Written Statement of

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Before the
Subcommittee on Energy and Water Development
Committee on Appropriations
United States House of Representatives

Office of Energy Efficiency and Renewable Energy
Fiscal Year 2016 Budget Request to Congress

March 17, 2015

INTRODUCTION

Chairman Simpson, Ranking Member Kaptur, and Members of the Subcommittee, thank you for the opportunity to testify on the President's Fiscal Year 2016 Budget Request for the U.S. Department of Energy's (DOE's) Office of Energy Efficiency and Renewable Energy (EERE).

The Department is pursuing an all-of-the-above approach to developing every source of American energy. In support of the Administration's Climate Action Plan, EERE leads DOE efforts as the U.S. Government's primary clean energy technology organization—working with some of the Nation's best innovators and businesses to support high-impact applied research, development, and demonstration (RD&D) activities in the three sectors under our purview: sustainable transportation, renewable power, and energy efficiency. With Congress's support, we implement a range of strategies aimed at reducing U.S. reliance on oil, saving American families and businesses money, creating jobs, and reducing pollution. We work to ensure that the clean energy technologies of today and tomorrow are invented and manufactured in America.

At the end of 2013, policymakers came together on a bipartisan basis to partially reverse sequestration and to pay for higher discretionary funding levels with long-term reforms. We have seen the positive consequences of that bipartisan agreement for our ability to invest in areas ranging from research and manufacturing to strengthening our military. We have also seen the positive consequences for the economy, with an end to mindless austerity and manufactured crises contributing to the fastest job growth since the late 1990s. The President's Budget builds on this progress by reversing sequestration, paid for with a balanced mix of commonsense spending cuts and tax loophole closers, while also

proposing additional deficit reduction that would put debt on a downward path as a share of the economy.

Meanwhile, the President has made clear that he will not accept a budget that reverses our progress by locking in sequestration going forward. Locking in sequestration would bring real defense and non-defense funding to the lowest levels in a decade. As the Joint Chiefs and others have outlined, that would damage our national security, ultimately resulting in a military that is too small and equipment that is too old to fully implement the defense strategy. It would also damage our economy, preventing us from making pro-growth investments in areas ranging from basic research to next generation biofuels and advanced manufacturing at the Department of Energy. As the President has stated, he will not accept a budget that severs the vital link between our national and economic security, both of which are important to the Nation's safety, international standing, and long-term prosperity.

Our Nation stands at a critical point in time in terms of the competitive opportunity in clean energy. According to Bloomberg, in 2014, $310 billion was invested globally in clean energy, a 500% increase since 2004. Trillions more are expected to be invested in the years ahead. As the world accelerates into a decades-long transition to clean energy, the United States faces a stark choice: the clean energy technologies of today and tomorrow can be invented and manufactured in America, or we can surrender global leadership and import these technologies from other countries like China, Germany, South Korea, and Japan. We can continue wasting hundreds of billions of dollars in unnecessary energy costs—money that we could reinvest into our economy—or we can strengthen our productivity and competitiveness by investing in more efficient American homes, buildings, and factories.

The United States has world-class innovation capacity, a unique culture of entrepreneurship, well-developed capital markets, and the finest scientists, engineers, and workers in the world. However, despite this tremendous opportunity, the U.S. energy industry is systematically underinvesting in research and development (0.4% of sales versus 12% in aerospace/defense and 20% in pharmaceuticals, according to one estimate).[1] Furthermore, the U.S. is investing significantly less in clean energy, on a percentage of GDP basis, compared to major trading competitors like China and Japan by a factor of nearly three. The highly strategic importance of energy to American economic growth, energy security, and the environment makes strong Federal backing for applied clean energy R&D crucial for our future competiveness and economic prosperity.

After four decades of investments in American innovation, a wide array of EERE-supported technologies—from solar power, wind power, and plug-in electric vehicles, to solid-state lighting and cellulosic biofuels—are showing a clear path to cost competitiveness with conventional forms of energy, bringing a number of these technologies to the edge of widespread market adoption. Now is the time to increase our efforts and accelerate progress in these areas. With smart, targeted investments and effective public-private partnerships, we have the opportunity to further accelerate the adoption of

1 Catalyzing American Ingenuity, 2011. http://www.americanenergyinnovation.org/wp-content/uploads/2012/04/AEIC_Catalyzing_Ingenuity_2011.pdf.

these and a number of other clean energy technologies, while also providing our Nation an opportunity to win one of the most important global economic races of the 21st century.

EERE INVESTMENT APPROACH AND RETURN ON INVESTMENT

EERE supports members of U.S. industry, research institutions, and academia in innovating, developing, and demonstrating cutting-edge technologies and breaking down market barriers to deploying these technologies. EERE's partnerships with DOE's National Laboratories are particularly important, as these unparalleled national resources offer core R&D capabilities in all of EERE's technology areas. With the National Laboratories, EERE's work focuses on R&D that leverages the institutional knowledge, intellectual assets, and world-leading facilities that these laboratories house—unique capabilities that are both rare and difficult to duplicate in the private sector.

Investment Prioritization

We are committed to supporting RD&D that has a strong potential to transform large existing energy markets and maximize the return on investment delivered to the taxpayer. To support the highest-impact activities to achieve our clean energy goals, EERE prioritizes all of its investments according to our "Five Core Questions":

1. *Impact: Is this a high-impact problem?*
   EERE must focus its funds on clean energy challenges and solutions that, if successful, will have the highest-possible impact on the energy sector. If successfully developed and fully deployed, the technologies and approaches supported by these investments should make material contributions toward national energy goals—such as petroleum import reductions, greenhouse gas emission reductions, total energy cost reductions, and increased economic growth. Accordingly, EERE will emphasize investments that have the potential to have a greater than 1% impact on national energy metrics if successful.

