DEPARTMENT OF ENERGY OVERSIGHT: OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED FOURTEENTH CONGRESS

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March 24, 2015

DEPARTMENT OF ENERGY OVERSIGHT: OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY

FRIDAY, MARCH 24, 2015

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Subcommittee met, pursuant to call, at 2:41 p.m., in Room 2318 of the Rayburn House Office Building, Hon. Randy Weber [Chairman of the Subcommittee] presiding.

Subcommittee on Energy

Department of Energy Oversight: Office of Energy Efficiency and Renewable Energy

Tuesday, March 24, 2015
2:00 p.m. – 4:00 p.m.
2318 Rayburn House Office Building

Witnesses

The Honorable David Danielson, Assistant Secretary, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy (DOE)

Mr. Nick Loris, Herbert and Joyce Morgan Fellow, Heritage Foundation

Ms. Ruth McCormick, Director of Federal and State Affairs, Business Council for Sustainable Energy (BCSE)

Dr. Veronique de Rugy, Senior Research Fellow, Mercatus Center, George Mason University

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HEARING CHARTER

Department of Energy Oversight: Office of Energy Efficiency and Renewable Energy

Tuesday, March 24, 2015
2:00 p.m. – 4:00 p.m.
2318 Rayburn House Office Building

PURPOSE

The Subcommittee on Energy will hold a hearing titled *Department of Energy Oversight: Office of Energy Efficiency and Renewable Energy* on Tuesday, March 24, 2015, at 2:00 p.m. in Room 2318 of the Rayburn House Office Building. The purpose of the hearing is to conduct oversight of the Department of Energy's $2.72 billion request for FY 2016 for the Office of Energy Efficiency and Renewable Energy (EERE) technology research, development, demonstration, and commercialization activities.

WITNESS LIST

- **The Honorable David Danielson**, *Assistant Secretary, Energy Efficiency and Renewable Energy, U.S. Department of Energy*
- **Mr. Nick Loris**, *Herbert and Joyce Morgan Fellow*, Heritage Foundation
- **Ms. Ruth McCormick**, *Director of Federal and State Affairs*, Business Council for Sustainable Energy (BCSE)
- **Dr. Veronique de Rugy**, *Senior Research Fellow*, Mercatus Center, George Mason University

BACKGROUND

The Office of Energy Efficiency and Renewable Energy (EERE) supports applied research, development, demonstration, and commercialization activities in transportation, renewable power, and energy efficiency, and is designated as the lead federal clean energy technology organization.[1] EERE's primary goals include reducing U.S. reliance on fossil fuels, reducing the cost of energy, reducing energy emissions, and promoting American manufacturing of clean energy technologies.[2] The FY 2016 budget request for EERE is $2.72 billion, an increase of $809 million or 42.3 percent over FY 2015 enacted levels. With this budget request, significant increases are requested in advanced manufacturing, building technologies, vehicle technologies, and wind and solar power.

[1] Department of Energy *FY 2016 Congressional Budget Request: Volume 3*, p. 9, February 2, 2015, Available at http://www.energy.gov/sites/prod/files/2015/02/f19/FY2016BudgetVolume3_7.pdf
[2] Ibid.

Office of Energy Efficiency and Renewable Energy Programs (dollars in millions)				
Program	**FY 2014 Enacted ($M)**	**FY 2015 Enacted ($M)**	**FY 2016 Request ($M)**	**FY 2016 vs FY 2015 (% Change)**
Energy Efficiency and Renewable Energy (EERE)	**1,913.6**	**1,937.0**	**2,723.0**	**42.3%**
Hydrogen & Fuel Cell Technology	92.9	97.0	103.0	6.2%
Bioenergy Technology	232.2	225.0	246.0	9.3%
Vehicle Technologies	289.7	280.0	444.0	58.6%
Solar Energy	257.1	233.0	336.7	44.5%
Wind Energy	88.2	107.0	145.5	36.0%
Geothermal Technologies	45.8	55.0	96.0	74.5%
Water Power	58.6	61.0	67.0	9.8%
Building Technologies	178.0	172.0	264.0	53.5%
Advanced Manufacturing	180.5	200.0	404.0	102.0%
Weatherization and Intergovernmental Programs	230.9	243.0	318.5	31.1%
Federal Energy Management Program	28.2	27.0	43.1	59.6%
Facilities & Infrastructure	46.0	56.0	62.0	10.7%
Program Direction	162.0	160.0	165.3	3.3%
Strategic Programs	23.5	21.0	27.9	32.7%

EERE is organized into three primary program areas: sustainable transportation ($793 million, an increase of 31.7 percent), renewable power ($645.2 million, an increase of 41.5 percent), and energy efficiency in buildings and manufacturing ($1.03 billion, an increase of 60.4 percent).[3] EERE programs are also major contributors for five out of six cross-cutting initiatives in the budget proposal, including Energy-Water Nexus, Grid Modernization, Subsurface Technology and Engineering, Supercritical CO_2, and Cybersecurity.

Specific EERE sub-programs under Science Committee jurisdiction include:[4]

- **Hydrogen and Fuel Cell Technologies.** EERE requests $103 million (a 6.2 percent increase) in FY 2016 to support efforts to reduce the cost and increase the durability of fuel cell systems. Fuel Cell R&D will focus on stack component R&D, stack and component operation and performance, systems and system integration, balance of plant components, testing and technical analysis. Hydrogen Fuel R&D will focus on materials and process development to enable hydrogen production from diverse renewable resources.

[3] Department of Energy *FY 2016 Congressional Budget Request: Budget in Brief*, p. 29-31, February 2, 2015, Available at http://www.energy.gov/sites/prod/files/2015/02/f19/FY2016BudgetinBrief.pdf

[4] Department of Energy *FY 2016 Congressional Budget Request: Volume 3*, February 2, 2015, Available at http://www.energy.gov/sites/prod/files/2015/02/f19/FY2016BudgetVolume3_7.pdf

- **Bioenergy Technologies.** EERE requests $246 million (9.3 percent increase) in FY 2016, focusing on the development of innovative processes to convert cellulosic and algal-based feedstocks to bio-based gasoline, jet, and diesel fuels at a cost of $3 per gallon gasoline equivalent. The program also includes a proposal for commercial-scale bio-refinery demonstrations to produce military specification fuels in collaboration with the Department of Agriculture and the U.S. Department of the Navy.

- **Vehicle Technologies.** EERE requests $444 million (a 58.6 percent increase) in FY 2016, with programs focused on reducing the cost, minimizing emissions, and improving the energy-related performance of a mix of medium- and long-term vehicle technologies including advanced batteries, electric drive technologies, lightweight and propulsion materials, advanced combustion engines, advanced fuels and lubricants, and other enabling transportation technologies. Program projects include continued support of the EV Everywhere Grand Challenge ($253 million),[5] new awards for a "SuperTruck II" initiative ($40 million), the Clean Energy Manufacturing Initiative ($30 million).

- **Solar Energy.** EERE requests $336.7 million (a 44.5 percent increase) in FY 2016 to support the SunShot Initiative goal to make solar power cost competitive with electricity from fossil fuels without subsidies by 2020. This includes solar photovoltaic R&D, development and demonstration of innovative solar energy manufacturing technologies, and activities designed to reduce non-hardware "soft costs" of solar power by 50%. The request also supports development of advanced thermal storage for concentrated solar power.

- **Wind Energy.** EERE requests $145.5 million (a 36 percent increase) in FY 2016 to support efforts to achieve full market cost competition for wind energy. The request funds three advanced offshore wind demonstration projects planned for operation by 2017, the Atmosphere to Electrons initiative designed to optimize entire wind farm performance and lower the cost of wind energy, and funding for designs, materials and manufacturing processes for longer turbine blades under the DOE Clean Energy Manufacturing Initiative.

- **Geothermal Technologies.** EERE requests $96 million (a 74.5 percent increase) in FY 2016, including continuing to support the Frontier Observatory for Research in Geothermal Energy (FORGE) dedicated test site and providing primary funding for the Department's Subsurface Technology and Engineering RD&D crosscut to reduce the cost and risk of geothermal development. The budget request would also fund "play fairway" analyses, a subsurface mapping technique currently used in oil and gas development, which would provide information on the probability of finding new geothermal resources on a regional scale.

- **Water Power.** EERE requests $67 million (a 9.8 percent increase) in FY 2016 to support research, development, demonstration, and deployment (RDD&D) in Hydropower and Marine and Hydrokinetic (MHK) energy. Hydropower focus areas include enabling increased hydropower opportunities at non-powered dams, water conveyance systems, and

[5] For more information on the EV Everywhere Grand Challenge:
http://www1.eere.energy.gov/vehiclesandfuels/electric_vehicles/index.html

new stream reach development, and the development of new low cost modular systems to minimize civil works and environmental impact and maximize design for manufacturing. Marine and hydrokinetic activities include front end engineering and design for a grid-connected open-water test facility.

- **Advanced Manufacturing.** EERE requests $404million (a 102 percent increase) in FY 2016, with funding to support the deployment of two additional Clean Energy Manufacturing Innovation Institutes, support of four existing institutes. Funding is also included for high-impact R&D focused on advanced manufacturing and materials, working to achieve significant gains in energy productivity, environmental performance, and product yield for U.S. manufacturers.

- **Building Technologies.** EERE requests $264 million (a 53.5 percent increase) in FY 2016, providing funding to accelerate the development of lighting, heating and cooling, and other energy efficiency solutions for buildings, with the goal of reducing national energy use by 50 percent, with 20 percent reduction in energy use by 2020. The request also supports the equipment and appliance standards programs, and a new advanced building envelope and refrigerant materials manufacturing R&D effort designed to promote energy efficiency solutions for home owners and builders.

Important questions and key issues to be discussed at the hearing include:

- What are the Administration's goals for clean energy technology investment as outlined in the President's FY 2016 budget proposal for EERE, and how do these goals reflect the long-term energy needs of the American economy?

- What is the impact of DOE's energy efficiency and renewable energy technology programs on the energy marketplace?

- What areas of fundamental research and development within EERE are expected to lead to technology breakthroughs in renewable energy and energy efficiency?

- What key management, structure, and policy changes has DOE proposed for EERE in the FY 2016 budget request?

Chairman WEBER. Subcommittee on Energy will come to order. Without objection, the Chair is authorized to declare recesses of this Subcommittee at any time.

Welcome to today's hearing titled "Department of Energy Oversight: Office of Energy Efficiency and Renewable Energy."

I recognize myself for five minutes for an opening statement.

Good afternoon, and as I have already said, welcome to today's Energy Subcommittee hearing. We are going to examine the Department of Energy's Office of Energy Efficiency and Renewable Energy, or EERE. Today, we will hear from the Department and a broad panel of expert witnesses on the value of the research, development, demonstration, and commercialization activities in EERE, and the impact DOE's clean energy programs have on the energy market and the United States economy.

EERE is the lead federal agency for clean energy research and development, with programs in transportation, renewable energy, and energy efficiency. This office is clearly a top priority for the Obama Administration, with this year's budget request coming in at $2.7 billion, which is an increase of over $800 million from enacted levels. That is a whopping 42 percent increase in one year. With our national debt at $18 trillion and rising, and mandatory spending caps guiding budgets on everything from energy to national defense, this kind of spending obviously deserves rigorous oversight from Congress. It is clear that EERE's budget is simply unaffordable. While every other federal program has had to adjust to spending caps and work within modest spending goals, EERE's budget has continued to increase. Despite a budget that has already grown by 58 percent in the last decade, and received over $16 billion, with a B, in stimulus funds, the Obama Administration continues to request more year after year. It is time to adjust EERE's budget to reality. By continuing to grow EERE spending, the Department of Energy's approach to energy research and development has also become more and more unbalanced. EERE's budget dwarfs that of the other applied offices at DOE. The $2.7 billion budget request for fiscal year 2016 is more than four times the budget request for fossil energy R&D, five times the request for nuclear energy R&D, and 16 times the request for electricity and energy reliability R&D. In fact, the proposed budget for EERE is more than double the budgets for nuclear, fossil, and electricity R&D combined.

Finally, the work prioritized by EERE is far too focused on increasing the use of today's technology, not conducting the fundamental research to lay the foundation for the next technology breakthrough. Many EERE programs are focused on reducing market barriers for existing technology or funding R&D activities already prioritized by the private sector. For example, in EERE's Vehicle Technologies program, $40 million is requested for "cost-share projects within—with industry" within the "SuperTruck 2" initiative. Funding for SuperTruck 2 is intended to improve the hauling efficiency of heavy-duty, Class 8 long-haul vehicles by 100 percent by the year 2020. But the freight industry and auto manufacturers, both billion dollar industries, already have the means and motivation to develop innovative technology to increase energy efficiency. Investing in technology to decrease costs is just good business

sense, and American industry does this every day, with or without federal funds. And I might add, on the trucking freight business, I used to do some freight hauling as one of my businesses. Unless you can decrease the weight of a pound, we are in for a long wait.

Instead of duplicating work that could be done in the private sector, the Department should prioritize basic research and development with broad application to all forms of energy, and energy efficiency. Models developed in the Office of Science's ASCR program, the subject of an Energy Subcommittee hearing earlier this year, can be used to study and improve techniques in manufacturing, renewable power, and energy efficiency, enabling the private sector to develop and bring new technology into the market without American tax dollars.

I want to thank Assistant Secretary Danielson and all our witnesses for testifying to the Committee today, and I look forward to a review of EERE's programs and a discussion about the impact DOE's clean energy programs have on the economy. As some of our witnesses will point out today, subsidizing one form of energy over another through federal programs is damaging to the energy market, it increases costs for the American people, and actually is often counterproductive to new the technology development. Investment in the next generation of energy technology must be balanced, technology-neutral, and responsible. By funding basic research and development, the Department of Energy could build a foundation for the private sector to bring new innovative technologies to market, and to grow the American economy.

With that, I yield back. And, Mr. Grayson, you are recognized.

[The prepared statement of Mr. Weber follows:]

PREPARED STATEMENT OF SUBOMMITTEE CHAIRMAN RANDY WEBER

Good morning and welcome to today's Energy Subcommittee hearing examining the Department of Energy's Office of Energy Efficiency and Renewable Energy, or EERE. Today, we will hear from the Department and a broad panel of expert witnesses on the value of the research, development, demonstration and commercialization activities in EERE, and the impact DOE's clean energy programs have on the energy market and the U.S. economy.

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With our national debt at $18 trillion and rising, and mandatory spending caps guiding budgets on everything from energy to national defense, this kind of spending deserves rigorous oversight from Congress.

It is clear that EERE's budget is simply unaffordable. While every other federal program has had to adjust to spending caps and work within modest spending goals, EERE's budget has continued to increase. Despite a budget that has already grown by 58% in the last decade, and received over $16 billion in stimulus funds, the Obama Administration continues to request more year after year. It's time to adjust EERE's budget to reality.

By continuing to grow EERE spending, the Department of Energy's approach to energy research and development has also become more and more unbalanced. EERE's budget dwarfs that of the other applied offices at DOE. The $2.7 billion budget request for Fiscal Year 2016 is more than four times thebudget request for fossil energy R&D, five times the request for nuclear energy R&D, and 16 times the request for electricity and energy reliability R&D. In fact, the proposed budget for EERE is more than double the budgets for Nuclear, Fossil, and Electricity R&D combined.

Finally, the work prioritized by EERE is far too focused on increasing the use of today's technology, not conducting the fundamental research to lay the foundation for the next technology breakthrough. Many EERE programs are focused on reducing market barriers for existing technology or funding R&D activities already prioritized by the private sector.

For example, in EERE's Vehicle Technologies program, $40 million is requested for "cost-share projects with industry" within the "SuperTruck 2" initiative. Funding for SuperTruck 2 is intended to improve the hauling efficiency of heavy-duty, Class 8 long-haul vehicles by 100% by 2020. But thefreight industry and auto manufacturers—both billion dollar industries—already have the means and motivation to develop innovative technology to increase energy efficiency. Investing in technology todecrease costs is just good business sense—and American industry does this every day, with or without federal funds.

Instead of duplicating work that could be done in the private sector, the Department should prioritize basic research and development with broad application to all forms of energy, and energy efficiency.

Models developed in the Office of Science's ASCR program—the subject of an Energy Subcommittee hearing earlier this year—can be used to study and improve techniques in manufacturing, renewable power, and energy efficiency, enabling the private sector to develop and bring new technology into the market without American tax dollars.

I want to thank Assistant Secretary Danielson and all our witnesses for testifying to the Committee today, and I look forward to a review of EERE's programs and a discussion about the impact DOE's clean energy programs have on the economy.

As some of our witnesses will point out today, subsidizing one form of energy over another through federal programs is damaging to the energy market, increases costs for the American people, and is often counterproductive to new technology development.

Investment in the next generation of energy technology must be balanced, technology-neutral, and responsible. By funding basic research and development, the Department of Energy could build a foundation for the private sector to bring innovative new technologies to market, and grow the American economy.

Mr. GRAYSON. Thank you, Chairman Weber, for holding this hearing. And thank you to our witnesses for appearing here today.

America is mired in a long-term negative energy trade balance. According to the most recent figures from the Energy Information Administration, our energy trade deficit as of the fourth quarter of 2013 was $203 billion, and it has been that way literally for decades. We must import to make up the difference, and the question is how much longer are we going to be able to spend our fortune that way.

Every year for the past two generations, energy imports have cost us hundreds of billions of dollars. Unfortunately, there are also massive hidden costs that aren't reflected in the prices that Americans actually pay for energy. One recent study estimates that the United States has spent about $8 trillion from 1976 through 2010, merely defending access to oil supplies in the Persian Gulf, not producing, not acquiring, not even transporting, but simply defending our access to oil. That is $25,000 for every man, woman and child in America. Continuing to pursue a business-as-usual energy policy clearly costs not only American dollars, but also American lives. We can't just drill our way out of that problem.

