DOE estimates that the adoption of automated controls and sensors provide the potential for up to 15% improved energy efficiency in manufacturing, but these new technologies introduce cybersecurity risks, which can limit their adoption. Addressing these cyber risks can accelerate adoption of energy efficient technologies in manufacturing, helping U.S. manufacturers remain resilient against cyberattacks and globally competitive. The institute is co-managed by EERE and the Office of Cybersecurity, Energy Security, and Emergency Response (CESER).

Energy-Water Desalination Hub

While Congressional report language called for funding the Energy-Water Desalination Hub, the FY2020 Budget favors a transition away from the hub model because the mortgaging of future appropriations reduces budgetary flexibility. Instead, the Budget proposes a set of smaller and more directly managed, early-stage, R&D consortia activities. On December 13, 2018, DOE announced up to $100 million (subject to appropriations) to establish an Energy-Water Desalination Hub.[4] The Hub will address water security issues in the United States, focusing on early-stage research and development for energy-efficient and cost-competitive desalination technologies, including the treatment of non-traditional water sources for multiple end-use applications. The Hub is part of the Water Security Grand Challenge,[5] a White House-initiated, DOE-led framework to advance transformational technology and innovation to meet the need for safe, secure, and affordable water.

[3] https://www.energy.gov/articles/doe-announces-70-million-cybersecurity-institute-energy-efficient-manufacturing

[4] https://www.energy.gov/articles/department-energy-announces-100-million-energy-water-desalination-hub-provide-secure-and

[5] https://www.energy.gov/articles/doe-launches-water-security-grand-challenge

Biofuel, Bioproducts, and Biopower

On May 3, DOE announced $79 million in funding for bioenergy research and development, including biofuels, bioproducts, and biopower.[6] This funding supports DOE's goal of providing consumers and businesses with a range of domestic energy options that are affordable, reliable, and secure. The FOA topics will advance DOE's objectives to reduce the price of drop-in biofuels, lower the cost of biopower, and enable affordable bioenergy through co-production of high-value bioproducts from biomass or waste resources. Areas of interest include biofuels derived from lignocellulosic feedstocks that are cost-competitive with gasoline or diesel fuels, advanced biotechnology processes capable of increasing energy production from lignocellulosic feedstocks, and co-produced bio-based plastics with improved performance and recyclability of existing plastics.

Advanced Vehicle Technologies

On April 3, DOE announced up to $59 million for new and innovative advanced vehicle technologies research.[7] Topic areas include advanced vehicle batteries and electric drive systems that reduce reliance on critical materials, energy efficient mobility systems, and co-optimized advanced engine and fuel technologies. Separately, on March 1, DOE announced up to $51.5 million for new and innovative research of technologies for trucks, off-road vehicles, and the fuels that power them. The funding opportunity addresses topics in gaseous fuels research, including natural gas, biopower, and hydrogen; heavy-duty freight electrification; hydrogen infrastructure and fuel cell technologies for heavy-duty applications; and energy efficient off-road vehicles. The truck FOA is co-managed by EERE's Vehicle Technologies Office, Fuel Cell Technologies Office, and Bioenergy Technologies Office.

Advanced Energy Storage Initiative

As we work to integrate more resources into the Nation's evolving energy system, flexibility of both generation and consumption is critical. This is why the Department announced the Advanced Energy Storage Initiative (AESI) as part of the FY2020 Budget Request, which includes $105 million for EERE. Coordinated across DOE's applied energy offices, this initiative builds on and expands EERE's Beyond Batteries Initiative from FY2019, and focuses a wide range of technologies to increase the flexibility of energy-generating resources and energy-consuming resources, thereby enhancing the reliability and resilience of energy systems.

The AESI will tackle the challenges associated with integrating diverse energy sources, such as integrating large amounts of variable wind and solar power into the electric grid. For example, EERE's Fuel Cell Technologies Office is focused on producing hydrogen with low-cost wind or nuclear generation to prevent the curtailment of variable renewables in the former and improve the economics of existing baseload resources in the latter. As another example, the Water Power

[6] https://www.energy.gov/articles/doe-announces-79-million-bioenergy-research-and-development
[7] https://www.energy.gov/articles/doe-announces-59-million-accelerate-advanced-vehicle-technologies-research

Technologies Office is working to improve the flexibility of hydropower and pumped storage to increase the value of hydropower as a grid balancing resource.

Technological advances also create new opportunities for flexibility of energy consumption. For example, electric vehicles create challenges and opportunities for the grid of the future. Flexibility in EV charging can create value and help balance the electric grid. The same is also true of buildings, which consume about 74 percent of all electricity used in the U.S.[8] If we can securely improve communication between buildings and the grid, new technologies can allow buildings to shift and shave their demand in response to real-time grid conditions, increasing flexibility on the electric grid.