2. *Additionality: Will EERE funding make a large difference relative to existing funding from other sources, including the private sector?*
   In addition to focusing solely on high-impact opportunities, EERE must also ensure that its investments have a meaningful additional impact relative to ongoing funding from the private sector and other sources. Therefore, EERE should avoid investing in areas where other sources of funding—especially from the private sector—are significant relative to the levels of funding that EERE could provide.

3. *Openness: Are we focusing on the broad problem we are trying to solve and open to new ideas, approaches, and performers?*
   EERE's work is guided by well-developed, long-term roadmaps that are created in collaboration with its key stakeholders. However, in the context of this approach, EERE must create and sustain an internal culture that is always open and receptive to new solutions and partners. Accordingly, EERE must regularly update its roadmaps and provide mechanisms to quickly onboard promising new approaches into its portfolio.

4. *Enduring Economic Impact*: *How will EERE funding result in enduring economic impact for the United States?*
   As a steward of taxpayer funds, EERE must go the extra mile to develop strategic approaches to ensure that the technologies it supports—if successfully developed and deployed—will result in long-term economic benefits to the country, including growing the U.S. manufacturing base.

5. *Proper Role of Government: Why is this investment a necessary, proper, and unique role of government rather than something best left to the private sector to address?*
   The U.S. private sector is the primary engine that will drive the transition to a national clean energy economy. To maximize its impact, EERE must focus its investments on topics and activities where there is a unique federal role relative to the private sector.

Investment Strategies

EERE works with industry, academia, National Laboratories, and other partners to create technology-specific roadmaps—evaluating the future market potential and public benefits of clean energy technologies by incorporating in-house expertise, market awareness, and knowledge of private investment. Once technology roadmaps and RD&D support strategies are established, EERE investment for these activities falls under three primary areas:

- Early stage research and development to enable **cost reduction and performance improvement**, working to accelerate the development and commercialization of technologies through applied research and development on components or whole technology systems;

- **Technology validation and risk reduction** activities to catalyze the wide-scale adoption of clean energy technologies and solutions by demonstrating the performance of technologies at increasing scales in controlled-laboratory and under real-world conditions, providing benchmarks for performance and durability to provide feedback into our research and development roadmaps, and reducing technology uncertainty to unlock private sector investment; and

- **Reducing market barriers** to the adoption of new technologies that are market ready—such as a lack of reliable information, inconsistent regulatory environments, and workforce training gaps—through activities that include providing best practice information, stakeholder outreach, sustaining and enhancing the clean energy workforce, and providing reliable, objective data.

Return on Investment

EERE takes its responsibility to deliver return on investment to the U.S. taxpayer very seriously. Accordingly, EERE performs ongoing return-on-investment (ROI) tracking and analyses for the technologies it supports, which are vital to understanding the impact of our RD&D activities. To date, third-party evaluators have completed five evaluations covering EERE's research and development investments in solar photovoltaics, wind energy, geothermal technologies, advanced battery technologies for electric-drive vehicles, and vehicle combustion engines, with additional ROI evaluations being planned to start in 2015. The results of these evaluations found that, from 1976 to 2008, EERE taxpayer investments of $15 billion in these five areas resulted in an estimated economic benefit to the

United States of $388 billion—a net return on investment of more than 24 to 1.[2] EERE is proud of this track record of returning value to the American taxpayer and accelerating innovative clean energy technologies to commercial success.

At the same time, EERE is taking steps to improve processes that establish, track, and aggregate project-level impact metrics, enabling a consistent methodology for analyzing and reporting on these metrics over the next several years. EERE's approach will increasingly involve quantifying and evaluating its contributions to creating knowledge, engineering solutions, validating new technologies, and accelerating the development of next-generation technologies. EERE will use these quantitative evaluations to inform its decision-making processes, expand or replicate highly effective activities, and curtail or eliminate ineffective investments. In FY 2016, EERE will conduct a holistic assessment of EERE program office methodologies and assumptions for prospective impact analyses and project data collection, identify best practices, and establish a standard approach across EERE to ensure consistent and comparable information is available to inform policy decisions.

EERE PROGRAMS, ACCOMPLISHMENTS, AND FY 2016 BUDGET REQUEST

In FY 2016, EERE is requesting $2.7 billion in budget authority from Congress to invest in RD&D activities that will support growing the domestic clean energy industry, increasing energy productivity for American businesses, and expanding access to renewable power and alternative vehicles. EERE will also sustain efforts to streamline and enhance its operations, conduct rigorous evaluations of its portfolios, and achieve the greatest possible efficiency and outcomes in each of its three sectors—Sustainable Transportation, Renewable Power, and Energy Efficiency—and its key organization-wide initiatives.

Sustainable Transportation Portfolio ($793 Million)

Through its sustainable transportation portfolio, EERE supports research, development, and demonstration work and efforts to break down market barriers for a variety of domestic and cost-effective sustainable transportation technologies. Broadly, the Vehicle, Bioenergy, and Hydrogen and Fuel Cell Technologies Offices support two key parallel solution pathways: (1) using less energy to move people and freight and (2) replacing conventional fuels with cost-competitive, domestically produced, sustainable alternative fuels with lower greenhouse gas emissions. Because most petroleum use in the transportation sector occurs in personal vehicles and heavy trucks, EERE's portfolio emphasizes transportation technologies in these areas.