Because the price of oil is set globally, a disruption of oil from the Middle East could severely spike U.S. oil prices no matter how much of it we are able to pull from our own ground. That is why reducing dependence on oil, and not just foreign oil, is a key strategic objective for both the United States economy and the U.S. Military. We can and we must end this strategic energy deficit. We can create a domestic energy infrastructure that is reliable, resilient and far less dependent on volatile regions around the world.

Towards these ends, the Department of Energy's Office of Energy Efficiency and Renewable Energy, which we are here to talk about today, helps to make that future come faster. Their sustainable transportation technology program focuses on improving energy efficiency in vehicles, and developing new alternative fuels from domestic resources. Research investments made by this program have reduced electric vehicle battery costs by 70 percent since 2008. They have also reduced the manufacturing costs for automotive fuel cells by more than 50 percent just since 2006. Research and development in biofuels has helped to reduce the production cost of cellulosic ethanol by more than $6 a gallon, to around $3.20 per gallon today, making it cost-competitive with gasoline.

Beyond reducing our dependence on oil, these programs improve energy efficiency in buildings and appliances, and they are providing major economic and environmental benefits to U.S. taxpayers as well. Efficiency standards enacted by the Department of Energy since 2009 are projected to save consumers hundreds of billions of dollars in their utility bills through 2030, and this agency-supported research in advanced lighting technology has helped to reduce LED costs by 90 percent since 2008. The renewable energy sector has also benefitted immensely from the agency-supported research and development. Since 2010, photovoltaic systems costs have been cut in half. DOE's SunShot Program, which has the goal of making solar energy costs competitive with conventional sources by 2020, is already more than 60 percent of the way to achieving that cost target. Overall, third party evaluators outside of the government estimate that from 1976 to 2008, these investments of $15 billion have resulted in an estimated economic benefit to the United States of $388 billion, a net return of more than 24 to 1. That is a very impressive track record, whether it is in government or in business, and it is one that we should continue to support.

Private investors in the energy sector are beginning to move from project-level loans to holding company loans, which means renewable energy industries may be starting at long last to take off. This development is encouraging, but we must realize that there is no Exxon Mobil, or for that matter, an Intel or a Pfizer in the renewable energy sector. There is no one with the capability to spend billions on research that the government is spending now. There remains a unique government role in supporting the advancement of new technologies at a sufficient pace to meet our national economic, environmental and energy security needs. And that is why I look forward to this hearing to hear more about that today.

The results from this agency's programs are tangible. They are having a direct positive impact on peoples' lives and, therefore, I want to thank Dr. Danielson and his office for their productive work, and for the information that they provide for us here today. And thank you again, Mr. Chairman.

And with that, I yield the balance of my time.

[The prepared statement of Mr. Grayson follows:]

PREPARED STATEMENT OF SUBCOMMITTEE ON ENERGY
MINORITY RANKING MEMBER ALAN GRAYSON

Thank you, Chairman Weber, for holding this hearing, and thank you to our witnesses for appearing here today.

America is mired in a long-term negative energy trade balance. According to the most recent figures from the Energy Information Administration, our energy trade deficit—as of the fourth quarter of 2013—was $203 billion.

Every year, for the past two generations, energy imports have cost us hundreds of billions of dollars. Unfortunately, there are also massive hidden costs that aren't reflected in the prices Americans actually pay for energy.

One recent study estimates that the U.S. has spent about $8 trillion from 1976 through 2010, merely defending access to oil supplies in the Persian Gulf. Not producing, not acquiring, not transporting—but defending access to oil. That's $25,000 for every man, woman, and child in America. Continuing to pursue a business-as-usual energy portfolio clearly costs not only American dollars, but American lives.

We can't just drill our way out of this problem.

Because the price for oil is set globally, a disruption of oil from the Middle East could severely spike U.S. oil prices no matter how much of it we are able to pull from the ground. That's why reducing dependence on oil, not just "foreign oil," is a key strategic objective for both the U.S. economy and the U.S. military.

We can, and we must, end this strategic energy deficit. We can create a domestic energy infrastructure that is reliable, resilient, and far less dependent on volatile regions of the world.

Toward these ends, the Department of Energy's Office of Energy Efficiency and Renewable Energy, or "EERE," which we are here to talk about today, helps make that future come faster. EERE's Sustainable Transportation technology program focuses on improving efficiency in vehicles, and developing new alternative fuels from domestic resources.

Research investments made by this program have reduced electric vehicle battery costs by 70% since 2008. They have also reduced the manufacturing costs for automotive fuel cells by more than 50% since 2006.

Research and development in biofuels has helped reduce production costs of cellulosic ethanol by more than $6 per gallon, to around $3.20 per gallon today, making it cost-competitive with gasoline.

Beyond reducing our crippling dependence on oil, EERE's programs to improve energy efficiency in buildings and appliances are providing major economic and environmental benefits to U.S. taxpayers as well.

Efficiency standards enacted by the Department of Energy since 2009 are projected to save consumers hundreds of billions of dollars in their utility bills through 2030, and EERE-supported research in advanced lighting technology has helped reduce LED costs by 90% since 2008.

The renewable energy sector has also benefited immensely from EERE-supported research and development. Since 2010, photovoltaic system costs have been cut in half. DOE's SunShot program, which has the goal of making solar energy cost-competitive with conventional sources by 2020, is already more than 60% of the way to achieving its cost target.

Overall, third-party evaluators estimate that from 1976 to 2008, EERE investments of $15 billion have resulted in an estimated economic benefit to the United States of $388 billion—a net return of more than 24 to 1. That is an impressive track record, and it is one we should continue to support.

Private investors in the energy sector are beginning to move from project-level loans to holding company loans, which means renewable energy industries are starting to take off. While this development is encouraging, we must realize that there is still no ExxonMobil, nor, for that matter, an Intel or Pfizer, in the renewable energy sector. There remains a unique government role in supporting the advancement of new technologies at a sufficient pace to meet our national economic, environmental, and energy security needs. And that is what I look forward to hearing more about today.

The results from EERE's programs are tangible, and they are having direct, positive impacts on people's lives.

I want to thank Dr. Danielson and his Office for their productive work, and for the information that they provide here today.Thank you again, Mr. Chairman, and with that I yield the balance of my time.

Chairman WEBER. Thank you, Mr. Grayson.

I now recognize the Chairman of the Full Committee, Mr. Smith.

Chairman SMITH. Thank you, Mr. Chairman.

Today, the Subcommittee on Energy will examine the Department of Energy's Office of Energy Efficiency and Renewable Energy, commonly referred to as EERE. The Department describes EERE as, "The U.S. Government's primary clean energy technology

organization." EERE's goals sound worthy enough. It seeks to reduce the use of fossil fuels, lower emissions, and speed up the adoption and decrease the cost of clean energy technology in transportation, renewable power and energy efficiency. However, while the EERE is billed as leading clean energy research and development, there are fundamental concerns with EERE's approach to advancing energy technology. EERE's activities demonstrate that it is heavily invested in forcing the Administration's preferred technology on the American people. When the government picks winners and losers in the energy technology marketplace, the American people pay the price.

The Solar Energy Technologies Program within EERE offers a ready example. This program's goal is to reduce the cost of solar power until they are cost-competitive with electricity from fossil fuels. It aims to achieve this goal by 2020. But because the program is focused on cost, not technology, EERE spends taxpayer dollars to market and deploy existing solar technology. Instead of research on the fundamental science behind solar energy, or development of new solar technology, EERE spends taxpayer dollars on "permitting, financing, and customer acquisition." It essentially puts promoting energy companies over research and development. Addressing these issues may help the solar industry market their product, but that is short-sighted and doesn't really make solar energy more competitive in the long term.

The Department of Energy should perform groundbreaking scientific research and develop on new technologies, not spend American tax dollars to promote what is already commercially available. The federal government should invest in basic research that could open the door for widespread use of solar and other renewable energy technology in the future. For example, energy storage research and development at the Joint Center for Energy Storage Research hub in the Office of Science explores new energy storage possibilities through basic scientific research. This energy storage research could have a groundbreaking impact not just on the solar industry, but also on all forms of energy.

The President's budget proposal for EERE includes a 42 percent, or $809 million, increase in spending. This is almost three times the requested increase for the Office of Science. In Congress, we have the responsibility to ensure the efficient and effective use of American tax dollars. We can't afford to impose expensive and inefficient technology on the energy market. We do not have unlimited resources, so we will have to make choices about where to make the best investment for the American people. By investing in basic research that benefits all forms of energy, we can make energy less expensive, and that benefits consumers and helps the United States achieve energy independence.

[The prepared statement of Mr. Smith follows:]

PREPARED STATEMENT OF FULL COMMITTEE CHAIRMAN LAMAR S. SMITH

Good morning. Today, the Subcommittee on Energy will examine the Department of Energy's Office of Energy Efficiency and Renewable Energy, commonly referred to as "E-E-R-E." The Department describes EERE as, "The U.S. Government's primary clean energy technology organization."

EERE's goals sound worthy enough. It seeks to reduce the use of fossil fuels, lower emissions, and speed up the adoption and decrease the cost of clean energy technology in transportation, renewable power and energy efficiency.

However, while the EERE is billed as leading clean energy research and development, there are fundamental concerns with EERE's approach to advancing energy technology. EERE's activities demonstrate that it is heavily invested in forcing the Administration's preferred technology on the American people.

When the government picks winners and losers in the energy technology marketplace, the American people pay the price. The Solar Energy Technologies Program within EERE offers a ready example. This program's goal is to reduce the cost of solar power until they are cost-competitive with electricityfrom fossil fuels. It aims to achieve this goal by 2020.

But because the program is focused on cost, not technology, EERE spends taxpayer dollars to market and deploy existing solar technology. Instead of research on the fundamental science behind solar energy, or development of new solar technology, EERE spends taxpayer dollars on "permitting, financing, and customer acquisition." It essentially puts promoting energy companies over research and development.

Addressing these issues may help the solar industry market their product, but that is short-sighted and doesn't really make solar energy more competitive in the long term.

The Department of Energy should perform groundbreaking scientific research and develop new technologies, not spend American tax dollars to promote what is already commercially available. The federal government should invest in basic research that could open the door for widespread use of solar and other renewable energy technology in the future.

For example, energy storage research and development at the Joint Center for Energy Storage Researchhub in the Office of Science explores new energy storage possibilities through basic scientific research. This energy storage research could have a groundbreaking impact not just on the solar industry, but alsoon all forms of energy.

The President's budget proposal for EERE includes a 42 percent, or $809 million, increase in spending. This is almost three times the requested increase for the Office of Science.

In Congress, we have the responsibility to ensure the efficient and effective use of American tax dollars. We can't afford to impose expensive and inefficient technology on the energy market. We do not have unlimited resources, so we will have to make choices about where to make the best investment for the American people.

By investing in basic research that benefits all forms of energy, we can make energy less expensive, and that benefits consumers and helps the U.S. achieve energy independence.

Chairman SMITH. Mr. Chairman, before I yield back, let me apologize to our witnesses, I have a Judiciary Committee markup that is ongoing right now, and I am going to have to shuttle back and forth between the most important hearing going on today, here, and an obligation to attend the Judiciary Committee. So I will yield back.

Chairman WEBER. Thank you, Chairman. We appreciate you.

Let me introduce our witnesses.

Our first witness today is the Honorable David Danielson, Assistant Secretary of the Office of Energy Efficiency and Renewable Energy for the United States Department of Energy. Previously, he served as program director for Department of Energy's Advanced Research Projects Agency Energy, where he developed and led research and development programs. Before working at the Department of Energy, Dr. Danielson was a clean energy venture capitalist at General Catalyst Partners, and was a cofounder of the New England Clean Energy Council. Dr. Danielson received his Ph.D. in materials science and engineering from the Massachusetts Institute of Technology, and his Bachelor's Degree in materials science and engineering from the University of California at Berkeley. Dr. Danielson, we are glad you are here.

Mr. Nick Loris—our second witness today is Nick Loris, a Herbert and Joyce Morgan Fellow for the Heritage Foundation. Mr. Loris specializes on energy, environmental and regulatory issues. He has been published and quoted in such publications as the Wall Street Journal, the New York Times, the Washington Post, Investor's Business Daily, and the Baltimore Sun. Before being named a Morgan Fellow, Mr. Loris was a policy analyst specializing in energy and environmental issues. Mr. Loris received his Masters in economics from George Mason University, and his Bachelor's Degree in economics, finance and political science from Albright College. Mr. Loris, welcome.

Our third witness is Ms. Ruth McCormick, the Director of Federal and State Affairs for the Business Council for Sustainable Energy. Ms. McCormick has over 25 years of experience in energy and environmental policy development. Prior to joining the council, Ms. McCormick represented the Western Regional Council, a coalition of businesses in the western United States. In addition, Ms. McCormick served as the legislative director for House Energy and Commerce Committee member Congressman Nielson. Ms. McCormick is a graduate of the University of Uhah—Utah. I can do this.

And Dr. Veronique, you told me it was okay, de Rugy. Am I saying that right?

Dr. DE RUGY. de Rugy.

Chairman WEBER. de Rugy, okay, good. A senior—is our next witness, a Senior Research Fellow for the Mercatus Center at George Mason University, with a focus on the U.S. economy, the federal budget, homeland security, and tax competition and financial privacy. In addition, Dr. de Rugy writes regular columns for Reason Magazine and the Washington Examiner, and she blogs about economics and National Review Online's The Corner. Previously, Dr. de Rugy has been a Resident Fellow at the American Enterprise Institute, a policy analyst at the Cato Institute, and a Research Fellow at the Atlas Economic Research Foundation. Before moving to the United States, she oversaw academic programs in France for the Institute for Humane Studies Europe. Dr. de Rugy received her MA in economics from the Paris Dauphine University, and her Ph.D. in economics from the Pantheon-Sorbonne University. Welcome, Doctor.

In order to allow time for discussion, we ask the witnesses to please limit your testimony to five minutes. And without objection, your entire written statement will be made a part of the record.

And I now recognize Dr. Danielson for five minutes to present his testimony. Doctor.

TESTIMONY OF THE HON. DAVID DANIELSON, ASSISTANT SECRETARY, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY (DOE)

Dr. DANIELSON. Thank you, Chairman. Chairman Smith, Chairman Weber, Ranking Member Grayson, and distinguished Members of the Subcommittee, thank you for the opportunity to appear

before you today to discuss the Office of Energy Efficiency and Renewable Energy, EERE, at the U.S. Department of Energy.

EERE supports cutting-edge American innovation to dramatically reduce U.S. reliance on foreign oil, cut energy costs for American families and businesses, avoid the damaging economic and health impacts of energy-related pollution, and enable the U.S. private sector to create good-paying American jobs through innovation. EERE's efforts in three critical energy sectors—sustainable transportation, renewable power, and energy efficiency—supportthe research, development and demonstration activities that are needed to make clean energy technologies directly cost-competitive without subsidies.

While clean energy markets grew to approximately $300 billion globally last year, with trillions more in market opportunity in the years ahead, the energy industry significantly underinvested in R&D compared to other industries. The strategic importance of energy to American economic growth and security means that government has a necessary and needed role to make the appropriate investments in cutting-edge energy innovation to seize this clean energy opportunity.

My experience as an MIT-trained scientist and engineer, a venture capitalist in the energy sector, and as one of the founders of ARPA–E, has given me unique insights into what is required for the U.S. energy innovation ecosystem to be successful. From this experience, I have developed five core questions that serve as the guiding principles by which EERE prioritizes its investments in energy innovation. These questions include the following. One: Impact. Is this a high-impact problem? Two: Additionality. Will EERE funding make a large difference relative to investments being made by the private sector? Three: Openness. Are we open to new ideas, and the most promising new energy innovations? Four: Economic benefit. Will EERE funding result in enduring U.S. economic impact? And five: Proper role of government. Is this investment a proper role of government, or something best left to the private sector to do on its own?

EERE has shown that smart, targeted investments in clean energy innovation can have a healthy return on investment for taxpayers. As just one example of many, over a 30-year period, EERE funded R&D on advanced combustion engines resulted in a net benefit of about $70 billion, representing a benefit-to-cost ratio of 53 to 1, at a seven percent discount rate.

In terms of our fiscal year 2016 budget request, in fiscal year 2016, EERE is requesting from Congress $2.7 billion across our three sectors to continue these successes, and to enable the United States to remain a global leader in innovative new clean energy technologies. The $793 million request for our sustainable transportation portfolio would help consumers and businesses use less energy to move business and freight, and replace conventional fuels with cost-competitive, domestically-produced, sustainable alternative fuels. And we are making significant progress. In 2014, the five-year SuperTruck program exceeded its goal of developing a suite of cutting-edge new long-haul trucking technologies to enable a 50 percent improvement in freight efficiency one year ahead of schedule. Our fiscal year 2016 budget request will enable EERE to

continue our focus on cutting-edge R&D, and advanced combustion and lightweight vehicles, developing new technologies that can diversify our fuel mix with drop-in biofuels, and enabling plug-in electric and fuel cell vehicles to become cost-competitive.

In our renewable power portfolio, EERE's request of $645 million will build on our R&D goal to enable the a development of multiple cost-effective renewable power technology options for every region of the country to diversify our power sector. Our fiscal year 2016 request will continue our SunShot Initiative's progress in making solar energy directly cost-competitive by 2020. Our request will also support the Frontier Observatory for Research in Geothermal Energy, or FORGE, a first-of-a-kind field laboratory, to address the key R&D challenges required to enable cost-effective advanced geothermal power, in addition to continued R&D efforts to reduce the cost of wind power, marine and hydrokinetic power, and hydropower.