National Wind Technology Center Expansion

To address the need to integrate diverse energy resources, in the FY2020 Budget Request, the Department is seeking $22 million to accelerate the conversion of the National Wind Technology Center (NWTC) campus into an experimental microgrid (Flatirons Campus) capable of testing grid integration at the megawatt scale. The mission of the current NWTC will expand to support a fully integrated, large-scale experimental research platform, including a Beyond Megawatt Scale Extreme Fast Charging Station to research, integrate, and evaluate electric vehicle fast-charging station impacts on the grid. These investments support research for DOE's Grid Modernization Initiative, which includes reliably integrating variable generation into the electric grid. These expanded capabilities will allow DOE to test a suite of technologies supported under the AESI and leverage the NWTC's future power capacity of 19.9MW with the capabilities of the National Renewable Energy Laboratory (NREL) Energy Systems Integration Facility.

Energy Sustainability and End-of-Life

As demand for energy integration technologies increases, we need to enhance our focus on energy sustainability and end-of-life considerations. Wind, solar, and energy storage are important for the future, but deployment of these technologies is increasing demand for critical minerals and rare earths from foreign and unstable sources. These technologies also present handling, disposal, and recycling issues, which means at the end-of-life they often end up in landfills.

The President's December 2017 Executive Order 13817 "A Federal Strategy To Ensure Secure and Reliable Supplies of Critical Minerals" directed Federal agencies, including DOE, to take steps to "ensure secure and reliable supplies of critical minerals" by "increasing activity at all levels of the supply chain, including exploration, mining, concentration, separation, alloying, recycling, and reprocessing."

To ensure sustainable growth of clean energy technologies and address U.S. dependence on foreign sources of critical minerals, DOE is pursuing a focused research and development

[8] https://www.energy.gov/eere/buildings/about-building-technologies-office

program to reduce supply chain risks posed by the limited availability of critical materials. This program is focused on 1) improvements in domestic production, 2) reuse and recycling, and 3) research into substitutes for critical materials.

EERE conducts foundational R&D to reduce our dependence on critical minerals through the Advanced Manufacturing Office (AMO) and Vehicle Technologies Office (VTO). AMO, for instance, conducts research into earth-abundant substitutes for critical minerals. Meanwhile, VTO is focused on reducing cobalt in electric vehicle battery cathodes and developing new battery chemistries that go beyond lithium ion.

Building on that foundational R&D, EERE recently launched a Lithium-Ion Battery Recycling Prize and established an associated Battery Recycling R&D Center. Lithium ion batteries used in a variety of applications (including consumer electronics, defense, energy storage, and transportation) contain a substantial amount of critical materials (e.g. cobalt, lithium) that are both expensive and dependent on foreign sources for production. Currently, lithium-ion batteries are collected and recycled at a rate of less than 5 percent.

Announced in January, the $5.5 million Battery Recycling Prize encourages American entrepreneurs to find innovative solutions for collecting, storing, and transporting discarded lithium-ion batteries for eventual recycling. The goal of the Recycling Prize and R&D Center is to develop technologies to profitably capture 90 percent of all lithium-based battery technologies in the United States.

While DOE conducts substantial research into recycling and substitutes, we are also expanding our focus to address technical challenges associated with domestic production, processing, and refining of critical minerals. Increasing domestic production without developing the domestic processing and manufacturing capabilities will simply move the source of economic and national security risk further down the supply chain and create dependence on foreign sources for these capabilities.

In addition to battery technologies, EERE is also focused on addressing end-of-life considerations with solar PV and wind turbines. As described above, on March 26 EERE's Solar Energy Technologies Office issued a Funding Opportunity Announcement that included a subtopic on "PV System Recycling and End-of-Life Management." To date, research to address the disposal of PV modules has been limited, and there is a lack of public information on how system components coming offline are being handled by owners or waste-management operations. This research area will focus on understanding the scale and composition of the expected PV waste stream, identifying recycling technologies that could be cost-effectively implemented, establishing tools to inform decommissioning and replacement decisions near the end of a PV system's life, and piloting a process for the recycling of PV components integrated within existing waste-management systems.

Conclusion

The challenge of affordable and reliable energy is what makes DOE's work so important. Technological innovation has contributed to dramatic changes in the energy sector over the last decade, including increased production of wind, solar, oil, and natural gas. Thanks in part to research and development that occurred at DOE and the National Laboratories, the U.S. is now the leading producer of oil and natural gas in the world, and we are exporting LNG to 36 countries.

As a result of our changing energy mix, the U.S. leads the world in reducing carbon dioxide emissions, with electric power sector CO2 emissions declining 28 percent since 2005 to their lowest levels since 1987.[9] The U.S. has achieved CO2 reductions while keeping our electricity prices affordable, with retail electricity rates that are almost three times lower than Germany and about twice as affordable as the European Union.[10,11,12]

While other countries' policies have resulted in higher energy prices and increased CO2 emissions, in the U.S. we have proven that through the power of innovation, we can advance affordable, reliable energy and protect the environment at the same time.

Thank you for the opportunity to appear before the Committee today to discuss the Office of Energy Efficiency and Renewable Energy, and I look forward to your questions.

[9] https://www.eia.gov/todayinenergy/detail.php?id=37816
[10] BP Statistical Review of World Energy, June 2018: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2018-co2-emissions.pdf
[11] EIA Electric Power Monthly, February 2019
https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_03
[12] Eurostat: https://ec.europa.eu/eurostat/data/database