Sustainable Transportation Accomplishments

EERE-supported technological accomplishments continue to help U.S. families and businesses by reducing fuel costs and providing a range of fuel choices, and by lowering greenhouse gas emissions. Key recent EERE accomplishments in the sustainable transportation sector include:

[2] Preliminary aggregate net benefits calculation by EERE Office of Strategic Programs, combining cost-benefit impact results from formal evaluation studies conducted for the Solar, Geothermal, Wind, Vehicles, and Advanced Manufacturing Offices.

- **Reduced fuel costs for heavy duty trucks to help businesses save money.** Through the EERE-supported SuperTruck Initiative, EERE partners developed a full-scale, prototype class 8 heavy-duty truck that achieved a 30% increase in engine efficiency and a 70% increase in freight efficiency in real-world driving conditions (compared to a 2009 baseline truck model).

- **Lowered costs of batteries to make plug-in electric vehicles more affordable.** EERE-supported research and development helped reduce the projected high-volume production cost of high-energy, high-power batteries to less than $300 per kilowatt-hour (kWh) in 2014—a more than 40% decrease from 2012 benchmarks, and a more than 70% decrease since 2008—and is on track to reach its program goal of $125/kWh by 2022—which would enable a range of plug-in electric vehicles to be directly cost competitive with conventional vehicles over the next 5 to 10 years.

- **Celebrated the grand opening of first of a kind cellulosic ethanol facilities**: In September of 2014, POET-DSM opened the first commercial-scale cellulosic ethanol plant to use corn waste as a feedstock. The POET-DSM facility is joined by two other pioneer cellulosic ethanol plants: INEOS which opened in FY 2013 and Abengoa of Kansas, which opened its doors in October 2014. These three pioneer cellulosic ethanol facilities benefited from more than a decade of R&D funded through this program, which resulted in the technologies necessary to convert cellulose into cellulosic ethanol.

- **Dramatically reduced the projected cost of fuel cell technologies**. EERE reduced the projected high-volume manufacturing cost of automotive fuel cell systems to $55 per kilowatt (kW) at the end of 2014, which is a reduction of more than 30% since 2008 and more than 50% since 2006.

- **Developed prototype of Lightweight Concept Vehicle with significant weight reduction.** EERE partnered with industry to develop an advanced prototype of the 2013 Ford Fusion with a nearly 25% weight reduction while maintaining safety and performance. Reducing a vehicle's weight by 10 percent can increase its fuel economy by 6 to 8 percent, so this lightweighting technology offers huge potential for increasing vehicle efficiency and fuel savings for consumers.

Program Description and FY 2016 Budget Highlights

Vehicle Technologies*:* The Vehicle Technologies Office supports research, development, and demonstration (RD&D), as well as efforts to reduce barriers to market introduction, for advanced highway transportation technologies that reduce petroleum consumption and greenhouse gas emissions while meeting or exceeding vehicle performance expectations.

EERE is requesting $444 million in FY 2016 to support RDD&D of efficient and alternative fuel vehicle technologies. One major continuing initiative, the EV Everywhere Grand Challenge, aims to reduce the combined battery and electric drive system costs of plug-in electric vehicles by up to 50 percent by 2022 from a 2012 baseline – which would enable plug-in electric vehicles to be directly cost-competitive with conventional gasoline vehicles, as measured by the initial vehicle purchase price and fuel savings accrued over a 5-year ownership period. FY 2016 funding also supports a significant new SuperTruck II initiative to improve the freight-hauling efficiency of Class 8 vehicles 100 percent by 2020 compared to

2009, as well as work to eliminate technical barriers to increased transportation use of alternative and renewable fuels, with a focus on natural gas and drop-in biofuels. Vehicle Technologies will also support an initiative to drive significant improvements in the strength, formability, corrosion resistance, and cost of extremely lightweight magnesium sheet alloys. A fuels and vehicle systems optima initiative will seek to optimize engine efficiency with low-carbon fuel properties. Major funding changes are the result of enhanced support for these activities, in particular, increased investment in vehicle electrification and electric vehicle integration into the grid, SuperTruck II, on-board natural gas storage, lightweight magnesium sheet alloys and manufacturing processes, co-optimization of fuels and engines, and partnerships to build high-impact community-scale demonstrations of alternative fuel vehicles.

***Bioenergy Technologies**:* The Bioenergy Technologies Office supports targeted RD&D activities to advance the sustainable nationwide production of advanced biofuels that will displace a share of petroleum-derived fuels, mitigate climate change, create jobs, and increase energy security.

EERE is requesting $246 million in FY 2016, with an emphasis on the development of innovative processes to convert cellulosic and algal-based feedstocks into bio-based gasoline, diesel, and jet fuel at a target cost of $3.00 per gallon of gasoline equivalent and reduce greenhouse gas emissions by 50% or more versus petroleum based alternatives. Emphasis will be on RD&D of "drop-in" hydrocarbon biofuels that can be used interchangeably with petroleum-based fuels. In collaboration with the U.S. Departments of Navy and Agriculture, the program will demonstrate commercial-scale biorefineries to produce military-specification fuels. Additionally, in FY 2016, funds will support R&D to advance new technologies from the lab bench to the commercial market. Major funding changes are the result of increased R&D funding targeted at technologies that are able to produce both transportation fuels and high-value coproducts to enable economically competitive integrated biorefineries. Funding will also fully support up to three pilot projects or one demonstration project for advanced biofuels technologies through cost-shared partnerships.