Finally, in our energy efficiency portfolio, EERE's request of $1.03 billion emphasizes cutting-edge R&D and next-generation efficient building technologies, including high-efficiency, low-cost heating and cooling technologies. We will also increase support for next-generation manufacturing R&D to lower energy costs for American manufacturers, and create American leadership in the next generation of emerging energy-related advanced manufacturing technologies.

As just one example of these advanced manufacturing technology R&D investments, in January we launched the Institute for Advanced Composites Manufacturing Innovation, a public-private consortium of 122 leading U.S. manufacturers and research organizations that will focus on advanced composites, foundational materials that are three times as strong and twice as light as the lightest metals.

As EERE invests in high-impact research, development and demonstration programs to make clean energy solutions more affordable, accessible, and reliable, we remain fiercely committed to being a good steward of taxpayer investments. Over the past two years, EERE has implemented a new active project management approach under which we hold all of our projects accountable to annual go/no-go milestones, and under which we are more aggressively discontinuing projects that are not achieving key milestones to protect taxpayer interests.

In closing, EERE looks forward to working with this Committee to make necessary and appropriate investments in clean energy innovation, to continue to make our organization effective and accountable to Congress and to taxpayers, and to ensure that the United States wins the global clean energy race.

Thank you.

[The prepared statement of Dr. Danielson follows:]

Written Statement of

David Danielson

Assistant Secretary
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

Before the
Subcommittee on Energy
Committee on Science, Space, and Technology
United States House of Representatives

March 24, 2015

INTRODUCTION

Chairman Weber, Ranking Member Grayson, and Members of the Subcommittee, thank you for the opportunity to testify on the U.S. Department of Energy's (DOE's) Office of Energy Efficiency and Renewable Energy (EERE).

In support of the Administration's all-of-the-above approach to energy and the 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. The President's Budget builds on this progress by reversing sequestration, 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, which would damage our economy prevent us from making pro-growth investments in areas ranging from basic research to next generation biofuels and advanced manufacturing at the Department of Energy.

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 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.

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

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.

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,

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[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.

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:

- **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.

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.
- **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); and concentrating solar projects focused on integrating best-in-class subsystem technologies at the 1-10MW scale.

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 request 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]

[3] EPACT 2005

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 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.

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 Budget 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 CO_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.

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.

DR. DAVID DANIELSON - ASSISTANT SECRETARY FOR ENERGY EFFICIENCY AND RENEWABLE ENERGY

Dr. David Danielson leads the Office of Energy Efficiency and Renewable Energy (EERE) within the U.S. Department of Energy (DOE). As Assistant Secretary, he oversees a broad energy portfolio that is intended to hasten the transition to a clean energy economy.

Previously, he was the first Program Director hired by DOE's Advanced Research Projects Agency-Energy (ARPA-E). At ARPA-E, he developed and led R&D programs with a budget of more than $100 million that focused on high-risk, high-reward, disruptive clean energy technologies.

Prior to joining ARPA-E, he was a clean energy venture capitalist at General Catalyst Partners, a Boston-based venture capital fund. He co-founded the firm's clean energy investment practice and helped build and grow startups in various clean energy technology areas including solar power, wind power, advanced biofuels, bio-gas, carbon capture and storage, and advanced lighting.

He was a co-founder of the New England Clean Energy Council. He has authored more than 20 scientific articles in the field of advanced materials. While at the Massachusetts Institute of Technology (MIT), he was the founder and President of the MIT Energy Club and a founding Director of the MIT Energy Conference. For his work in building a strong multidisciplinary energy community at MIT, he was awarded the Karl Taylor Compton Prize, MIT's highest student award. He holds a Bachelor of Science, summa cum laude, in Materials Science and Engineering from the University of California, Berkeley, and a Ph.D. in Materials Science and Engineering from the Massachusetts Institute of Technology.

Chairman WEBER. Thank you, Dr. Danielson.
Mr. Loris, you are recognized for five minutes.

TESTIMONY OF MR. NICK LORIS,
HERBERT AND JOYCE MORGAN FELLOW,
HERITAGE FOUNDATION

Mr. LORIS. Thank you. Chairman Weber, Ranking Member Grayson, and distinguished Members of the Subcommittee, thank you for this opportunity to discuss the Department of Energy's Office of Energy Efficiency and Renewable Energy.

My name is Nick Loris, and I am the Herbert and Joyce Morgan Fellow at the Heritage Foundation. The views I express in this testimony are my own, and should not be construed as representing any official position of the Heritage Foundation.

Often overlooked in the criticism of policies that pick winners and losers in energy markets is the proper scrutiny of all the spending programs within EERE. The given logic for many of these initiatives is that a gap exists between basic research and economic viability, and thus, more taxpayer dollars must be spent to attract private investment. The reality though is that the market demand for transportation fuel and electricity are incentive enough to spur competition and innovative breakthroughs. Globally, these are multitrillion dollar markets. If any renewable technology captures a mere slice of that market, it would stand to make billions, if not tens of billions of dollars in profit annually. Breaking into this market is not a problem of the so-called valley of death where good ideas are unable to attract substantial investment. It is a valley of wealth waiting to be had.

The objectives of this office may be laudable, but it is simply not the role of the Federal Government to reduce cost and lower risk. When the government attempts to drive commercialization, it circumvents the competitive process that appropriately assigns risk and reward, and disregards how markets efficiently allocate resources. Take, for instance, the bioenergy technologies program that aims to make advanced biofuels cost-competitive with conventional gasoline at $3 per gallon. Why is that an objective in the first place, and how does the government know that $3 will be the magic price point at which alternative fuels become competitive? As we all know, markets are very unpredictable. And even if somehow $3 does change the market for alternative fuels, businesses are much better equipped and flexible to deal with the changing economic circumstances. Most importantly, the private sector should be responsible for taking on that risk and innovating to lower costs.

The same holds true for the electricity sector. For instance, the budget justification for the SunShot initiative states a goal of reducing the price for utility scale solar to 6 cents per kilowatt hour without subsidies, and that will result in rapid, large-scale adoption of solar across the United States. The problem is that the SunShot initiative in and of itself is a huge government subsidy by spending hundreds of millions of taxpayer dollars to reduce the cost of solar. And if 6 cents per kilowatt hour results in rapid solar deployment, that is great, but that should be a business decision. Government has no business trying to make projects cost-competitive or improving a technology's reliability to make it more enticing

for private financiers. Furthermore, the government is not very good at it, compared to those industries that actually have skin in the game. How many times have we heard from the DOE that an economically viable alternative energy source was just around the corner, and decades later and billions of taxpayer dollars squandered, the technology is still just around that corner.

Another goal for this office is improving energy efficiency. Programs like the Advanced Manufacturing Office sound nice and like an easy sell to constituents, but manufacturers already know that energy is a significant cost, and will find ways to reduce energy consumption in order to gain a competitive advantage. Companies will make these investments if they believe the technology is promising, worth the risk, and the best use of their investment dollars.

Instead, the Advanced Manufacturing Office provides nothing more than corporate welfare. For instance, past grant recipients have been some of the world's largest companies and massive energy users, including GE, Dow Chemical, and Boeing. These are not companies that need help from the taxpayer.

Now, when it comes to energy efficiency, one area that makes more sense as a government function is to reduce energy use within the federal government. The government as an energy consumer does not face the same incentive structure, nor do they always weigh trade-offs like families and businesses do. But the Federal Energy Management Program should be carried out in a technology-neutral manner to ensure the purpose is actual energy savings to save taxpayer dollars, not meet a political agenda.

All of this is not to say, however, that innovative technologies cannot emerge from federal spending, but there is a stark difference between how successes like the Internet became commercially viable versus attempts to commercialize specific energy technologies. Government projects that have become commercial successes, such as the Internet, computer chips and GPS, were not initially intended to meet a commercial demand, but instead, national security needs. Entrepreneurs saw an opportunity and created the commercially viable products that we enjoy today. The objective for Congress and the federal government should be to fund that basic research that meets national objectives, and create the proper pathway for DOE lab researchers to push that basic research out to the market, and for the private sector to tap into that expertise at our national labs.

To conclude, America doesn't need a man-on-the-moon-style mission for energy because the government has a diverse mix of energy supplies to competitively price energy, and provide families and businesses with choice. True reforms that lay the groundwork and lay the framework for renewable energy technologies to succeed and achieves—achieve the goal that EERE sets will not come from more government spending, but instead, free market reforms that create a competitive economic environment.

Thank you, and I look forward to your questions.

[The prepared statement of Mr. Loris follows:]

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CONGRESSIONAL TESTIMONY

Department of Energy Oversight: Office of Energy Efficiency and Renewable Energy

Subcommittee on Energy
Committee on Science, Space, and Technology

March 24, 2015

Nick Loris
Herbert & Joyce Morgan Fellow
The Heritage Foundation

My name is Nick Loris. I am a senior energy policy analyst and the Herbert & Joyce Morgan Fellow at The Heritage Foundation. The views I express in this testimony are my own, and should not be construed as representing any official position of The Heritage Foundation.

I want to thank the members of the Committee on Science, Space and Technology Subcommittee on Energy of the U.S. House of Representatives for this opportunity to address the Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE).

For far too long, the Department of Energy (DOE) has attempted to use taxpayer money to drive technologies to the market, crippling the role of entrepreneurs and wasting billions of taxpayer dollars in the process. If the global race for clean energy technologies is as valuable and promising as President Obama's Fiscal Year (FY) 2016 budget proposal says it is, the private sector will find ways to capture those opportunities.

Often overlooked in the criticism of taxpayer-funded grants, targeted tax credits, government-backed loans and loan guarantees is the proper scrutiny of all the spending programs within EERE. Policymakers have used EERE to drive their desired technologies into the marketplace. The given logic for many of these initiatives is that a gap exists between basic research and economic viability, and more taxpayer money must be spent to attract private investment for commercialization. Littered throughout the President's budget justification are phrases such as cost reduction, risk reduction, energy savings, improved U.S. competitiveness, keeping production and jobs in America, technology validation, performance improvement, and workforce training.

Such initiatives and objectives are exactly the wrong role for the federal government and the wrong approach to spur innovation at the DOE. When the government attempts to drive technological commercialization, it circumvents the competitive process that properly assigns risk and reward in an open market. Using taxpayer dollars to force commercialization is wasteful and disregards how markets and private investment efficiently determine how to allocate investments.

Basic research that has promising commercial application will attract private investment. Some of those investments will succeed, and others will fail. But when private money is spent, benefits and losses will be assigned to the appropriate entities, rather than the taxpayer. The objective for Congress and the federal government is to fund basic research that meets national objectives and create the proper pathway for DOE laboratory researchers to push basic research out to the market and the private sector to tap into the expertise housed at America's national labs.

Some research conducted by the DOE may never have commercial application but we should not view those programs as failures because commercial application should never be the objective. Programmatic success should be determined by whether or not the program meets the established government need or national objective. Value exists in

national objectives that advance scientific discovery or is critical to meeting government needs and priorities. Granted, there is spending within EERE that the private sector might not undertake on its own but that does not mean the federal government needs to fill the gap. Even if that research qualifies as basic, government spending should not establish a specific roadmap to commercialization.

A legitimate government function exists for saving energy within the federal government because the government as energy consumers do not face the same incentive structure as families and businesses. But those programs should be carried out in a technology-neutral manner to ensure the purpose is energy savings and reducing the cost to the taxpayer, not meeting a political agenda. Additionally, the office can also play a role in assisting with collecting information, for instance, assisting in voluntary energy-information programs like EnergyStar, and reducing true market barriers created by unnecessarily onerous permitting and regulatory days.

The following testimony dissects the EERE budget in four sections: alternative transportation fuel technologies, alternative electricity technologies, advanced manufacturing and energy efficiency spending, and federal energy use.

America does not need a "man on the moon"–style mission for energy because the country has a diverse mix of energy suppliers to competitively price energy and provide families and businesses with choices. When energy markets do not operate efficiently, it is largely because of government meddling, either through blocked access, burdensome regulations or an array of market-distorting subsidies. True reforms that lay the framework for renewable energy technologies (and all energy technologies) to succeed and to achieve the goals EERE sets will not come from more government spending, but instead free-market reforms that create a competitive economic environment.

Alternative Fuels: Vehicle, Bioenergy, Hydrogen, and Fuel Cell Technologies

The President's budget request bemoans the fact that Americans have been sending billions of dollars overseas to buy oil and that oil volatility impacts household budgets (although it ignores that we receive a useful commodity in return). Therefore, the budget recommends using taxpayer dollars to "replace conventional fuels with cost competitive domestically produced alternatives and use conventional fuels more efficiently."[1] Spending initiatives include: attempting to lower the costs of alternative fuels, improving electric vehicle battery life, accelerating alternative fuel infrastructure, using more natural gas in transportation, improving heavy-duty engine efficiency, among others. Both the reasoning behind the vehicle technologies program and the activities in which the government spends taxpayers' dollars is not in the government's purview and leads to a profound misuse of taxpayer dollars for the following reasons:

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[1]U.S. Department of Energy, *FY 2016 Congressional Budget Request. Volume 3*, February 2015, http://www.energy.gov/sites/prod/files/2015/02/f19/FY2016BudgetVolume3_7.pdf (accessed March 20, 2015).

The Incentive for Alternative Fuel Technologies Already Exists. Oil's dominance as a transportation fuel is not because a government program is lacking or because more taxpayer investments are needed to jumpstart a transformation in the fuel industry. It is because oil is the most efficient and economic source of transportation fuel, even when oil prices were high. Americans spend approximately a billion dollars a day on gasoline and in many cases more than that.[2] Globally, the transportation fuels market is a multi-trillion-dollar one. If any alternative fuel technology captured a mere slice of that market, it would capture billions of dollars in profit annually. The market demand for transportation fuel is incentive enough to spur competition in the industry. Breaking into this market is not a problem of the so-called valley of death where good ideas are not able to attract substantial investment. It is a valley of wealth waiting to be had. Any viable technology that competes with the internal combustion engine will not need help from the federal government. This is why, for example, more heavy-duty trucks are fuel switching to natural gas.

The Auto and Trucking Industries Are Well Aware of Fuel Efficiency. The budget request includes funding to "award new cost-shared projects with industry under the SuperTruck II Initiative to develop technologies to improve the freight hauling efficiency of heavy-duty Class 8 long-haul vehicles by 100 percent in 2020, compared to a 2009 baseline vehicle."[3] Auto manufacturers and the freight and long-haul transportation industry understand the importance of fuel efficiency. Nearly 3 million heavy-duty Class 8 trucks carry approximately 70 percent of America's freight, consuming more than 50 billion gallons in fuel and spending more than $140 billion in diesel costs.[4] The industry operates on razor-thin margins and plans its driving routes down to the tenth of a mile to save on fuel costs. Companies are driven to invest in innovative technologies or alternative fuel to lower costs when it makes sense for them to do so. Of course, the industry will support such programs, whether paid outright by the taxpayer or cost-shared with the taxpayer, because it substantially reduces their risk. The spending will offset private-sector money that would be spent if the idea was worthy of investment. But even if the program fails, industry is willing to take a chance because the taxpayers cover a share of the loss.

Oil Price Volatility Does Not Justify Government Intervention. Many subprograms within the Vehicles Technologies program spend money to address economic concerns stemming from oil price volatility. Oil price volatility is no reason for government intervention through spending in the DOE. Markets adapt to changes in resource demand and supply through the price mechanism. If vehicles powered by natural gas, electricity, or biofuel became economically competitive, consumers would respond, and alternative-fuel vehicles and necessary supporting infrastructure would be built.

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[2]Philip Bump, "Americans Are Spending More than $2 Billion Less a Week on Gas than This Time Last Year," *The Washington Post*, January 13, 2015, http://www.washingtonpost.com/blogs/the-fix/wp/2015/01/13/americans-are-spending-over-2-billion-less-a-week-on-gas-than-this-time-last-year/ (accessed March 20, 2015).

[3]U.S. Department of Energy, *FY 2016 Congressional Budget Request, Volume 3.*

[4]American Trucking Association, Reports, Trends & Statistics, http://www.trucking.org/News_and_Information_Reports_Energy.aspx (accessed March 20, 2015).

One example within EERE is the Bioenergy Technologies program, which is pushing to make advanced biofuels cost-competitive with conventional gasoline at $3 per gallon.[5] The goal for hydrogen from renewable resources is $4 per gallon of gasoline equivalent.[6] However, as the country has experienced over the past several months, gasoline prices could be well below that for a long period of time. How does the federal government know $3 will be the magic price point at which alternative fuels become competitive in the marketplace? What prevents these sources of energy from becoming volatile? Market analyses and government projections may deem that the appropriate price point, but unpredicted drop in oil prices indicates just how unreliable future cost projections are and, importantly, how unpredictable markets are. Furthermore, fuel prices in much of Europe were $8 equivalent for an extended period of time and there was no massive fuel-switching; even at such high prices, oil-based fuels served as the most affordable and reliable fuel. Even if $3 or $4 does change the market for alternative fuels, businesses are much better equipped and flexible to deal with changing economic circumstances. Most importantly, the private sector is the one that should be responsible for innovating to lower costs.

Markets Solve the Chicken-and-Egg Problem. A common argument for federal spending is not only technology validation to reduce the risk for private investment, but also spending on the infrastructure necessary to support those alternative sources. Proponents of such spending initiatives argue that consumers will not buy the cars if they have no place to re-charge or re-fuel them, thus creating a chicken-and-egg problem. However, markets and economically viable technologies overcome the chicken-and-egg problem all the time. Consumers would not buy diesel cars without diesel pumps, nor would they buy cell phones without cell phone towers. Neither needed massive government spending programs to get them off the ground, nor does their commercial success come from a technology-specific initiative.