***Hydrogen & Fuel Cell Technologies*:** The Fuel Cell Technologies Office develops technologies to enable fuel cells to be cost competitive in diverse applications, especially light-duty vehicles, and to enable renewable hydrogen to be cost competitive with gasoline.

EERE is requesting $103 million in FY 2016 to support the goal to reduce the cost and increase the durability of fuel cell systems, with a targeted cost of $40/kW and durability of 5,000 hours, which is equivalent to 150,000 miles, by 2020. In addition, EERE will invest in R&D for technologies that can bring the cost of hydrogen from renewable resources to less than $4.00 per gallon of gasoline equivalent—dispensed and untaxed—by 2020. In FY 2016, Fuel Cell R&D will emphasize areas such as stack component R&D, systems, and balance of plant components. Hydrogen Fuel R&D will focus on technologies and materials that will reduce hydrogen production, compression, transport, and storage costs. Funding will also provide resources to rapidly advance the development of quality control tools for the manufacturing of fuel cell components and systems.

Renewable Power Portfolio ($645 Million)

EERE's renewable power portfolio supports developing solutions to significantly increase the amount of cost-competitive electric power that is generated from renewable resources across the Nation. The Solar, Geothermal, and Wind and Water Power Technologies Offices help advance technology RD&D to cost-effectively harness the United States' abundant and diverse supply of renewable resources. While each renewable power technology has unique tradeoffs, EERE seeks to enable the development of multiple renewable power technology options for every region of the country, enabling the U.S. to diversify its energy portfolio and better protect our environment and respond to the threat of climate change.

Renewable Power Accomplishments

By supporting renewable power technologies development and demonstration, EERE helps U.S. homes and businesses take advantage of clean, affordable renewable energy. Key recent EERE accomplishments in the renewable power sector include the following:

- **Reductions in the cost of solar photovoltaic technology**. By the end of 2014, reductions of 56 percent, 52 percent, and 54 percent were achieved for U.S. photovoltaic (PV) system costs at the utility, commercial, and residential scales respectively, from 2010 benchmarks.

- **Cutting red tape for U.S. businesses and consumers.** The Rooftop Solar Challenge cut solar permitting time by 40% and reduced fees by 12%, helping make it possible for more than 47 million Americans to install solar technology. These "soft costs" now make up over half the cost of total system prices for residential and small and large commercial PV systems, and reducing them presents present the most substantial opportunity to spur strong U.S. growth in solar deployment in the coming years.

- **Supporting U.S. solar manufacturing**. Three solar manufacturing companies that have received research and development funding from the SunShot Initiative have recently announced new factories or factory expansions in the U.S. These include a new 200 megawatt plant that is up and running in Michigan and an expansion of an Oregon manufacturing facility, with plans to create 200 new jobs. A third company just broke ground on a 1 gigawatt capacity factory in New York.

- **Enabled the first U.S. grid-connected Enhanced Geothermal System (EGS) project**. In FY 2013, the Desert Peak demonstration project in Nevada completed an 8-month, multi-stage stimulation of an existing well—making it the first grid-connected EGS project in America to generate commercial electricity by providing an additional 1.7 megawatts (MW) at the existing well field.

- **Supported development of the U.S. offshore wind industry**. In FY 2014, EERE selected the next round of advanced demonstration projects to support the establishment of a competitive U.S. offshore wind industry. These projects are anticipated to be operational by the end of 2017 representing an opportunity to leapfrog global competition and advance the creation of a new U.S. energy industry.

Program Description and FY 2016 Budget Highlights

Solar Energy*:* The Solar Energy Technologies Office supports activities targeted at achieving the SunShot Initiative's goal of making solar energy technologies cost competitive with conventional energy sources by 2020.

In this area, EERE is requesting $337 million in FY 2016 to dramatically lower technology and manufacturing costs of solar power, as well as for activities that break down non-hardware market barriers. Only four years into the 10-year SunShot Initiative, EERE has tracked progress at about 70% toward its 2020 goal of reducing the total installed cost for utility-scale solar electricity to roughly $0.06/kWh without subsidies. The FY 2016 Budget Request builds on this progress by supporting: development and demonstration of innovative manufacturing technologies to increase U.S. competitiveness (part of DOE's *Clean Energy Manufacturing Initiative*); research and development that enables seamless integration of higher levels of solar penetration into the electricity grid (through advanced sensors, controls, power electronics, and behind-the-meter energy storage integration); concentrating solar projects focused on integrating best-in-class subsystem technologies at the 1-10MW scale; and continued solar PV activities focused on reductions in non-hardware "soft costs."

Wind Energy*:* The Wind Energy Technologies Office accelerates U.S. deployment of clean, affordable, and reliable domestic wind power through RD&D.

EERE is requesting $146 million in FY 2016 to support the goals of lowering the cost of onshore wind power to $0.06/kwh and offshore wind power to $0.17/kwh by 2020. The FY 2016 request includes funding for three advanced offshore wind demonstration projects, planned to be in operation by FY 2017, to address technology and deployment challenges unique to U.S. waters in order to tap into America's offshore wind resources. The request also supports a National Laboratory-led wind plant optimization R&D initiative (Atmosphere to Electrons) focused on optimizing entire wind farms as a system to lower the cost of land-based and offshore wind energy. Through wind plant R&D, the initiative targets innovations in high-fidelity modeling capabilities and novel measurement techniques that leverage DOE high-performance computing assets to monitor the flow into and through the wind plant. The FY 2016 funding request also expands the program's ongoing efforts to address the impacts of expanded wind development on wildlife.

Water Power*:* The Water Power Technologies Office supports RD&D to accelerate technology development for cost effective and environmentally responsible renewable power generation from water.

EERE is requesting $67 million in FY 2016 to support innovative technologies for generating electricity from water resources. The HydroNEXT initiative aims to improve the performance, flexibility, and environmental sustainability of technologies applicable to existing hydropower facilities, while also developing and demonstrating technologies that will enable new, low-impact, fish-friendly hydropower development. HydroNEXT emphasizes modular, "drop-in" systems that will minimize capital costs and environmental impact and maximize ease of manufacture.. FY 2016 funding also supports RD&D of next generation wave, current, and tidal energy systems through technology advancement, computational

modeling and analysis, environmental research and risk mitigation, and resource characterization, as well as supporting front end engineering and design for a grid-connected open-water test facility. These efforts will help compress technology development timelines of marine and hydrokinetic devices with the goal of reducing the levelized cost of energy to local coastal hurdle rates of $0.12/kWh to $0.15/kWh by 2030.

***Geothermal Technologies**:* The Geothermal Technologies Office accelerates research and development of clean, domestic geothermal energy in order to reduce the risks and costs of bringing geothermal power online.

EERE is requesting $96 million in FY 2016 toward the goal of lowering the cost of energy from newly developed geothermal systems to $0.06/kWh by 2030, including support for implementing the DOE-wide Subsurface Technology and Engineering RD&D crosscut (see additional details below). A key ongoing effort at EERE is the Frontier Observatory for Research in Geothermal Energy (FORGE), a first-of-a-kind field laboratory focused on creating an accelerated commercial pathway to large-scale EGS power generation in the U.S. As a collaborative effort, FORGE will involve a diverse group of geothermal stakeholders and allow testing of novel technologies and methodologies in a deep rock environment, with a focus on EGS optimization and validation. Additionally, FY 2016 funding will target validation activities for the program's "Play Fairway Analysis," which assesses exploration risk and the probability of finding new geothermal resources on a regional scale, resulting in maps and studies that reduce the industry's drilling and development risks.

Energy Efficiency Portfolio ($1,030 Million)

EERE's energy efficiency portfolio seeks to improve the energy efficiency of the Nation's homes, buildings, and industries. The Buildings Technologies, Advanced Manufacturing, Weatherization and Intergovernmental Programs, and Federal Energy Management Program Offices develop and help provide businesses, consumers, and government agencies with innovative, cost-effective energy-saving solutions to improve their energy efficiency—from higher-efficiency products, to new ways of designing homes and buildings, to new ways of improving the energy intensity and competitiveness of American manufacturers. EERE's energy efficiency portfolio also supports better integrating the built environment with our energy system to combat costly peaks in energy demand and to increase the capabilities and value of buildings and facilities.

Energy Efficiency Accomplishments

EERE continues to support RDD&D that helps U.S. consumers and businesses to save money and advance their energy productivity and global competitiveness. Key recent EERE accomplishments in the energy efficiency sector include the following:

- **Helping American commercial, industrial, and multifamily buildings become at least 20 percent more energy efficient by 2020.** Through the Better Buildings Challenge, more than 250 DOE partners are on track to achieve average energy savings of 2.5% annually and saving 36 TBtus and $300 million since the Better Buildings Challenge began in 2011

- **Curbing greenhouse gas emissions with advanced refrigeration systems.** Through the Building Technologies Office's Emerging Technologies R&D program, a leading commercial refrigeration manufacturer worked with Oak Ridge National Laboratory to design a refrigeration system with 25% lower energy consumption and 78% lower GHG emissions than existing systems.

- **Pushing the boundaries of additive manufacturing.** The EERE-supported Manufacturing Demonstration Facility (MDF) at Oak Ridge National Laboratory collaborated with private sector partners to design, develop, and prototype a 3D-printed car – all in just six months.

- **Assuring supply chains of materials critical to clean energy technologies.** The Critical Materials Institute (CMI), an Energy Innovation Hub for the U.S. Department of Energy (DOE), celebrated its second anniversary with twenty-seven invention disclosures. Critical materials, including some rare earth elements that possess unique magnetic, catalytic, and luminescent properties, are key resources needed to manufacture products for the clean energy economy.

- **Provided critical funding for states to weatherize homes.** In FY 2014 alone, EERE helped improve the energy performance and comfort in the homes of 37,831 American low-income families across the Nation, resulting in an estimated 1.1 trillion Btu of first-year energy savings and $16 million in first-year energy cost savings.

Program Description and FY 2016 Budget Highlights

Advanced Manufacturing*:* The Advanced Manufacturing Office advances RD&D of critical industrial efficiency and clean energy manufacturing technologies, supports shared research facilities tackling cutting-edge, foundational technological challenges, and helps lower market barriers to energy-efficient manufacturing technologies and practices.