Renewable Electricity: Solar, Wind, Water, and Geothermal Energy

Through direct government spending, grants, loan guarantees, and targeted tax credits, the federal government has spent billions of dollars to integrate more renewable energy into America's electricity mix with little to show for it. Wind and solar technologies supply only 6.5 percent of the nation's electricity generation.[7] In attempts to boost solar, wind, geothermal, and hydropower's place in the market, the federal government extends well beyond basic research to promote the development of specific technologies. Even the so-called basic R&D has the end goal of reducing costs for these energy sources. Policymakers should recognize that:

Cost Reduction Is Not a Federal Government Role. The role of the federal government should not be to reduce the costs of technologies or sources of energy, yet many programs within the EERE explicitly state cost reduction and performance improvement as objectives. For instance, the DOE's SunShot Initiative launched in 2011 and mirrored

[5]U.S Department of Energy, *FY 2016 Congressional Budget Request, Volume 3.*
[6]Ibid.
[7]Ibid.

after President Kennedy's man-on-the-moon mission aggressively pursues a goal of cutting the cost of solar-energy technology by 75 percent by 2020. The budget request states that "[r]educing the total installed cost for utility-scale solar electricity to roughly 6 cents per kilowatt hour without subsidies will result in rapid, large-scale adoption of solar electricity across the United States." The statement is fundamentally oxymoronic. The SunShot Initiative is itself a huge government subsidy, spending hundreds of millions of taxpayer dollars a year to reduce the cost of solar. Government has no business trying to make private-sector projects cost-competitive or improving a technology's reliability to make it more palatable for private investors and financiers. Furthermore, the government is not very good at it compared to those industries that have skin in the game. How many times have we heard from the DOE that an economically viable alternative-energy source was "just around the corner"? Years later and billions of taxpayer dollars squandered, the technology is still just around the corner.

The same is true for the DOE's Wind Energy Program and the "Atmosphere to Electrons" initiative to reduce costs for onshore and offshore wind. Nor is it the responsibility of taxpayers to pay for programs that provide cost projections for wind and conduct economic feasibility analyses. Congress should eliminate these activities for all alternative electricity technologies.

Such wasteful spending is not unique to the EERE; Congress should eliminate similar spending activities for nuclear or conventional electricity sources such as coal and natural gas. It is neither appropriate nor necessary; furthermore, the government is not the best vehicle to take on the risks when there are potential profits to be had.

Much like transportation, the market for electricity already exists and is not going anywhere any time soon. Residential energy expenditures averaged $750 per person in 2012.[8] Americans paid more than $350 billion in retail electricity and more than $1.35 trillion in total energy expenditures for the same year.[9] The opportunity to provide electricity is a multi-trillion-dollar market with more than a billion people without reliable electricity who desperately want it. President Obama's budget request cites a Navigant Research study that says the global market for small wind farms will double to 180 megawatts from 2013 to 2018. Similarly, the budget points to tremendous potential for offshore wind, geothermal, and hydropower. If the opportunity is there, the industry, using its own money, will find ways to capture it. And if opportunities exist to form partnerships to make the entire industry competitive while protecting proprietary information, that should be done solely through private participation. The federal government does not have to be the facilitator nor does the partnership have to be public-private in nature.

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[8]Daniel Wood, "How Much Do You Spend?" U.S. Department of Energy, July 2, 2014, http://energy.gov/articles/how-much-do-you-spend (accessed March 20, 2015).
[9]U.S. Energy Information Administration, Table E8. Primary Energy, Electricity, and Total Energy Expenditure Estimates, 2012, http://www.eia.gov/state/seds/sep_sum/html/pdf/sum_ex_tot.pdf (accessed March 20, 2015).

More Spending Is Not the Path Toward Making America More Competitive. The EERE attempts to address some of the soft costs involved with renewable energy such as "financing, customer acquisition, permitting, installation, labor, inspection, and other non-hardware costs."[10] But the EERE's spending goes about addressing these issues through a top-down, federal approach and spending more money rather than addressing the underlying policy problems that could reduce the burden. For instance, the budget request for solar includes the focus area of Empowering State and Local Leaders, calling for $25.2 million to support leaders "that develop strategies and reduce the costs and barriers to solar access and that may slow deployment at the local level."[11] To the extent that is a problem, regional, state, and local leaders should address those problems; assistance does not need to come from Washington.

Another subprogram within the EERE is the Innovations in Manufacturing Competitiveness, which aims to improve U.S. competitiveness for clean energy manufacturing. Part of the program spends money to keep the American manufacturing solar supply chain competitive with companies in other nations. There are three problems with this line of thinking: (1) we are unlikely to outspend countries like China; (2) even if the United States would outspend other countries, it would be wasteful and ignores the real policies that make American less competitive; and (3) the United States is not going to have a competitive advantage in every product in the world. If it makes sense to import a product or technology at a lower cost, consumers in the U.S. are made better and it frees up resources to be more productive elsewhere in the economy.

Advanced Manufacturing, Building Technologies, and Weatherization

A significant portion of the EERE's budget allocates money toward advanced manufacturing technologies, improving energy efficiency in residential and commercial buildings, and weatherizing homes to save homeowners money on their energy bills. These activities typically enjoy bipartisan support because the promotion on American manufacturing and the enticement of saving families and businesses money makes these spending initiatives appear to be win-win. The reality, however, is that manufacturers both large and small are driven to provide consumers with better products at lower costs, leading to dramatic improvements in energy consumption per dollar of gross domestic product. Families and businesses have the wherewithal to make energy-saving investments with their own money and when they choose not to, they are making that choice after weighing preference and trade-offs. When discussing energy efficiency it is important to note that:

Manufacturers, Builders, and Families Know Energy Is a Significant Cost. The EERE's goal of supporting American manufacturing and making America's energy-intensive industries more competitive is a laudable one. But the solutions are not found in taxpayer-funded programs. Manufacturers know that energy is a significant input cost and will innovate to find ways to lower their costs and gain any competitive advantage they can. Companies will make these investments if they believe that the technology is

[10]U.S. Department of Energy, *FY 2016 Congressional Budget Request, Volume 3.*
[11]Ibid.

promising, worth the risk, and the best use of their investment dollars. Instead, the DOE's Advanced Manufacturing Office provides nothing more than corporate welfare. For instance, past grant recipient companies have included LyondellBasell—one of the largest chemical companies in the world—and Dow Chemical—which had $57 billion in sales in 2013 and invests over $1 billion annually in research and development.[12] Even if the EERE does not allocate grants or funds to specific companies, the general spending on materials, structures, chemical processes and machinery to reduce technical uncertainty and reduce risk for the private sector is a misappropriation of taxpayer monies.

Markets Will Provide Better Buildings, More Efficient Homes. The EERE provides money to reduce energy consumption in commercial and residential buildings through spending on innovative materials for the structure and windows or attempting to approve efficiency in technologies such as HVACs, water heaters, air conditioners, and appliances like washers and dryers. In addition, the EERE's weatherization assistant program supplies grants to retrofit homes to reduce energy consumption and worker training programs to provide the necessary support to weatherize the homes. The argument for subsidized worker-training programs is not just that without the trained expertise the construction industry will lack the necessary labor force to identify energy savings and build more energy-efficient homes and buildings. The argument also rests on the assumption that the federal government is the best institution to incentivize that training. Proponents of such an approach either lack an understanding of how industries generate workforces, or acknowledge that the efficiency gains they are advocating do not have much market value. What is clear is that they understand how it is easy to get the federal government to pay for state, local, or private-sector needs.

Whether federal handouts are distributed at the federal level or funneled down to the state and local communities, the government should not be in the financing or banking business. The fact is that if efficiency improvements really saved that much money, and if demand for more energy-efficient buildings and manufacturing processes existed, these programs would not be necessary. The private sector expands and trains workers appropriately to meet demand or capture more opportunities and will make those investments with its own resources. For example, there are already "energy home audits"—services that identify how homes could save energy—and companies that sell energy-efficient windows and other technologies for commercial and institutional buildings, which should be the ones training the workers. Those who invest wisely today will be the ones best positioned to take advantage of any emerging markets in the future. The federal government's involvement distorts that risk, or makes investments for a market that would otherwise not exist, and with insufficient demand, these subsidies will be a serious waste of taxpayer money.

Taxpayers already experienced the inability of the federal government to create a market through the green-jobs training programs funded in the stimulus. When the government doled out billions of dollars in the stimulus bill to make homes more energy efficient,

[12]The Dow Chemical Company, "Our Company," http://www.dow.com/company/index.htm (accessed March 20, 2015), and The Dow Chemical Company, "Research and Development," http://www.dow.com/michigan/locations/midmichigan/research.htm (accessed March 20, 2015).

shoddy workmanship requiring follow-up work, uncompetitive bidding, poor record-keeping, and overpriced energy-efficient light bulbs and carbon-monoxide detectors became commonplace across the U.S.[13] A September 2011 Department of Labor Office of Inspector General report found that "grantees have expressed concerns that jobs have not materialized and that job placements have been fewer than expected for this point in the grant program."[14] A follow-up report released in October 2012 found that the program fell well short of its retention goal of 71,017 workers (only 16 percent of participants remained employed longer than six months); much of the training was delivered to already employed workers and was not necessary for them to perform their jobs.[15] The same report also found that more than 20 percent of training certificates went to workers who had only one day of training, and 47 percent received five or fewer days of training.[16] Job-training programs may score political points for politicians who like to point to the jobs they "created" at election time, but they are a needless waste of taxpayer money.

Manufacturers Have Preferences, Constraints, and Trade-offs to Consider. Supporters of energy-efficiency mandates and subsidies argue that, by failing to realize all of their possible energy savings, manufacturers are virtually throwing away money. Plenty of engineering analyses support the idea that an "efficiency gap" exists and investments will yield substantial savings.[17] But there are several problems with these engineering analyses of energy investments. The most glaring problem with many of these engineering analyses is that they fail to take into account the costs of the paternalistic role of the federal government. That is, when the government forces efficiency measures on people, it takes away choices, or at the very least, overrides them. When firms are not spending money for the most energy-efficient technology, it is not that they are acting irrationally; they simply have other preferences, budget constraints, and other ignored costs such as comfort, convenience, and product quality. A business very well knows that investing in a more energy-efficient technology will save energy in the long run, but they may choose to spend money on hiring more employees or allocating those resources elsewhere.

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[13]See, for instance, U.S. Department of Energy, Office of Inspector General, "Audit Report: The State of Illinois Weatherization Assistance Program," October 2010, http://energy.gov/sites/prod/files/igprod/documents/OAS-RA-11-01.pdf (accessed May 16, 2013), and U.S. Department of Energy, Office of Inspector General, "Examination Report: Cuyahoga County of Ohio Department of Development—Weatherization Assistance Program Funds Provided by the American Recovery and Reinvestment Act of 2009," September 2011, http://energy.gov/sites/prod/files/OAS-RA-11-19.pdf (accessed March 19, 2015).

[14]U.S. Department of Labor, Office of Inspector General, "Recovery Act: Slow Pace Placing Workers into Jobs Jeopardizes Employment Goals of the Green Jobs Program," September 30, 2011, http://www.oig.dol.gov/public/reports/oa/2011/18-11-004-03-390.pdf (accessed March 19, 2015).

[15]U.S. Department of Labor, Office of Inspector General, "Recovery Act: Green Jobs Program Reports Limited Success in Meeting Employment and Retention Goals of June 30, 2012," October 25, 2012, http://www.oig.dol.gov/public/reports/oa/2013/18-13-001-03-390.pdf (accessed March 19, 2015).

[16]Ibid.

[17]McKinsey & Company, "Unlocking Energy Efficiency in the US Economy," July 2009, http://www.mckinsey.com/client_service/electric_power_and_natural_gas/latest_thinking/unlocking_energy_efficiency_in_the_us_economy (accessed July 29, 2013).

In fact, studies have shown that manufacturers will reject about half of the energy-efficiency projects recommended by engineering analyses because of unaccounted physical costs, risks, opportunity costs, lack of staff of implementation, risk of inconvenience to personnel, or suspected risk of problems with the equipment.[18] Other problems with efficiency spending for businesses include questions about the cost of the upfront investment, the payback horizons, overstated energy savings, and predictions of future energy prices, all of which play an important role in the actual savings realized from investments and make families and businesses skeptical of efficiency upgrades.[19]

Federal Energy Management Program: Opportunity for Savings, not for a Political Agenda

President Obama's budget request highlights that the federal government is America's largest energy consumer, spending $24 billion on energy.[20] While the government's energy use comprises only 1.7 percent of the nation's total energy consumption, opportunities exist to reduce that consumption and save taxpayers money. Improving energy efficiency in the federal government can save taxpayer dollars when done appropriately, but those investments should remain technology neutral and does not need to be housed within the EERE. Whereas the government has less incentive than businesses and homeowners to save money, energy-efficient investments can make economic sense for the taxpayer.

Nonetheless, those investments should not be made to advance a renewable energy or climate agenda—they should be done on the merits of reducing energy costs and on improving capabilities. However, this is clearly not the case. For example, Executive Order 13423 requires federal agencies to achieve goals such as increasing the "use of alternative fuel consumption by at least 10 percent annually, compared to an FY 2005 baseline," and increasing the "purchase of alternative fuel, hybrid, and plug-in hybrid vehicles when commercially available."[21]Though required mandates originate from legislation or executive orders and not the EERE, Congress should eliminate any technology-specific requirements or mandates.

Additionally, Congress should do more to ensure that these efficiency upgrades are actually saving money. Today, an energy service company (ESCO) will identify potential savings for a federal agency and enter into an energy savings performance contract (ESPC). The ESCO guarantees the cost savings, and those cost savings pay for the service rendered by the ESCO with additional cost savings after completion of the

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[18]Hunt Allcott and Michael Greenstone, "Is There an Energy Efficiency Gap?" *Journal of Economic Perspectives*, Vol. 26, No. 1 (Winter 2012), pp. 3–28.
[19]Ibid., and Lucas Davis, "Evaluating the Slow Adoption of Energy Efficient Investments: Are Renters Less Likely to Have Energy Efficient Appliances?" Energy Institute at Haas *Working Paper* No. 205, June 2010, http://ei.haas.berkeley.edu/pdf/working_papers/WP205.pdf (accessed July 29, 2013).
[20]U.S. Department of Energy, *FY 2016 Congressional Budget Request, Volume 3*.
[21] U.S. Environmental Protection Agency, "Strengthening Federal Environmental, Energy, and Transportation Management," Executive Oder No. 13423, January 24, 2007, http://www.epa.gov/oaintrnt/practices/eo13423.htm (accessed March 20, 2015).

contract accruing to the federal agency.[22] While ESPCs have lowered energy use and saved taxpayers money, the Government Accountability Office and the DOE's Inspector General (IG) have outlined problems with ESPCs, including lack of reliable data, failure to verify savings, failure to protect agency interests, and agencies paying ESCOs even though no energy savings had been realized.[23]

A Better Path Forward from Research to Marketplace

The criticism of the EERE and spending on specific technologies with the goals of cost reduction, commercialization, and risk reduction is not to say, however, that the federal government does not have a role in technology development or that innovative technologies and commercial products cannot emerge from federal research. Proponents of government spending promise the next Internet, but deliver Solyndras instead. That is because there is a stark difference between how the Internet became commercially viable versus attempts to commercialize energy technologies.

Advocates of government spending on technology-specific activities tout the federal government's involvement in commercial successes such as the Internet, computer chips, and the global positioning system (GPS). But none of these was initially intended to meet a commercial demand; they were developed for national security needs. Entrepreneurs saw an opportunity in these defense technologies and created the commercially viable products available today. The role of the DOE should be to conduct the basic research to meet national objectives that the private sector would not undertake and create a system that allows the private sector, using private funds, to tap into that research and commercialize it. Federal labs should allow basic research to reach the market organically.

A current challenge to transferring research from government labs to the market is cultivating a better relationship between the labs and industry. Connecting the two so that industry can use lab resources with their own money to do research, identify new commercialization opportunities, or enhance or develop a product would drive innovation and economic growth. Members of Congress have taken steps to address such challenges through the Senate's INNOVATES Act and the House of Representatives' Department of Energy Laboratory Modernization and Technology Transfer Act of 2014.[24]

Address Cost and Competitiveness Concerns Through Free Markets

Opportunities exist to implement market reforms that would allow renewable energy companies and all other energy technologies to be more competitive and operate on a level playing field. Free-market reforms that address poor tax policy, inadequate access to capital, burdensome environmental regulations, and labor regulations would do much

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[22]U.S. Department of Energy, Federal Energy Management Program, "Energy Savings Performance Contracts," http://www1.eere.energy.gov/femp/financing/espcs.html (accessed March 20, 2015).
[23]Ibid.
[24]Nicolas Loris and Katie Tubb, "Six Easy Energy Reforms for Congress to Take Up," Heritage Foundation *Backgrounder* No. 2981, December 8, 2014, http://www.heritage.org/research/reports/2014/12/six-easy-energy-reforms-for-congress-to-take-up.

more to accomplish the EERE's objectives of cost and risk reduction and the creation of a competitive manufacturing sector with a vibrant labor supply.[25]

For instance, America is experiencing a manufacturing resurgence, but not because of a government program or generous taxpayer-funded initiatives. Entrepreneurs and energy producers sparked a shale gas revolution that has dramatically lowered input costs. American manufacturers and chemical and industrial companies are flocking to the United States and citing cheap natural gas as the reason why. Imagine the growth if Congress and the federal government implemented free-market tax, labor, energy, and regulatory reforms.

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[25]David, Burton, testimony before the Committee on Small Business, U.S. House of Representatives, March 4, 2015, http://www.heritage.org/research/testimony/2015/building-an-opportunity-economy-the-state-of-small-business-and-entrepreneurship.