EERE is requesting $404 million in FY 2016 to enable the research, development, and demonstration of industrial efficiency and crosscutting clean energy manufacturing technologies. This funding will support high-impact R&D focused on advanced manufacturing, working with U.S. manufacturers to help improve the energy productivity, environmental performance, and product yield of domestic manufacturing. In FY 2016, EERE will release up to six new funding opportunity announcements in specific areas of foundational manufacturing technology. Final topics will be determined through analysis, workshops, and stakeholder input, but high-potential topic areas include chemical process intensification, smart manufacturing, and others with the potential to reduce the energy requirements for production and significantly improve energy productivity.

The FY 2016 request includes plans to establish and fully fund two new Clean Energy Manufacturing Innovation Institutes as part of the National Network for Manufacturing Innovation (see additional details below). Funding will be provided for the fifth year of the original five-year award for the Critical Materials Hub to enable American manufacturers to make better use of critical materials to which they have access and use less of those that are subject to supply disruptions, as well as the Manufacturing Demonstration Facility at Oak Ridge National Laboratory for industrial research partnerships related to additive manufacturing.

Finally, FY 2016 funding will support the deployment of energy efficient manufacturing technologies and practices, including strategic energy management and combined heat and power, across American industry through training programs, site assessments, and standards development, supporting the goal of reducing manufacturing energy intensity by 25 percent over ten years.[3] FY 2016 funding will allow EERE to continue partnerships with industry in breaking down barriers to commercializing energy-efficient manufacturing technologies and practices, such as CHP, towards a national goal of 40 GW of new cost-effective industrial CHP by 2020.[4]

***Building Technologies**:* The Building Technologies Office supports development and demonstration of advanced building efficiency technologies and practices that support more efficient, affordable, and comfortable U.S. buildings.

EERE is requesting $264 million, which supports an increased emphasis on emerging technologies R&D in key areas such as lighting, heating and cooling, and building envelope, needed to achieve EERE's goal of reducing the Nation's energy use in buildings by 50%. FY 2016 funding supports a new area of research focused on advanced, high-throughput materials development to improve building energy efficiency. FY 2016 funds will continue to support building-to-grid integration activities focused on improving the efficiency and resiliency of the electric grid, including connected buildings and building systems. In addition to R&D activities, the request supports initiatives to overcome market barriers to widespread adoption of cost-effective energy efficiency technologies and solutions, as well as the development of national appliance and equipment standards and building energy codes in support of the goal to reduce carbon pollution by at least 3 billion metric tons cumulatively by 2030.

***Weatherization and Intergovernmental Program**:* The Weatherization and Intergovernmental Programs Office partners with state and local organizations in order to make clean energy technologies more accessible to a wide range of government, community, and business stakeholders.

EERE is requesting $318 million in FY 2016, including $228 million to support the Weatherization Assistance Program, which provides access to home weatherization services for low-income households across the country to reduce the comparatively large percentage of available income that they spend on energy. The State Energy Program will continue to support states in establishing and implementing clean energy plans, policies, and programs to reduce energy costs, increase competitiveness, enhance economic competitiveness, improve emergency planning, and improve the environment. FY 2016 also establishes a new local program that will provide competitive grants and technical assistance to local governments, creating partnerships to catalyze investments in the advancement of the U.S. clean energy economy.

***Federal Energy Management Program**:* The Federal Energy Management Program supports the federal government to provide individual federal agencies with resources and technical expertise that enable the federal sector to lead by example and meet energy efficiency and clean energy goals.

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[3] EPACT 2005
[4] E.O. 13624

EERE is requesting $43 million in FY 2016 to continue FEMP's core activities to assist and enable federal agencies to meet energy-related goals and provide federal energy leadership to the country. Areas of focus in FY 2016 will include efforts to: standardize the collection, calculation, and reporting of energy savings data across the Federal Government; support federal agencies to identify and implement energy projects using performance contracting; assist agencies to achieve $4 billion of performance contracting investment through 2016; and to streamline the process for small federal facilities to install energy conservation measures. FY 2016 funds will also support a challenge to improve U.S. data center efficiency by 20 percent over ten years through the Better Buildings Data Center Challenge. If all U.S. data centers were just 20 percent more efficient, we could save more than 20 billion kWh by 2020 as a nation, or roughly $2 billion in cost savings.

ADVANCING U.S. MANUFACTURING COMPETITIVENESS

One of EERE's continued areas of strong emphasis across our technology offices—and one that I know is of great importance to this Committee as well as to the Administration—is supporting U.S. manufacturing competitiveness.

EERE recognizes the many benefits of U.S.-based manufacturing within the clean energy economy—including job creation and high-tech intellectual property generation—and leads the Department of Energy's *Clean Energy Manufacturing Initiative.* The DOE Clean Energy Manufacturing Initiative is a Department-wide approach to increase U.S. competitiveness in clean energy manufacturing while advancing progress toward the nation's energy goals..

The FY 2016 Request continues support for crosscutting Clean Energy Manufacturing Innovation Institutes, as well as the establishment of two additional Institutes, all of which are part of the larger multi-agency National Network for Manufacturing Innovation. These EERE-supported Institutes are public-private partnerships focusing on RD&D of foundational technologies that are broadly applicable and prevalent in multiple industries and markets within the energy sector and that have potentially transformational technical and productivity impacts for the U.S. manufacturing sector more broadly. All institutes will be actively managed through cooperative agreements with well-defined milestones, and oriented toward clearly stated research objectives and outcomes to ensure timely achievement of all technical, operational, organizational and partnership goals. Also, within 5 years of its launch, each institute is expected to be financially independent and sustainable using only private-sector and other sources of funding without further federal financial assistance.