Nicolas (Nick) Loris

Herbert and Joyce Morgan Fellow, The Heritage Foundation

Nick Loris, an economist, focuses on energy, environmental, and regulatory issues as the Herbert and Joyce Morgan Fellow at The Heritage Foundation. In Heritage's Roe Institute for Economic Policy Studies, Loris researches and writes about energy prices and other economic effects of environmental policies and regulations. He also articulates the benefits of free-market environmentalism. Loris has been published and quoted in such publications as The Wall Street Journal, The New York Times, The Washington Post, Investor's Business Daily and The Baltimore Sun. His radio and television appearances include MSNBC, Fox News Channel, CNN and National Public Radio.

He is a prolific contributor to "The Daily Signal," Heritage's rapid-response policy blog. Loris was a policy analyst specializing in energy and environmental issues such as the Keystone XL pipeline in spring 2012 when he was named to succeed Ronald Utt, a retiring Roe Institute colleague, as Morgan Fellow. "Nick's work on energy has been crucial to advancing understanding of the need for reliable supplies of domestic energy, unfettered by reams of government red tape," Heritage President Edwin J. Feulner said. The fellowship was endowed by retired real estate developer Herbert Morgan and his late wife, Joyce, of Arlington, Va., longtime proponents of free enterprise and limited government.

Before joining Heritage in June 2007, Loris was an associate at the Charles G. Koch Charitable Foundation, immersing himself for a year in a market-based management program. Loris received his master's degree in economics from George Mason University in Fairfax, Va. He holds a bachelor's degree in economics, finance, and political science from Albright College in Reading, Pa.

Chairman WEBER. Thank you, Mr. Loris.
Ms. McCormick?

**TESTIMONY OF MS. RUTH MCCORMICK,
DIRECTOR OF FEDERAL AND STATE AFFAIRS,
BUSINESS COUNCIL FOR SUSTAINABLE ENERGY (BCSE)**

Ms. MCCORMICK. Thank you for the opportunity to testify today. My name is Ruth McCormick, and I am the Director of Federal and State Affairs for the Business Council for Sustainable Energy. The Council is a broad-based industry trade group, representing companies and associations in the energy efficiency, renewable energy, and natural gas industries.

Over the past several years, the United States has seen real market penetration of a wide range of sustainable energy technologies and resources, and we have witnessed the results of policies and research and development that work, but to continue the momentum of growth in these sectors, and to receive their co-benefits, long-term, stable policies will be needed to level the playing field and to provide market access. And the United States needs to continue to invest in energy research, development and demonstration to increase the efficiency of our energy generation and use, and to spur new innovations. This is important both for domestic economic growth and for U.S. competitiveness in global energy markets.

I would like to focus my testimony in two areas. First, I would like to share some of the findings from the recently released 2015 edition of the Sustainable Energy in America Fact Book. The fact book was researched and produced by Bloomberg New Energy Finance, and commissioned by the Business Council for Sustainable Energy. It is intended to be a resource for policymakers with up-to-date market information.

The second area I would like to discuss is the valuable and effective role that federal investments in the energy sector have played, and should continue to play, in the availability of new innovative energy technologies and practices.

The fact book points to the dramatic changes underway in the U.S. energy sector. The data shows that traditional energy sources are declining, and natural gas, renewable energy, and energy efficiency are on the rise. These changes are increasing the diversity of the country's energy mix, improving our energy security, cutting energy waste, increasing our energy productivity, and reducing air pollution and greenhouse gas emissions. While technology costs have fallen, market barriers and grid integration challenges continue to hinder greater use of clean energy technologies. To continue the momentum of growth, long-term, stable policies will be needed to level the playing field and to provide market access to new technologies.

Electricity markets are evolving, and the U.S. power sector, long organized around large, centralized systems, is considering distributed power options such as combined heat and power, waste heat to power, small scale renewables, and fuel cells. Other changes are also occurring in the U.S. energy sector, including the introduction of smart grid technologies for improving grid management, and a

growing role for dispatchable resources such as natural gas plants, hydropower, and demand response.

Many market structures do not yet fully recognize the benefits of some of the technologies, such as energy storage, or best practices, which allow for increased flexibility of the grid. For this reason, BCSE strongly supports the continued funding of basic and applied research for clean energy technologies. This must be balanced with work on commercialization, market transformation, and other efforts to ensure that products do not sit on laboratory or university shelves, but are transferred to the private sector to achieve the intended public benefit.

There are strong analytical findings that show the overall return on federal investments in this area. For example, 3 decades of investment in extraction of natural gas from shale has led to low natural gas prices, saving households and businesses money, attracting new industrial manufacturing opportunities in the United States, and helping to create U.S. jobs. As a result of energy efficiency policies and investments, total energy use in the United States is down 2.4 percent since 2007, while gross domestic product has grown eight percent. The cost of solar PV models has fallen more than 80 percent since 2007. Thirty-two percent of new electric generating capacity came from solar in 2014, and the industry now employs nearly 175,000 workers, more than tech giants Google, Apple, Facebook and Twitter combined. These are just a few examples. The energy sector involves technologies that have been transformed over the course of more than a century, and it is critical that the U.S. Government continue to invest in advancements.

Council members look forward to working with this Committee and the federal government to ensure that public investments in these sectors are highly leveraged, effective and efficient in carrying out the intended policy aims.

Thank you.

[The prepared statement of Ms. McCormick follows:]

Ruth McCormick, Director, Federal and State Affairs

Business Council for Sustainable Energy

Testimony before the House Committee on Science, Space and Technology

Subcommittee on Energy

Hearing on Department of Energy Oversight: Office of Energy Efficiency and Renewable Energy

March 24, 2015

Chairman Weber, Ranking Member Grayson, and Subcommittee Members, thank you for the opportunity to testify today.

My name is Ruth McCormick, and I am the Director of Federal and State Affairs for the Business Council for Sustainable Energy.

The Council is a broad-based industry trade group representing companies and associations in the energy efficiency, natural gas and renewable energy industries. Its membership includes independent electric power producers, investor-owned utilities, public power, commercial end-users, equipment manufacturers, project developers as well as service providers for energy and environmental markets. Since 1992, the Council has been a leading industry voice advocating for policies at the state, national and international levels that increase the use of commercially-available clean energy technologies, products and services.

I have been asked to address the Council's view about the value of the research, development, demonstration, deployment (RDD&D) and commercialization activities funded through the Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE) and the impact of DOE's clean energy technology programs, including those at EERE, on the energy marketplace. This subcommittee has a significant role to play in overseeing the country's strategic energy investments, which have contributed to the development and deployment of highly valuable energy technologies and resources that underpin the United States economy.

Over the past several years, the United States has seen real market penetration of a wide range of sustainable energy technologies and resources and we have witnessed the results of policies that work. But there is more work to be done.

To continue to the momentum of growth in these sectors, and to receive their co-benefits, long-term, stable polices will be needed to level the playing field and to provide market access to new technologies. We also need continued investment in energy research, development and deployment to increase the efficiency of our energy generation and use, and to spur new innovations. This is important for domestic economic growth and for U.S. competitiveness in global energy markets.

I would like to focus my testimony on two areas. First, I would like to share some of the findings from the 2015 edition of the *Sustainable Energy in America Factbook*.[1] The *Factbook* was researched and produced by Bloomberg New Energy Finance and commissioned by the Business Council for Sustainable Energy. It is a quantitative and objective report, intended to be a resource for policymakers with up to date, accurate market information. Its goal is to offer important benchmarks on the contributions that sustainable energy technologies are making in the United States energy system today. It also provides information on finance and investment trends in clean energy resources.

The second area I would like to discuss is the valuable and effective role that federal government investments in the energy sector have played, and should continue to play, in the availability of new, innovative energy technologies and practices. These investments in the form of research, development and deployment initiatives as well as federal tax incentives have expanded the energy technologies and resources available for the nation, while helping to lower energy costs for businesses and consumers, and create hundreds of thousands of jobs in the United States. As a neutral player, rather than one with a financial interest, DOE can help analyze policy options for deploying new energy technologies and their potential impacts on the grid. In addition, DOE can help streamline the processes of permitting, inspection, and interconnection of new energy technologies. DOE should continue to dedicate resources and increase prioritization of this effort.

Sustainable Energy in America Factbook Findings

Some of the most significant findings from the *Sustainable Energy in America Factbook* point to the dramatic changes underway in the United States energy sector over the past several years. Traditional energy sources are declining, while natural gas, renewable energy, and energy efficiency are playing a larger role.

These changes are increasing the diversity of the country's energy mix, improving our energy security, cutting energy waste, increasing our energy productivity and reducing air pollution and greenhouse gas emissions.

Behind this change are a portfolio of new energy innovations, technologies, and applications. These include: newly applied techniques for extracting natural gas from shale rock formations; lower-cost and higher-efficiency photovoltaic panels for converting sunlight to electrons; highly efficient, natural gas end-use applications; natural gas vehicles and battery and fuel cell electric vehicles; and 'smart meters' that allow consumers to monitor, modulate, and cut electricity consumption, among others.

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[1] 2015 edition of *the Sustainable Energy in America 2013 Factbook,* February 2015, http://www.bcse.org/sustainableenergyfactbook

The *Factbook* looks at a broad spectrum of sustainable energy technologies and provides data on a wide range of clean energy industries including natural gas, renewable energy sources (including solar, wind, hydropower, geothermal, biomass, biogas and waste to energy – but excluding liquid biofuels), stationary fuel cells and other distributed technologies, as well as energy efficiency.

The *Factbook* also aims to fill data gaps. For example, data sources and economic models of the United States energy industry often fail to capture the full contribution of sectors such as distributed generation. The *Factbook* seeks to accurately quantify some sectors that are currently small, but growing.

Recent Changes in the U.S. Energy Sector

The United States economy is becoming more energy productive and less energy intensive. By one measure—United States gross domestic product (GDP) per unit of energy consumed—productivity has increased by 54% since 1990. Between 2007 and 2014, total energy use fell 2.4%, while GDP grew 8%. This was driven largely by advances in energy efficiency in the transportation, power generation and buildings sectors.

While energy demand has fallen more steeply than it has in at least 50 years, the use of natural gas and renewable energy has increased. Natural gas provided the United States with 28% of its total energy supply in 2014, and renewable energy is supplying 9.7% of U.S. energy. Natural gas-fired power plants provided 27% of U.S. electricity in 2014, up from just 22% in 2007. Renewable energy generation has meanwhile grown from 8.3% to 12.9% between 2007 and 2014.

The United States energy sector is witnessing structural changes in its infrastructure that reflect its low-carbon transformation: the retirement of high-emissions power plants, the build-out of new natural gas pipelines, advances in a smarter grid, and growing interest in distributed generation from rooftop photovoltaics, fuel cells and combined heat and power (CHP).

The commercial and industrial sector is demonstrating a continued appetite for CHP (about 700 megawatts (MW) per year since 2009) as well as interest in microgrids.

Market Dynamics

The cost to deploy many clean energy technologies is falling while new business models for financing and technology innovation are accelerating deployment.

The technology innovations in the natural gas sector that have opened up new supply from shale gas production have lowered natural gas prices and have resulted in 2014 being a record year for both natural gas production, which has increased by 25% since 2007, and consumption.

The United States economy is becoming more energy-productive and less energy intensive—with efficiency improvements in buildings, and transportation breaking new ground. Smart

meters have been deployed to 39% of electricity consumers, increasing their ability to make decisions on when and how to use energy.

Renewable energy is a prominent part of the United States capacity mix, with 205 gigawatts (GW) installed across the country. For example, wind and solar have more than tripled in capacity since 2008. Hydropower is the largest source of the United States' renewable energy at 79 GW (excluding pumped storage). Biogas, biomass, geothermal and waste-to-energy, represent 17 GW of capacity in the United States and can provide power 24/7. While these technologies have comparable economics in terms of unsubsidized costs, they have lacked access to the same incentives as the fast-growing sectors.

The Impact of Policy on Renewable Energy and Energy Efficiency Growth

Stable, long-term policies at state and federal levels that provide a level playing field and enable market access, combined with targeted investments in research, development and deployment, are needed to sustain the growth in clean energy sectors.

Though the levelized costs of electricity of many renewable generation technologies have fallen drastically, most of these technologies still rely on incentives to compete. State-level mandates have been important drivers for renewable growth in the United States, though in the case of most states, targets for the next several years have already been satisfied and uptake in energy efficiency policies has been slowing.

DOE works to address 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. These efforts can help these technologies to the edge of widespread market adoption and should be continued.

Grid Modernization, Reliability and Resiliency

Ensuring ongoing grid reliability will become a growing concern for electricity market operators and regulators. Dynamics contributing to this focus include declines in the use of coal, the impacts of severe weather events and the increased presence of variable energy resources on the electricity grid. Yet other changes are occurring – including reduced electricity demand through energy efficiency; the introduction of smart grid technologies for improved grid management; and the growing role for distributed generation from stationary fuel cells and other technologies for back up or base load power, as well as dispatchable resources such as natural gas plants, hydropower, and demand response – that can help the electricity industry meet these challenges. Still, many market structures do not yet fully recognize the benefits of some of the technologies offering increased flexibility, such as energy storage.

Given these factors, research, development and deployment (RD&D) investments are needed in this area to improve efficiency, demonstrate performance and spur new innovations that will be required to meet the evolving needs of the power grid. For example, investment being made in smarter and more efficient technologies such as voltage sensors can help utilities better pinpoint what is happening on the grid and speed power restoration efforts when outages occur.

Federal Investments in Research, Development and Deployment Foster U.S. Competitiveness, Energy Security

BCSE strongly supports the continued funding of basic and applied research and development for clean energy technologies. This must be balanced with work on commercialization, market transformation and other efforts to ensure that products do not sit on laboratory or university shelves, but are transferred to the private sector to achieve the intended public benefit of the research and development.

While DOE is primarily a research and development institution, it is uniquely positioned to address barriers in the marketplace that inhibit the successful deployment of clean energy technologies and should dedicate significant resources to these market efforts, especially for technologies that are ready to progress out of the "innovators" area of the technology adoption cycle and into "early majority" stage.

There are strong analytical findings that show the overall return on investment that has resulted in federal energy RD&D investments. This jump starts private sector innovation, which is critical to our long-term economic growth, energy security, and international competitiveness. DOE has supported effective programs, many in partnership with the private sector, that have resulted in the availability of new, more efficient energy technologies.

DOE's programs are helping to drive new investments and the United States has become one of the most attractive markets in the world for companies whose operations entail significant energy-related costs. At 6.87¢/kWh, the retail price of electricity for the industrial sector in the United States is lower than that in other major economies, such as Europe, China and Mexico.

In our current constrained budgetary environment, support for energy RD&D might be questioned. In response, I would argue that the energy sector, like the transportation sector for example, involves technologies that have been transformed over the course of a century. Just as the government should not stop investing in automotive research & development (R&D) – improving fuel efficiency and economy, safety, incorporating new materials, etc., it is critical that the federal government continue to investment in advancements in the energy sector.

Sustainable Energy RD&D Investments

Natural Gas

The technological advances allowing for the low cost extraction of natural gas from shale occurred due to more than three decades of federal government investment in research, demonstration, and production. According to a 2011 Breakthrough Institute report, both directly and indirectly, the government supported critical moments and tools in the shale gas revolution – massive hydraulic fracking (MHF), 3-D mapping, horizontal drilling, and horizontal wells.[2] This technological advancement offers the potential for stable natural gas prices in the $4 to $6 MMBtu range.[3] At these price ranges, natural gas has the potential to provide an abundant, clean and domestic fuel source for direct use applications, transportation and power generation.

Related to this, DOE should consider undertaking more RD&D into efficient natural gas technology, ensuring that businesses and consumers utilize natural gas wisely and efficiently. Specific technology areas for increased focus would include: fuel cells, micro combined heat and power, natural gas fired cooling and heat pumps, solar/gas hybrid systems, and natural gas vehicles.

Further, in 2011, the American Gas Association, Gas Technology Institute and Navigant consulting released a white paper that offered a vision of a smart energy infrastructure integrating natural gas with electricity from multiple sources, including renewable energy. To achieve this vision, several RD&D areas were recommended. I note a few below.

- Include natural gas in advanced metering infrastructure development to optimize common infrastructure, interoperability and cross-compensation among all utility infrastructures including electricity and water;
- Ensure that future federal funding programs including Smart Grid encourage and allow the use of funding for dedicated natural gas projects and combined electric/natural gas projects; and
- Increase governmental funding for basic as well as applied research in natural gas safety and reliability and smart energy infrastructure technology.[4]

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[2] *Where the Shale Gas Revolution Came From: Government's Role in the Development of Hydraulic Fracturing in Shale,* Michael Shellenberger, Ted Nordhaus, Alex Trembath, Jesse Jenkins, Breakthrough Institute, May 23, 2012. http://thebreakthrough.org/index.php/programs/energy-and-climate/where-the-shale-gas-revolution-came-from

[3] *Rethinking Natural Gas, A Future for Natural Gas in the U.S. Economy,* p. 6 , American Gas Association, © 2012, citing Source: Wood MacKenzie Spring 2012.

[4] *Natural Gas in a Smart Energy Future*, Gas Technology Institute, Navigant. January 26, 2011. http://www.gasfoundation.org/ResearchStudies/natural-gas-smart-energy-future.htm

Hydropower

The DOE Water Power Program is growing the nation's global position by funding cutting-edge research to produce the next generation of conventional hydropower and marine and hydrokinetic (MHK) technologies, and by accelerating the development of markets for those technologies. The main objectives of the Water Power Program are to improve hydropower technologies and to gather critical industry, operational and environmental impact data.

Currently, the conventional hydropower industry employs more than 300,000 workers in the United States, making it the largest renewable electricity production workforce in the nation. With the Water Power Program's goal for water power technologies to provide 15% of the nation's energy by 2030, hydropower can provide hundreds of thousands of new jobs and economic development benefits for communities.[5]

Further, increasing hydropower generation provides more clean energy megawatts to the grid, and also increases the amount of grid reliability, stability and integrations services to enhance the penetration of variable energy resources. While hydropower and pumped storage projects can provide regional and grid-scale energy storage and other ancillary services, doing so will require projects to operate in new ways and modes, and in some cases, utilize new technologies. This makes continued federal research investments vitally important.