In January of this year, we supported the launch of PowerAmerica, also called the Next Generation Power Electronics Manufacturing Innovation Institute, led by North Carolina State University. PowerAmerica will bring together more than 25 companies, universities, and state and federal organizations to invent and to develop the manufacturing processes necessary to make wide bandgap (WBG) semiconductor-based power electronics -- which can operate at much high power levels, temperatures, and conversion efficiencies than the current state-of-the-art silicon-based technology -- directly cost-competitive with incumbent technology on a systems level. If successfully developed, this technology will help enable U.S. leadership in low-cost electric vehicles, more efficient industrial motors,

advanced inverters connecting renewable power to the grid, and a number of other critical clean energy applications. .

Our recently awarded Institute for Advanced Composites Manufacturing Innovation, led by the University of Tennessee and headquartered in Knoxville, already has 122 committed partners united toward the common goal of lowering overall costs for manufacturing advanced composites by 50 percent, reducing the energy use to do so by 75 percent, and increasing the ability to recycle composites by more than 95 percent. Advanced composites have the potential to deliver clean energy products with better performance and lower costs, such as lighter and longer wind turbines blades; high pressure tanks for natural gas- and hydrogen-fueled cars; lighter, highly energy-efficient industrial equipment; and lightweight vehicles.

EERE efforts in clean energy manufacturing extend across EERE into its technology programs, which will carry out targeted manufacturing R&D to address specific clean energy technology needs consistent with their individual missions. In support of the Administration's Materials Genome Initiative and as an FY 2016 key focus area of DOE's Clean Energy Manufacturing Initiative, EERE offices will collaborate in a coordinated cross-cutting advanced materials development acceleration effort across the Department. This collaborative effort across DOE in advanced materials manufacturing R&D will use high performance computing and high throughput combinatorial experimentation to develop validated models of materials systems capturing the effects of manufacturing processes and end-use to accelerate the development of materials from the point of discovery to qualification. This will be carried out in robust public-private partnership that could form the basis of a new approach to materials process development. Initial focus areas for EERE include materials for solar energy conversion, non-vapor-compression refrigeration systems and building envelope materials, non-platinum group metal catalysts, and development of materials, such as magnesium, for vehicle lightweighting.

DOE CROSS-CUTTING INITIATIVES

In addition to EERE's technology offices, we also work to break down silos across DOE and EERE offices to address critical, crosscutting energy initiatives that broadly impact our clean energy goals. Within our technology office budgets, the FY 2016 Budget continues crosscutting programs which coordinate across the Department and seek to tap DOE's full capability to effectively and efficiently address the U.S.'s energy, environmental, and national security challenges, and achieve maximum impact for the U.S. taxpayer.

Grid Modernization Initiative

U.S. prosperity and energy innovation in a global clean energy economy depends on the modernization of the National Electric Grid. To support this transformation, DOE's Grid Modernization Initiative will create tools and technologies that measure, analyze, predict, and control the grid of the future; focus on key policy questions related to regulatory practices, market designs, and business models; ensure the development of a secure and resilient grid; and collaborate with stakeholders to test and demonstrate combinations of promising new technologies. The FY 2016 EERE request includes $153 million to continue to support this Initiative, a collaborative effort among EERE and DOE's Office of Electricity

Delivery and Energy Reliability, with contributions from the Office of Energy Policy and Systems Analysis, and Office of Indian Energy Policy and Programs. Within the Grid Modernization Initiative, EERE's grid modernization activities -- organized across its Buildings, Solar, Vehicles, Wind, and Fuel Cells Technology Offices and including an investment of $36 million in base funding for the new Energy Systems Integration Facility (ESIF) at DOE's National Renewable Energy Laboratory -- focus on holistically enabling the seamless integration of EERE technologies into the electrical grid in a safe, reliable, and cost-effective manner.

Subsurface Technology and Engineering Initiative

Over 80 percent of our total energy supply comes from the subsurface, and this importance is magnified by the ability to also use the subsurface to store and sequester fluids and waste products. The subsurface crosscut, SubTER, will address identified challenges in the subsurface through highly focused and coordinated research in Wellbore Integrity, Stress State and Induced Seismicity, Permeability Manipulation, and New Subsurface Signals to ensure enhanced energy security, material impact on climate change via CO_2 sequestration, and significantly mitigated environmental impacts from energy-related activities and operations. The EERE request includes $71 million—within the Geothermal Technologies program—in support of this crosscutting initiative.

EERE's FY 2016 request also includes support for the Department's new Energy-Water Nexus initiative ($9 million) across the requests for the Water Power, Geothermal Technologies, and Advanced Manufacturing offices, as well as the Supercritical $C0_2$ initiative ($0.5 million) within the request for the Geothermal Technologies office. As with the Grid Modernization and Subsurface Technology and Engineering initiatives, these initiatives are the product of a concerted coordination effort across the Department in close collaboration with the National Laboratories.

EERE OPERATIONAL EXCELLENCE AND ORGANIZATIONAL IMPROVEMENTS

In FY 2016, EERE will maintain its strong focus on operational excellence. Building on early progress of recently initiated, multi-year comprehensive organizational reforms, EERE will conduct our work with greater speed, quality, and higher-impact results year by year.

Ensuring Program Planning, Prioritization, and Review Are Clear and Transparent

EERE will continue to articulate and communicate its future plans and program priorities, both internally and externally, through updates to EERE technology office Multi-Year Program Plans (MYPPs). Specifically, MYPP activities and priorities will describe, in greater detail, the goals, program thrusts, roadmaps, and prioritization methodologies that drive them. Furthermore, office MYPPs are informed by extensive stakeholder engagement, such as through regular external expert peer reviews of our portfolios. By ensuring a process of regular updates to major plans and engaging in rigorous dialogue with experts and other stakeholders, EERE will responsively move into new and highly promising program areas, and we will terminate programmatic thrusts that are deemed to no longer be highly relevant or impactful.

While EERE strategically plans and evaluates its support of RD&D activities according to these technology roadmaps, we also recognize how dynamic innovators in the clean energy economy constantly integrate new ideas and discoveries to create competitive advantages. The FY 2016 EERE Budget Request includes a small fraction of its annual funding for "Incubator" funding opportunities within each of its technology offices. The Incubator programs will focus on technologies and solutions that are not currently significantly represented within EERE's RD&D portfolio and roadmaps but are within congressionally authorized activities. Incubator funding opportunities will allow EERE to develop, assess, and screen new "off-roadmap" technologies and solutions for their potential to be "on-ramped" into future program plans, roadmaps, and project portfolios. It should be noted that these Incubator funding opportunities competitively fund R&D projects and do not fund any central technology incubation facilities. Incubator efforts will be coordinated with ARPA-E as needed to ensure that there is no duplication of effort between the two program offices.

Maximizing the Impact of EERE's Work with DOE National Laboratories

The DOE National Laboratory infrastructure is a world-leading scientific enterprise that has been integral in DOE's mission to ensure America's security and prosperity by addressing its energy, environmental, and security challenges through transformative science and technology solutions. EERE is developing and implementing a coordinated strategy to increase the impact of DOE National Laboratories in the U.S. clean energy sector. As a part of that strategy, EERE recently launched a new $2.3 million pilot called Lab-Corps that aims to better train and empower DOE National Laboratory researchers to successfully transition their discoveries into high-impact, real world technologies.

EERE has also worked to strengthen our relationship with the National Laboratories and to define clear principles around the EERE and National Laboratory engagement which focus on laboratory stability and the interactions necessary for the Labs to achieve maximum market impact. This year, EERE will focus on developing new mechanisms to enable the DOE National Laboratories to provide technical assistance and opportunities for small businesses and to build stronger relationships between the Labs and larger industry partners. America's aptitude for technological innovation and competitiveness remains vital to our continued economic growth and energy security. This strategy unites the mission objectives of EERE and the enduring role for the National Laboratories in clean energy technology innovations by creating lasting alliances with industry and other strategic partners.

Protecting Taxpayer-funded Intellectual Property

EERE continues to take proactive steps toward ensuring that taxpayer-funded innovation and intellectual property (IP) is being leveraged in the U.S., boosting American competitiveness and manufacturing jobs. Mindful of the objectives of related legislation, such as the Patent and Trademark Law Amendments Act ("Bayh-Dole"), EERE is piloting innovative approaches to help encourage more U.S. manufacturing from DOE funded research and development projects, such as requiring applicants to EERE competitive Funding Opportunity Announcements to submit manufacturing plans—or agree that subject inventions be substantially manufactured in the U.S.—as a component of their applications. These efforts will help foster U.S. innovation, strengthen manufacturing competitiveness, and provide

our research partners the assurance that EERE is dedicated to leveraging the clean energy economy's opportunities to enhance U.S. competitiveness on the world stage.

Enhancing EERE's Stewardship of Project Portfolios through Active Management Approaches

In order to be an effective steward of taxpayer dollars and produce the highest impact from its investments, EERE has implemented Active Project Management approaches—inspired by the Advanced Research Projects Agency–Energy's (ARPA-E) rigorous project management efforts—across its portfolio of projects and is currently applying lessons learned to further refine our management of risk within the portfolio. These approaches provide clearer accountability through:

- More clearly defined roles and responsibilities in project execution by establishing uniform position requirements across the organization;
- Enhanced project management standard operating procedures;
- Guidance to more effectively negotiate detailed statements of project objectives for each project, including quarterly progress reviews and annual "Go/No-Go" milestones; and
- End-of-project deliverables clearly oriented around accomplishments that can impact the energy marketplace.

By implementing rigorous Active Project Management principles, EERE has increased the rate at which we discontinue projects for technical reasons, meaning those that are unable to meet their targets or fulfill their original intent. Between FY 2005 and when we began to implement active project management in October 2013, EERE had discontinued 53 projects. Since then, we have discontinued 66 projects, and 42 of those are since I last addressed this committee in March 2014. In total, EERE has discontinued nearly 120 projects with a combined award value of about $435 million, and we expect to continue this level of enhanced rigor in the years to come.

CONCLUSION

In conclusion, allow me to reiterate the key points that I want to leave you with today. At EERE, we recognize the enormous opportunity that clean energy represents for the United States. Working in partnership with the private sector, we are optimistic that we can create and sustain American leadership in the global transition to clean energy, and in so doing grow high-paying jobs and strong market share for our workers and businesses. We stand behind EERE's track record of accomplishments and successful market-stimulating investments and our efforts to make our organization ever more effective and accountable to you and to the American taxpayer. We are privileged to play this role and to work with this Committee to help ensure that the United States continues to lead the global clean energy race.