Energy Efficiency

Policy measures have helped further the cause of energy efficiency and DOE's efficiency programs have resulted in exceptional value for American consumers and businesses, yielding benefits far beyond their nominal outlays. These programs have retrofitted over 450,000 homes in 43 states, dramatically improved the efficiency of household appliances such as refrigerators and clothes washers, and improved the quality of commercial and residential buildings across the country.[6]

On February 7, 2013, the Commission on National Energy Efficiency Policy, convened by the Alliance to Save Energy released at its Energy2030 vision. The Commission's report includes a goal of doubling energy productivity in the United States by 2030 and a set of recommendations to achieve this goal, which includes continued support of energy productivity RD&D. Achieving the goal could save $327 billion annually and add 1.3 million jobs.[7]

The Commission noted that private R&D budgets are limited in many energy efficiency sectors. Market barriers also prevent adoption and commercialization of new innovations. Thus

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[5] *Water Power for a Clean Energy Future*, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy,
http://www1.eere.energy.gov/water/pdfs/wp_accomplishments_brochure.pdf

[6] Alliance to Save Energy at http://www.ase.org/advocacy/immediate-action-needed-defend-federal-energy-efficiency-programs

[7] *Energy2030: Doubling U.S. Energy Productivity by 2030*, http://ase.org/programs/ee-commission

government support both for R&D and for a wide range of deployment programs has been critical to advances in energy productivity. Looking forward, the Commission recommends increased federal investment in basic and applied research, development, demonstration, deployment, and technical assistance at DOE, the Environmental Protection Agency, and other federal agencies. The federal government should also encourage private R&D through other policy approaches such as public-private consortia, the R&D tax credit, and supporting challenges or contests.

Building envelope assemblies including, insulating materials and air-sealing system technologies are essential to improving building efficiency. To enable mass market adoption, these next-generation technologies must maintain or improve building enclosure durability, including moisture, fire, indoor air quality, acoustic, and structural performance requirements. In the case of retrofitting existing buildings, the installation must be fast and easy so that there is minimal impact on building occupants. BCSE believes DOE should focus additional efforts to accelerate, and improve, building energy performance.

Fuel Cells

Fuel cells are a unique set of clean, efficient, and resilient energy technologies for stationary power generation, backup power, material handling equipment, and motor vehicles. Fuel cells generate electricity electrochemically, and therefore are more efficient than traditional power-generation technologies.

The industry continues to see progress in all sectors. For example, the largest stationary fuel cell project in the country was placed in service at a major utility last year. This news was followed a by series of high-profile announcements by Fortune 500 companies choosing fuel cells for their power needs, both for the positive environmental impact, and because they make a real difference on a company's bottom line.

Furthermore, warehouses and other logistic-based businesses continue to acquire fuel cell forklifts and material handling equipment to replace traditional platforms. The transition has helped businesses streamline operations, improve productivity, and make better use of warehouse space.

Automobile companies including Toyota, Hyundai, Honda, General Motors Daimler, Nissan, and BMW have invested billions of dollars in fuel cell technology, resulting in a new generation of electric vehicles that completely replicate the driving experience of today's vehicle technology. By 2016 three automobile manufacturers will offer FCEVs for sale in United States showrooms.

We also encourage DOE to expand their existing efforts to move the technology out of the laboratory and into the market place. The Department should build off of the success it enjoyed to introduce fuel cell technology in the material handling sector by leveraging state activities to encourage stationary fuel cells and hydrogen infrastructure to support fuel cell electric vehicles. This will help improve overall resiliency and continue to reduce carbon emissions from transportation.

Solar

The cost of solar photovoltaic (PV) modules has fallen more than 80% since 2007. The United States installed 6,201 megawatts (MW) of solar PV in 2014 and 767 MW of concentrating solar power to reach 20 gigawatts (GW) of total installed capacity, enough to power 4 million American homes. 32 percent of new electric generating capacity came from solar in 2014, and the industry now employs nearly 175,000 workers, more than tech giants Google, Apple, Facebook and Twitter combined.[8] This development and these lower costs can be attributed to the Investment Tax Credit and smart investments in R&D at DOE and national laboratories over the last four decades.

While solar hardware costs have fallen significantly, however, market barriers and grid integration challenges continue to hinder greater deployment. Non-hardware "soft costs," such as permitting, financing and customer acquisition, are becoming an increasingly large fraction of the total cost of a solar system. DOE can help to streamline the processes of permitting, inspection, and interconnection of solar systems. As a neutral player, rather than one with a financial interest, DOE can help analyze policy options for deploying solar and their potential impacts on the grid. EERE should continue to dedicate resources and increase prioritization of this effort.

Some are of the opinion that DOE's mission stops at the laboratory bench. This is a fallacy that if brought to fruition would leave technologies unable to cross the chasm to commercialization. We need engineering and economic expertise at DOE to complement physics and chemistry.

Wind

Past investments in wind have resulted in significant improvements over the past 30 years, such as increased output, improved reliability, and lower costs. In fact, between 2007 and 2014 the cost of wind dropped more than 27%; In 2014, wind developers secured power purchase agreements (PPAs) with utilities below the levelized cost of electricity (in $20-30/MWh) range for fossil-fired power and below the price of wholesale power in the Midwest, Southwest, and Texas.

The wind industry has done more than any other energy industry to study and address impacts to birds and other wildlife. In this spirit, the industry is requesting clarifying language in the budget for the Wind Energy Program. $9.5 million of the Administration's FY2016 DOE budget request is directed to assist in funding research designed to understand the potential impacts of wind energy development and operations on wildlife and to develop practical technology-based solutions to avoid and reduce those impacts. The industry requests that $4.5 million within the DOE Wind Energy Program budget be spent on a research initiative to develop and evaluate advanced mitigation technologies to better understand and minimize wind energy project impacts on eagles. This funding would also support wind industry efforts in obtaining new

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[8] *U.S. Solar Market Insight: Q3 2014*, http://www.seia.org/research-resources/us-solar-market-insight

permits required by the Bald and Golden Eagle Protection Act. The industry is also requesting that $5 million within the Wind Energy Program be used for expanding ongoing work to understand and develop mitigation measures to reduce the impact of wind projects on bird and bat populations.

Information and Communications Technology Infrastructure

In an increasingly complex energy system, Information and Communications Technology (ICT) can be used to improve the reliability, resiliency and efficiency of the grid's transmission, storage and distribution infrastructure, and to help reduce pollutant emissions through better real time monitoring and control of grid systems. Further ICT applications to enhance end-use energy efficiency and facilitate demand response strengthen grid efficiency and reliability by reducing peak load stresses and line losses and by allowing better grid management in case of generation outages or transmission anomalies.

In the past, transmission, storage and delivery in the energy grid historically was a relatively straightforward, linear system of generation to transmission to distribution. Dispatching was generally local and based on marginal cost considerations. Margins of safety were large because of limited real-time information and limited options for replacement of power generation sources in an emergency.

Today's grid must adapt to emerging challenges and opportunities – fluctuating energy prices, an increasingly transactive role for customers, integration of distributed energy resources, the need for improved resilience, and the need to reduce greenhouse gas emissions. In order to meet these challenges, a vastly increased role for ICT is essential. Without continually enhanced ICT in the TS&D infrastructure, the grid cannot achieve these 21st century goals. ICT will allow real-time monitoring of actual conditions throughout the system, and provide the ability to control TS&D system functions so as to maximize efficiencies and ensure reliability with less additional costly excess capacity.

Studies have shown grid-related investment in ICT provides enormous benefits for energy efficiency, economic growth and maximum use of non-polluting energy sources.

Energy Efficient Lighting

Light emitting diode – or LED – bulbs use 75 percent less energy than the old incandescent light bulbs and last up to 25 years. Using LED bulbs on streets and highways, and in our homes, can save taxpayers and consumers a significant amount of money.

For example, LED bulbs, can cut a city's outdoor lighting bill by half or more. Given that most municipalities are strapped for funds, shifting to energy-saving LED light bulbs helps local governments cut operating expenses.

DOE has led the effort in the transformation to more efficient lighting through demonstration projects to validate the effectiveness of outdoor LED lights and to develop procurement

guidelines for interested communities and businesses. LED lights are directional light sources so well-designed fixtures can point the light exactly where the light is needed, while also preventing light from going where it's not wanted, such as in the sky or a neighboring property.

Today, less than 5 percent of outdoor lighting fixtures use LEDs bulbs so the savings potential is significant. DOE has estimated that a total shift to LED outdoor lights would save more than $6 billion and prevent 40 million metric tons of carbon dioxide emissions per year. The upfront cost for LED bulbs is quickly paid back and represents a great investment toward lower bills and reduced air pollution for years to come.[9]

Conclusion

The *Sustainable Energy in America Factbook* shows that with a mix of research, development and deployment initiatives supported by policies and incentives at the state and federal level, the United States has experienced a rise in market penetration of a broad range of sustainable energy technologies. The data shows that the policies that have been adopted have worked but the work is not done. To ensure secure, clean, reliable, affordable energy sources in the United States we must continue the federal government's partnership in research, development and deployment programs. Council members have specific views on programs that have been effective for their industries and look forward to working with this Committee to identify effective programs that bring a strong rate of return to tax payers while unlocking the vast domestic potential for sustainable energy technologies.

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[9] http://energy.gov/eere/ssl/led-lighting-facts

Ruth McCormick serves as Director of Federal and State Affairs for the Business Council for Sustainable Energy (BCSE) a broad-based industry trade group representing companies and associations in the energy efficiency, natural gas and renewable energy industries.

Ms. McCormick represents the Business Council on a wide range of state and federal issues including tax policy, and energy and environmental policy. In her role with the BCSE she manages the coalition's outreach and advocacy before the United States Congress and federal agencies, as well as outreach to state utility commissions, energy offices and other state officials.

Ms. McCormick has over twenty-five years of experience in energy and environmental policy development working on behalf of businesses and in Congress.

Chairman WEBER. Thank you, Ms. McCormick.
Dr. de Rugy.

**TESTIMONY OF DR. VERONIQUE DE RUGY,
SENIOR RESEARCH FELLOW,
MERCATUS CENTER,
GEORGE MASON UNIVERSITY**

Dr. DE RUGY. Good afternoon, Chairman Weber, Ranking Member Grayson, Members of this Subcommittee. My name is Veronique de Rugy. I am a Senior Research Fellow at the Mercatus Center at George Mason University where I study tax and budget issues.

So for decades now, policymakers have tried to expand the federal role in developing alternative energy technology and move the economy away from oil, gas and coal. While I agree that we shouldn't subsidize fossil fuels, we should not subsidize green energy either. I would like to highlight three reasons for that.

First, even with the best of intentions, nobody knows which particular energy sources will make the most sense down the road. This level of uncertainty is not unique to the energy industry. Every industry faces similar issues of innovation in a rapidly changing world. In most industries, the policy solution is to allow the decentralized market efforts of entrepreneurs and early adopting consumers to figure out the best route to the future.

Second, government efforts to push markets in certain directions has real cost. Some of these costs are very visible, such as the $5 billion spent since 2009 on the Weatherization Assistance Program, which was found to be incredibly wasteful by federal auditors, riddled with corruption and questionable work, all this at the expense of taxpayers. But not all these costs are visible either. For instance, government subsidies to particular technology or industries can also delay the development of superior alternatives that don't receive subsidies, and that is because when the government invests in an area, it tends to shift resources in the private sector and the capital market away from unsubsidized projects, towards subsidized project, and that independently of the merits of the project.

Third, the federal government's track record for picking winners in industries and technology is very bad. The Department of Energy has subsidized more than its share of failed projects. Also, the projects that do not fail often we find are subsidizing companies that did not need the help in the first place, and tend to be very well connected politically. The Department of Energy's 1705 Loan Program is a good example of the gap that exists between what the program's proponents claim it will achieve, and what it actually achieves. So I am going to focus on 1705, but actually, my findings pretty much apply to every other government programs that we are talking about here.

These policies were put in place under the claim that renewable energy companies do not have access to sufficient credit to support new projects. However, when you look at the data, nearly 90 percent of the loans went to companies that were backed by giant, well-connected companies like NRG Energy Company and Goldman Sachs. It is very hard to imagine that these projects and these companies would not have access to capital, absent the 1705 loan. This

program is also a good example of government favoring two distinct interest groups at the expense of taxpayers. First, in this case it is a loan guarantee, the lenders who shift the risk away from them, if they pick a program that ends up defaulting. Second, interest group, the companies that borrow at very beneficial terms and rates, especially compared to their competition. But while banks and companies that receive the guarantee get the upside of the program, taxpayers bear the risk and shoulder the burden when companies such as Solyndra and Abound Solar go under and default on their loans.

So while the data on 1705 Loan Program speaks for itself, the problem is actually much bigger. Like most government interventions, these programs create serious and systemic distortions in the market. These distortions create the conditions for businesses to maximize profits by pleasing political interests, rather than by pleasing consumers. This is called cronyism and it entails enormous and most often unseen economic costs. The tragedy is that despite the evidence, lawmakers don't get rid of these programs. They are more likely to respond to pressure from vested interest than to taxpayers who are unlikely to realize how much they pay directly and indirectly for it.

To conclude, I don't pretend to know what America's energy future will look like, and while I am all in favor of green energy, we have over six decades of research on government decision-making that shows that the sensible solution is often to leave these activities outside of the purview of government. It is not a loss, but a gain for government. Not only will it prevent the type of government failures we have been talking about, it will also allow government to focus on its core competency, providing public goods, and protecting human and property rights.

Thank you.

[The prepared statement of Dr. de Rugy follows:]

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TESTIMONY

SUBSIDIES ARE THE PROBLEM, NOT THE SOLUTION, FOR INNOVATION IN ENERGY

BY VERONIQUE DE RUGY, PhD
Senior Research Fellow, Mercatus Center at George Mason University

Testimony before the House Committee on Science, Space, and Technology, Subcommittee on Energy

Hearing on "Department of Energy Oversight: Office of Energy Efficiency and Renewable Energy"

March 24, 2015

Good afternoon Chairman Weber, Ranking Member Grayson, and members of the subcommittee. Thank you for inviting me here to discuss the Department of Energy's energy efficiency and renewable energy programs. I appreciate the opportunity to testify.

My name is Veronique de Rugy, and I am a senior research fellow at the Mercatus Center at George Mason University, where my primary research interests include the US economy, the federal budget, federal programs, and tax policy.

The Obama administration's FY 2016 budget asks for a 42 percent increase in funding for the Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) and its portfolio of programs. Yet more than 40 years after President Richard Nixon announced "Project Independence"—to wishfully wean the American economy off oil and decades of federal involvement in efforts to develop "alternative" energies—we are once again discussing how many more taxpayer dollars should be thrown at the alternative energy wall in the hopes that something will finally stick.

Far from suggesting that alternative energies aren't welcome or desirable, I believe that it's time for policymakers to recognize that allowing the marketplace to determine winners and losers is preferable to a politicized, top-down approach that has produced more black eyes than benefits.

These black eyes belong to both parties and extend well beyond Solyndra and the ill-fated 1705 energy loan program, which has become a symbol of the problems with federal involvement in energy markets. Indeed, a short list of the federal missteps over the years would include so-called clean coal, the Synthetic Fuels Corporation, the Clinch River Breeder Reactor, National Ignition Facility, Superconducting Super Collider,

FutureGen, Partnership for a New Generation of Vehicles, FreedomCAR, and the Yucca Mountain nuclear waste repository mess.[1]

I would argue that the most important consideration today should not be whether the Obama administration wishes to spend too much on EERE programs. (It does.) Nor should it be to figure out which special-interest squeaky wheels should get the most grease. What I believe we should be discussing is whether these subsidy programs should exist at all. I would argue that EERE programs should be abolished, along with all other energy subsidies—including those that benefit fossil-fuel production—because

1) government lacks the incentives to manage funds that private investors have;

2) giving subsidies to some businesses puts other businesses that do not receive such subsidies at a disadvantage, distorting investment and other economic activity; and

3) the existence of government subsidies increases the incentive to lobby and the power of special interests.

GOVERNMENT LACKS THE PROPER INCENTIVES

Even with the best of intentions, elected officials and bureaucrats simply do not possess the proper incentives to manage taxpayers' money prudently. They are not rewarded when they maximize consumer value; nor are they punished when they take unnecessary risks or fail to minimize costs. Government actors operate with limited knowledge. While individuals acting in markets are able to use price signals to guide their decisions. When a private company fails, the owners and its investors lose. Government decision makers have no such guide. They have no way of accounting for the value or costs of their decisions. And when the government fails, taxpayers lose.

Subsidies are justified as being necessary to encourage the development of alternative energies because the private sector is unwilling to undertake the risk necessary for their development. The truth is that private investors *should* avoid throwing scarce dollars at endeavors that do not make economic sense. Instances where the private sector will not invest signal that it would also be a bad idea for taxpayers to "invest."

Policymakers who believe that entrepreneurs and venture capitalists are investing insufficiently in new technologies should focus their efforts on reducing the federal tax burden on businesses and investment rather than attempting to subsidize specific firms, industries, or technologies. Lowering the tax burden is more likely to result in higher economic growth, innovation, and job creation—the same canned justification that policymakers often fall back on to justify subsidy programs.

It is amazing that many of the policymakers who believe that the private sector needs the government to fill this mythical investment gap are the same ones who want to further tax the rewards of investment, and support sending the money to agencies like EERE that fund the research and development of commercial products. Advanced research and development subsidies are a form of corporate welfare because the rewards end up going to private interests while the costs are borne by taxpayers. This cycle of "tax and subsidize" is just another example of the government robbing Peter to pay Paul. Policymakers like to tout Paul's "success stories" when defending energy subsidies, but somehow Peter escapes acknowledgement.

1. See Chris Edwards, "Energy Subsidies" (Downsizing the Federal Government, Cato Institute, Washington, DC, February 2009), http://www.downsizinggovernment.org/energy/energy-subsidies.

SUBSIDIES DISTORT ECONOMIC ACTIVITY

Policymakers justify energy subsidies by arguing that they are needed to fix alleged imperfections in the marketplace. The imperfections, however, are typically short-term issues (e.g., oil price spikes) that the marketplace will address—if allowed. Policymakers often rush to address short-term concerns with government interventions, including subsidies, which end up distorting economic activity and generating failures of their own.[2] The problem is compounded by the reality that policymakers usually have political and parochial interests in mind when creating and sustaining subsidy programs. When government intervenes,

1) subsidized firms get an unfair competitive advantage over firms that do not receive a government subsidy, and

2) policymakers, instead of the market, pick winners and losers.

Unseen Losses of Unsubsidized Competitors

By aiding particular businesses and industries, subsidies put other businesses and industries at a disadvantage. This market distortion generates losses to the economy that are not easily seen and thus generally aren't considered by policymakers. For example, energy companies that don't receive a government subsidy are disadvantaged when they compete against companies that do receive government backing. A company or entrepreneur with a superior product or technology might never reach the market because they didn't have access to government handouts. The result is a diversion of resources from businesses preferred by the market to those preferred by policymakers, which leads to losses for the overall economy.

The Cost of Policymakers Picking Winners and Losers

When the government starts choosing industries and technologies to subsidize, it often makes bad decisions at taxpayer expense, because policymakers possess no special knowledge that allows them to allocate capital more efficiently than markets. Businesses and venture capital firms make many mistakes as well, but they bear the consequences of those mistakes. When the government picks losers, the costs are involuntarily borne by taxpayers.

Even the supposed "success stories" that government officials and the direct beneficiaries of subsidies like to tout at congressional hearings do not come without cost. In addition to the taxpayer money that's spent when policymakers try to steer the market in certain directions, government intervention can also delay the development of superior alternatives by companies and entrepreneurs who didn't receive government backing. Worse, young companies and entrepreneurs can have a harder time acquiring capital because private investors usually prefer to provide capital to projects that are subsidized over ones that are not.

In a 2009 article in *Wired* magazine, Darryl Siry, a former executive with Tesla Motors, which has benefitted from government handouts, wrote that startup companies applying for energy subsidies "have admitted that private fundraising is complicated by investor expectations of government support."[3] He noted that the government trying to pick winners distorts the market for private capital, which "will have a stifling effect on innovation, as private capital chases fewer deals and companies that do not have government backing have a harder time attracting private capital."[4]

2. See Jerry Taylor and Peter Van Doren, "Energy Interventions" (Downsizing the Federal Government, Cato Institute, Washington, DC, February 2009), http://www.downsizinggovernment.org/energy/intervention.
3. Darryl Siry, "In Role as Kingmaker, Energy Department Stifles Innovation," *Wired*, December 1, 2009.
4. Ibid.

CORRUPTING INFLUENCE OF SPECIAL INTERESTS

Numerous economists have demonstrated that government officials benefit by acting on behalf of special interests under the guise of working on behalf of the public good.[5] Policymakers aren't driven by the profit motive as is the case in the marketplace; rather, concerns about reelection and other self-rewarding benefits drive the decision-making process. Thus, interest groups who gain, or stand to gain, from government subsidies are willing and able to exploit the natural self-interest of policymakers.

When "free" government money is up for grabs, interests that stand to benefit have a strong incentive to organize and lobby for a slice of the pie. Policymakers face little or no cost for conferring benefits on particular interests who return the favor by delivering votes and campaign funds. Adding in the lack of incentive for policymakers to be good stewards of taxpayers' money results in government programs that exist to pick winners and losers in the marketplace—the "winner" being a politically predetermined outcome. Unfortunately, when the government tries to pick winners and losers, it often picks the wrong horse at the expense of taxpayers and the broader economy.

Government subsidies create an unhealthy—and sometimes corrupt—relationship between commercial interests and the government. The more the government has intervened in energy markets, the more lobbying activity has been generated. The more subsidies that it hands out to businesses, the more pressure policymakers face to keep the federal spigot flowing. As the number of lobbyists grow, more economic decisions are made on the basis of politics, and more resources are misallocated. And the door opens to cronyism and corruption.

Solyndra has become emblematic of these issues, even as policies expanding subsidies for alternative energy companies have been pursued enthusiastically over the past several years. According to the New York Times, Solyndra "spent nearly $1.8 million on Washington lobbyists, employing six firms with ties to members of Congress and officials of the Obama White House" during the period of time that its subsidized loan request was under review by the Department of Energy.[6] Beyond Solyndra, the Washington Post found that "$3.9 billion in federal grants and financing [from the Department of Energy] went to 21 companies backed by firms with connections to five Obama administration officials."[7]

THE DEPARTMENT OF ENERGY'S 1705 LOAN PROGRAM[8]

The Department of Energy's 1705 loan program is a good example of the gap between what subsidy proponents claim they will achieve and what actually happens. The program was a key part of the Obama administration's 2009 stimulus program and was justified on the grounds that viable renewable energy companies lack sufficient access to capital. The alleged imperfections of capital markets is a common—and mistaken—claim often used by policymakers to justify government intervention in various areas of the economy.

In reality, nearly 90 percent of the 1705 loan guarantees went to subsidize projects backed by large, politically connected companies including NRG Energy Inc. and Goldman Sachs. Thus, it's hard to believe that taxpayer-backed loans were necessary to make up for a supposed lack of capital available to economically viable commercial concerns.

The 1705 program is also a good example of the government favoring multiple interest groups at the expense of taxpayers: (1) lenders who are reimbursed by taxpayers in the event of a default and (2) the companies that

5. See Mancur Olson, *The Logic of Collective Action* (Cambridge, MA: Harvard University Press, 1971); and Gordon Tullock, "Rent Seeking," *New Palgrave Dictionary of Economics*, ed. Steven N. Durlauf and Lawrence E. Blume (Palgrave Macmillan, 2008).
6. Eric Lipton and John M. Broder, "In Rush to Assist a Solar Company, U.S. Missed Signs," *New York Times*, September 22, 2011.
7. Carol Leonnig and Joe Stephens, "Federal Funds Flow to Clean-Energy Firms with Obama Administration Ties," *Washington Post*, February 14, 2012.
8. This section is a summary of testimony I previously delivered on the subject, which is attached: Veronique de Rugy, "A Guarantee for Failure: Government Lending under Sec. 1705" (Testimony before the House Committee on Oversight and Government Reform, Subcommittee on Regulatory Affairs, Mercatus Center at George Mason University, Arlington, VA, July 18, 2012).

borrow at beneficial rates and conditions. But while banks and companies that receive the guarantees get the upside of the program, taxpayers bear the risk and shoulder the burden when companies like Solyndra go under and default on their loans.

While the results of the 1705 loan program speak for itself, the true problem is deeper than the numbers. Like most government interventions, this program—and government interventions in general—create serious and systemic distortions in the market. These distortions create the conditions for businesses to maximize profits by pleasing government officials rather than customers. This is called cronyism, and it entails enormous—and, most often, unseen—economic costs.

CONCLUSION

When the government subsidizes businesses, it weakens profit-and-loss signals in the economy and undermines market-based entrepreneurship. Most of America's technological and industrial advances have come from innovative private businesses in competitive markets. Indeed, it is likely that most of our long-term economic growth has come not from existing large corporations or governments but from entrepreneurs creating new businesses and pioneering new industries. Such entrepreneurs have often had to overcome barriers put in place by governments and dominant businesses receiving special treatment.

Policymakers who are interested in supporting the entrepreneurs and companies that will deliver the next generation of energy supplies and products should focus their attention on correcting the federal government's hostile tax climate and dispense with the futile hopes of outsmarting the marketplace.

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TESTIMONY

A GUARANTEE FOR FAILURE: GOVERNMENT LENDING UNDER SEC. 1705

VERONIQUE DE RUGY
Senior Research Fellow

Testimony Before the House Committee on Oversight and Government Reform, Subcommittee on Regulatory Affairs
The Administration's Bet on Abound Solar: Assessing the Costs to the American Taxpayers
July 18, 2012

In 2009, renewable energy company Solyndra received $535 million through the federally backed 1705 loan guarantee program of the Department of Energy (DOE). Two years later, the firm filed for bankruptcy and had to lay off its 1,100 employees, leaving taxpayers to bear the cost of the loan. For obvious reasons, more than any other recent events, this waste of taxpayer money has attracted much attention.

But Solyndra isn't the only company to fail after receiving a loan through this particular program. Back in October, Beacon Power Corp., an energy-storage company that received $43 million in backing from the 1705 loan program, filed for bankruptcy. More recently, Abound Solar, Inc, a U.S. solar manufacturer that was awarded $400 million through the program, announced that it would suspend operations and file for bankruptcy. Abound borrowed about $70 million against the guarantee, which is likely to result in a cost of $40 million to $60 million to U.S. taxpayers after Abound's assets are sold and the bankruptcy proceeding is completed.

In addition, there are signs that other companies may follow in the steps of Solyndra and Abound. First Solar's Antelope Valley project, which received a $646 million 1705 loan in 2011 through its partner Exelon, is one likely casualty; SunPower's California Valley Solar Ranch– now owned by NRG Solar—is another. The ranch received a $1.2 billion loan guarantee last September. Whether these companies will fail or not is not yet clear, and the potential cost to taxpayers is not known. However, the precarious situation of these companies exemplifies the risk faced by taxpayers when the government extends loan guarantees to high-risk companies.

Now, the important question is whether or not these examples are representative of the 1705 loan program. What we find is that loan guarantees in this program go to two types of projects:

- Projects that would not have been funded in the open market without a government guarantee because they are too risky, and
- Projects that could have gotten a loan but were happy to benefit from the lower interest rate available through a DOE loan guarantee.

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The failure of Solyndra has attracted much attention, but the problems with loan guarantees are much more fundamental than the cost of one or more failed projects. In fact, the economic literature shows that every loan guarantee program (a) transfers the risk from lenders to taxpayers, (b) is likely to inhibit innovation, and (c) increases the overall cost of borrowing. At a minimum, such guarantees distort crucial market signals that determine where capital should be invested, resulting in lower interest rates that are unmerited and a reduction of capital for more worthy projects. At their worst, these guarantees introduce political incentives into business decisions, creating the conditions for businesses to seek financial rewards by pleasing political interests rather than customers. This is called cronyism, and it entails real economic costs.[1]

Yet these loan programs remain popular with Congress and the executive branch. That's because in general most of the financial cost of these guaranteed loans will not surface for many years. Consequently, Congress can approve billions of dollars to benefit special interests with little or no immediate impact to federal appropriations, because these dollars are almost entirely off budget.

HOW DO THESE LOAN GUARANTEES WORK?

The DOE Loan Programs Office (LPO) administers three separate loan programs: (1) Section 1703 loan guarantees, (2) Section 1705 loan guarantees, and (3) Advanced Technology Vehicles Manufacturing (ATVM) loans. Here are descriptions of the three loan programs, as explained by DOE:

- Section 1703 of Title XVII of the Energy Policy Act of 2005 authorizes the U.S. Department of Energy to support innovative clean energy technologies that are typically unable to obtain conventional private financing due to high technology risks.
- Advanced Technology Vehicles Manufacturing (ATVM) loans support the development of advanced technology vehicles (ATV) and associated components in the United States. They also meet higher efficiency standards.
- The Section 1705 Loan Program authorizes loan guarantees for U.S.-based projects that commenced construction no later than September 30, 2011 and involve certain renewable energy systems, electric power transmission systems, and leading edge biofuels.[2]

According to LPO's website, DOE's loan guarantee authority originated from Title XVII of the Energy Policy Act of 2005 (P.L. 109–58).[3] Under Section 1703, the federal government can guarantee 80 percent of a project's total cost. The American Recovery and Reinvestment Act of 2009 (P.L. 111–5) amended the Energy Policy Act of 2005 by adding Section 1705.[4] Section 1705 was created as a temporary program, and 1705 loan guarantee authority ended on September 30, 2011.

The dollar volume of loans that can be guaranteed under DOE's authority is predetermined by congressional appropriations that oversee the program. A simple way to explain how these loans work is this: If a recipient defaults on its loan, the federal government pays the remainder of the debt to the lenders and repossesses all of the assets from the unfinished projects.[5]

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1. Matt Mitchell, "The Pathology of Privilege: The Economic Consequences of Government Favoritism" (Mercatus Research, Mercatus Center at George Mason University, Arlington, VA, July 2012).
2. United States Department of Energy, accessed June 13, 2012, https://lpo.energy.gov/.
3. Section 1703 of the Energy Policy Act of 2005 (P.L. 109-58).
4. Section 1705 of the Energy Policy Act of 2005 (P.L. 109-58). Section 1705 was created by amending the Energy Policy Act of 2005 through the American Recovery and Reinvestment Act of 2009 (P.L. 111-5).
5. However, the Office of Management and Budget has calculated that only 55 percent of loans can be recouped from the sale of assets.

As with other loan programs, the federal government has established a credit subsidy fee to prevent taxpayer exposure. In this case, the cost of the fee is determined by DOE, with guidance from the Office of Management and Budget (OMB). The lenders usually charge the up-front guarantee fee to the borrower after the lender has paid the fee to DOE and has made the first disbursement of the loan.

Lenders handle fees differently for 1705 loans, however. Under the stimulus bill, DOE received appropriated funds to pay for credit subsidy costs associated with Section 1705 loan guarantees, which, after rescissions and transfers, was $2.435 billion. As the Congressional Research Service rightly puts it, "Section 1705 loan guarantees were very attractive as they provided an opportunity to obtain low-cost capital with the required credit subsidy costs paid for by appropriated government funds."[6]

DOE does not provide loans directly. Instead, borrowers have to apply to qualified lenders, who are expected to perform a complete analysis of the application. DOE then reviews the lender's credit analysis, rather than conducting a second analysis, and DOE makes the final credit and eligibility decision.

DO LOAN GUARANTEES DO WHAT THEY CLAIM TO DO?

Leaving aside the question of whether the government should encourage the production of certain goods or services, the economic justification for any government-sponsored lending or loan-guarantee program must rest on a well-established failure of the private sector to allocate loans efficiently (meaning that deserving recipients could not have gotten capital on their own). Absent such a private-sector deficiency, the DOE's activities would simply be a wasteful subsidy at best, and a politically motivated one at worst, to this sector of the economy.

Yet many argue that some public policy objectives require the sacrifice of marketplace efficiency. It is an accepted feature of modern American government that some public interests or social policy gains outweigh economic losses. In the case of green energy, the government's lending programs could fulfill specific public policy objectives that the marketplace on its own would either not serve, or would supply at suboptimal levels. But do these programs do what they claim to do?

The DOE proclaims that its loan guarantees help save the planet[7] by helping to secure funding for early-stage technologies or for the later (risky) commercialization stage—known as the manufacturing "Valley of Death."[8] It also claims that loan recipients will generate economic growth and "green" jobs that otherwise would not appear. DOE can thus be judged on its ability to meet these public policy goals—specifically, on its ability to fill the supply-and-demand gap in the clean energy loan market, particularly for startups.

To measure the DOE results, I looked at the flow of DOE credits to evaluate who receives them and whether the DOE is meeting its stated policy objectives of promoting new startups and encouraging the creation of green jobs. Close examination demonstrates that neither stated DOE policies nor actual lending patterns provide evidence that DOE's loan guarantees serve any of their defined public policy purposes.

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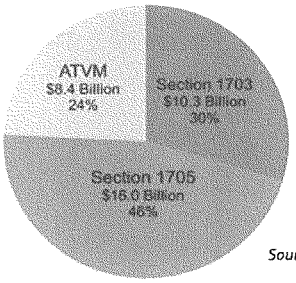
6. Phillip Brown, "Solar Projects: DOE Section 1705 Loan Guarantees" (Congressional Research Service, October 25, 2011), accessed June 13, 2012, http://op.bna.com/env.nsf/id/jstn-8mzszy/$File/CRSSolar.pdf.
7. Mike King and W. David Montgomery, "Let's Reset Our Energy Policy Starting with Loan Guarantees," in *Pure Risk: Federal Clean Energy Loan Guarantees*, ed. Henry Sokolski (Arlington, VA: Nonproliferation Policy Education Center, 2012).
8. Sustainablebusiness.com, "Clean Energy: Crossing the Valley of Death," June 2010, http://www.sustainablebusiness.com/index.cfm/go/news.display/id/20544.

FOLLOWING THE 1705 LOAN GUARANTEE PROGRAM MONEY

Since 2009, DOE has guaranteed $34.7 billion, 46 percent of it through the 1705 loan program, 30 percent through the 1703 program, and 24 percent through the ATVM.[9]

Loan Guarantees by Program



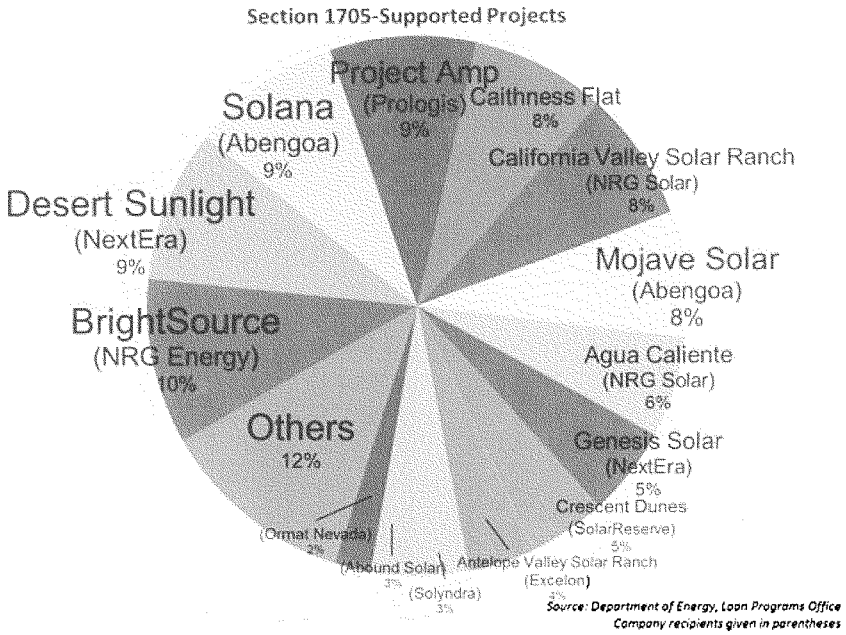
Source: U.S. Department of Energy, Loan Guarantee Programs

As noted earlier, the 1705 program (under which Solyndra received funding) is a product of the economic stimulus bill of 2009. This program offered borrowers better terms than the 1703 program; in fact, in some cases the government paid a substantial fee out of appropriated funds, a fee that is the borrower's responsibility under the 1703 plan. Also, many 1703-eligible projects were also eligible under the 1705 program.

The data on the 1705 program shows that 26 projects were funded under the 1705. Further analysis showed that

- The program guaranteed roughly $16 billion in all.
- Some 2,378 permanent jobs were claimed to be created under the program. That works out to a taxpayer exposure of $6,731,034 per job.
- The recipient of the most 1705 loans was NRG Energy Inc. (BrightSource), which received $1.6 billion, or 11 percent of the overall amount guaranteed under the program.
- The top 10 recipients of loans under the 1705 program were all solar generation companies, which received a combined $12.2 billion in loan guarantees (76 percent of the overall amount guaranteed). Included were NextEra Energy Resources, LLC (Desert Sunlight), a Fortune 200 company; Abengoa Solar Inc. (Solana), a Spanish multinational company; and Prologis (Project Amp), a global real estate investment trust. Utility firms like NRG Energy received three separate loans in the top-10 recipient list.
    - Prologis received $1.4 billion (8.75 percent of the total) to install solar panels on top of a building it owns.
    - Cogentrix, a wholly owned subsidiary of the Goldman Sachs Group, Inc., received a $90 million guarantee from the government.
    - Three companies have filed for bankruptcy so far: Solyndra, which received $535 million in loan guarantees (3.34 percent of the total); Abound Solar, which received $400 million (3 percent of the total); and Beacon Power, which received $43 million (less than 0.1 percent).

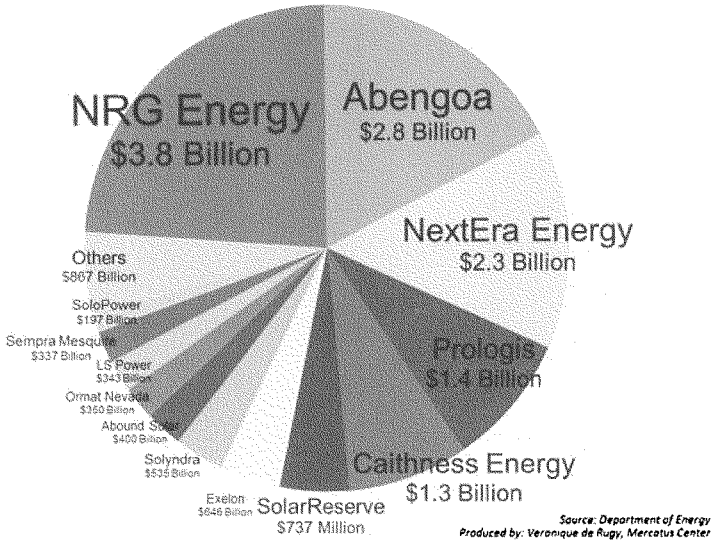
9 U.S. Department of Energy, Loan Programs Office: https://lpo.energy.gov/?page_id=45.



If we organize the data by the companies that received the 1705 loans, we find

- The recipient of the most 1705 loans was NRG Energy, Inc., which received a total of $3.8 billion—23.7 percent of the overall amount guaranteed under the 1705 program.
- Four companies— NRG Energy, NextEra Energy, Arbogea, and Prologis—received 64 percent, or $10.3 billion, of the total amount guaranteed under the program.

Section 1705-Supported Companies



So what can we make of these figures? First, it should be noted that very few permanent green jobs were created under the 1705 loan program, or any of the other loan programs. The Obama administration had initially pushed these projects as job generators, claiming that these programs could create 5 million American jobs through investment in green technology. Also, to the extent that green jobs were created, the $6.7 million taxpayer exposure per job is quite spectacular. This number alone would seem to debunk the idea that these DOE loan programs efficiently generate new permanent jobs.

Second, our data demonstrates that under the 1705 program most of the money has gone to large, established companies rather than to startups. Companies that benefited included established utility firms, large multinational manufacturers, and a global real estate investment fund. In addition, the data shows that nearly 90 percent of the loans guaranteed by the federal government since 2009 went to subsidize lower-risk power plants, which in many cases were backed by big companies with vast resources. This includes loans such as the $90 million guarantee granted to Cogentrix, a subsidiary of Goldman Sachs. Currently, Goldman Sachs ranks number 80 on the list of America's Fortune 500 companies.[10]

Quoted in the *New York Times* recently, David W. Crane, NRG's chief executive, explained, "I have never seen anything that I have had to do in my 20 years in the power industry that involved less risk than these projects," he said. "It is just filling the desert with panels."[11]

10. CNN Money, "America's Fortune 500 Companies," http://money.cnn.com/magazines/fortune/fortune500/2012/snapshots/10777.html.
11. Eric Lipton and Clifford Krauss, "A Gold Rush of Subsidies in Clean Energy Search," *New York Times*, November 11, 2011, http://www.nytimes.com/2011/11/12/business/energy-environment/a-cornucopia-of-help-for-renewable-energy.html?pagewanted=all.

This probably means that if there were an actual gap between supply and demand in the area of loans for energy companies, startups, and others, this program wouldn't be filling it. In fact, most of these loans look like government transfers of the worst kind. Subsidies to very large corporations smack of cronyism.

Further, while these projects are relatively low risk and backed by large companies, that does not mean that they are risk-free for taxpayers. These projects are organized as separate corporations from the parent companies, so in case of a problem, the parent company could simply restructure and get rid of the struggling project, leaving taxpayers with the bill.

Third, some of the loans went to provide capital for high-risk projects—projects likely unable to get financing from the broader market without a government guarantee. Either the company or the technology did not have the credibility that is normally required for a major loan, or the company had serious, existing financial woes that were not alleviated by the loan. Companies like Solyndra, Beacon Power, and Abound fall in this category; it may also prove to be the case for BrightSource, Solar Reserve, US Geothermal, First Solar, and California Valley Solar Ranch.

Fourth, there seems to be an even more troubling trend of "double dipping" by large companies that received loan guarantees from the DOE program. Many of the companies that have benefitted from subsidized loans under the 1705 guarantee program also received grants under the American Recovery and Reinvestment Act (ARRA). Prologis, for example, received $1.4 billion in subsidized loans and also received a grant for $68,000 under the Recovery Act for the purpose of "rent for warehouse space."

Green Mountain Energy, a company of NRG Energy, received two grants under the ARRA in the second quarter of fiscal year 2011. Likewise, Reliant Energy and Reliant Energy Tax Retail LLC, two other NRG Energy companies, reported receiving *at least 37 grants* under the ARRA. These grants augmented the $3.8 billion in loan guarantees distributed to NRG Energy under the Section 1705 loan program.

NRG will also be eligible to receive $430 million from the Department of the Treasury.[12] Many other companies that have received DOE loan guarantees have also benefited from the Department of Treasury 1603 grants.[13]

Overall, NRG and its partners have secured $5.2 billion in federal loan guarantees, plus hundreds of millions in other subsidies for four large solar projects.[14] Examples abound of companies benefitting from multiple assistance programs initiated during this period. For instance, in addition to the $538 million it received under the 1705 loan program, Solyndra benefited from a $10.3 million loan guarantee that the Export-Import Bank extended to a Belgian company (described in the Ex-Im deal data as "Zellik Ii Bvba") to finance a sale of Solyndra products.[15]

Solyndra isn't alone. First Solar's Antelope Valley project received a $646 million 1705 loan in 2011 through its partner Exelon, and per my calculation from the Ex-Im Bank FOIA deal data information for FY2011,[16] the company also scored $547.7 million in loan guarantees to subsidize the sale of solar panels to solar farms abroad.

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12. Eric Lipton and Clifford Krauss, "A Gold Rush of Subsidies in Clean Energy Search," *New York Times*, November 11, 2011, http://www.nytimes.com/2011/11/12/business/energy-environment/a-cornucopia-of-help-for-renewable-energy.html?pagewanted=all
13. Department of Treasury, "1603 Program: Payments for Specified Energy Property in Lieu of Tax Credits," http://www.treasury.gov/initiatives/recovery/Pages/1603.aspx.
14. Eric Lipton and Clifford Krauss, "A Gold Rush of Subsidies in Clean Energy Search," *New York Times*, November 11, 2011, http://www.nytimes.com/2011/11/12/business/energy-environment/a-cornucopia-of-help-for-renewable-energy.html?pagewanted=all.
15. Export-Import Bank of the United States, 2011 Annual Report, http://www.exim.gov/about/reports/ar/2011/index.html, p. 30.
16. Export-Import Bank of the United States, "Open Government Initiative," http://www.exim.gov/open/.

More troubling is the fact that some of the Ex-Im money went to a Canadian company named St. Clair Solar, which is a wholly owned subsidiary of First Solar.[17] St. Clair Solar received a total of $192.9 million (broken into two loans) to buy solar panels from First Solar. In other words, the company received a loan to buy solar panels from itself. Incidentally, First Solar also received a $16.3 million loan from the government in 2010 to expand its factory in Ohio.[18]

Unfortunately, this double dipping by energy companies isn't new—and while there is no doubt that the deals are lucrative for the companies involved, taxpayers have a lot to lose. Further, double-dipping provides evidence that businesses will be tempted to steer away from productive value creation for society and instead work on narrowly serving political interests for financial gain.

THE CASE AGAINST CLEAN ENERGY LOAN GUARANTEES

The case of Solyndra—a startup that received $528 million in federal loans before it went bankrupt, laid off over one thousand workers, and left taxpayers to foot the bill—is striking, but it actually represents only one aspect of the fundamental problems caused by loan guarantee programs in general, and DOE's clean energy loan programs in particular.

Socialized Losses and Privatized Gains

One conspicuous issue is the default rate. Historically, loans guaranteed by the government have had a higher default rate than loans issued by the private sector. For instance, the Small Business Administration (SBA) has a long-term default rate of roughly 17 percent.[19] This compares to 4.3 percent for credit cards and 1.5 percent for bank loans guaranteed by the Federal Deposit Insurance Corporation.

The Congressional Budget Office has calculated that the risk of default on the DOE's nuclear loan guarantee program is well above 50 percent.[20] In 2011, the CBO updated its study and replaced this embarrassing default rate with a list of variables affecting the rate.[21] The report now asserts that higher equity financing of these projects would reduce the risk of default; such a solution seems unlikely, however, as most loan guarantee programs cover 80 percent of their financing through debt rather than equity.

Moreover, according to the CBO, when the federal government extends credit, the associated risk of those obligations is effectively passed along from private lenders onto taxpayers who, as investors, would view this risk as costly. In other words, when the federal government encourages a risky loan guarantee it is "effectively shifting risk to the members of the public."[22]

Another issue might best be summarized as the sharing of loss versus the privatizing of gain. If a loan is not repaid, the cost of the investment devolves to the taxpayers. But what if the loan is repaid? The lender will benefit from all the interest payments it collected thanks to a low-risk loan, and the borrower will benefit from its successful

17. Tim Carney, "Firm Sells Solar Panel to Itself: Taxpayers Pay," *Washington Examiner*, March 18, 2010, http://campaign2012.washingtonexaminer.com/article/firm-sells-solar-panels-itself-taxpayers-pay/434251.
18. Tim Carney, "Firm Sells Solar Panel to Itself: Taxpayers Pay," *Washington Examiner*, March 18, 2010, http://campaign2012.washingtonexaminer.com/article/firm-sells-solar-panels-itself-taxpayers-pay/434251.
19. Veronique de Rugy, "Banking on the SBA" (Mercatus on Policy, Mercatus Center at George Mason University, Arlington, VA, 2007), accessed on June 13, 2012, http://mercatus.org/publication/mercatus-policy-banking-sba.
20. Pamir Wang, "Federal Clean Energy Loan Guarantees: Their Moral Hazards," in *Pure Risk: Federal Clean Energy Loan Guarantees*, ed. Henry Sokolski (Arlington, VA: Nonproliferation Policy Education Center, 2012).
21. Congressional Budget Office, "The Cost-Effectiveness of Nuclear Power for Navy Surface Ships" (May 12, 2011), http://www.cbo.gov/publication/41454.
22. Congressional Budget Office, "Fair-Value Accounting for Federal Credit Programs" (Issue Brief, March 2012).

business venture. In other words, loan guarantee programs are yet another way that the federal government socializes losses while privatizing benefits.[23]

The Moral Hazard

Federally backed loans create a classic moral hazard. Because the loan amount is guaranteed, banks have less incentive to evaluate applicants thoroughly or apply proper oversight. In other words, the less skin the lender has in the game, the less likely it is that the lender will vet the quality of the project. In addition, the company that borrows the money risks less than it would if its loan weren't guaranteed. Further, each time the government bails out a firm or shoulders the cost of a loan guarantee, it conveys to borrowers and bankers alike the mistaken idea that it's okay for them to take excessive risks.

In a March 2012 report, the Government Accountability Office (GAO) found that the DOE loan guarantee program was riddled with program inefficiencies, which calls the fairness of its decisions into question.[24] When the GAO requested data from the DOE on the status of applications, the DOE did not have consolidated data readily available and had to assemble the data from various sources over several months. Inadequate documentation and out-of-date review processes reduce one's sense of confidence in the consistency and fairness of DOE's decisions and raise questions about DOE's ability to fully assess and mitigate project risks.

Moreover, the private sector (in the absence of government intervention) builds the infrastructure to assess risk, but the federal government has neither the expertise nor the incentive to build such a safety net. This increases the likelihood that loan guarantees will be awarded based on factors other than the ability of the borrower to repay the loan, such as political connections and congressional pork.[25]

The moral hazard of loan guarantees increases when rules intended to prevent the program from being a pure company giveaway are removed. When, as part of the stimulus bill of 2009, the government lifted the subsidy fees for 1705 loans, the cost to taxpayers went up and high-risk companies were drawn in.

Mal-investment

Loan guarantee programs can also have an impact on the economy beyond their cost to taxpayers because mal-investment—the misallocation of capital and labor—may result. In theory, banks lend money to the projects that represent the greatest likelihood of success, in terms of loan repayment, profits, and economic growth. However, since there isn't an infinite amount of capital available at a given interest rate, loan guarantee programs could redirect resources from politically neutral projects to politically motivated ones. Think about it this way: When the government reduces a lender's exposure to fund a project it wouldn't have funded otherwise, it reduces the amount of money available for projects that would have been viable without subsidies.

This government involvement can distort the market's signals further. For instance, the data shows that private investors tend to congregate toward government guarantee projects, regardless of the merits of the projects. This takes capital away from unsubsidized projects that have a more viable business plan and a better probability of success without subsidies. As the GAO noted, "Guarantees would make projects [the federal government] assists

23. Russ Roberts, "Gambling With Other People's Money" (Mercatus Center at George Mason University, Arlington, VA, April 28, 2010), accessed June 13, 2012, http://mercatus.org/publication/gambling-other-peoples-money.
24. Government Accountability Office, "DOE Loan Guarantees: Further actions are needed to improve tracking and review of applications" (March 2012), accessed June 13, 2012, http://www.gao.gov/assets/590/589210.pdf.
25. King and Montgomery, "Let's Reset," 22.

financially more attractive to private capital than conservation projects not backed by federal guarantees. Thus both its loans and its guarantees will siphon private capital away."[26]

This reallocation of resources by private investors away from viable projects may even take place within the same industry—that is, one green energy project might trade off with another, more viable, green energy project.

More important, once the government subsidizes a portion of the market, the object of the subsidy becomes a safe asset. Safety in the market, however, often means low return on investments, which is likely to turn venture capitalists away. As a result, capital investments will likely dry out, and innovation rates will go down.[27]

In fact, the data show that in cases in which the federal government introduced few distortions, private investors were more than happy to take risks and invest their money– even in projects that required high initial capital requirements. The Alaska pipeline project, for example, was privately financed at a cost of $35 billion, making it one of the most expensive energy projects undertaken by private enterprise.[28] The project was ultimately abandoned in 2011 because of weak customer demand and the development of shale gas resources outside Alaska.[29] However, the undertaking proves that the private sector invests money even when there is a chance that it could lose it. Private investment in U.S. clean energy totaled $34 billion in 2010, up 51 percent from the previous year.[30]

Finally, when the government picks winners and losers (in the form of a technology or a company), it often fails. Two factors come into play. First, the government does not have an advantage in information or technology over private agents. In many cases their decision makers are insulated from market signals and won't learn important and necessary lessons about the technology or the market. Second, the resources that the government offers are so addictive that companies may switch their focus from the needs of the customer to the wishes of government officials.

Cronyism

In a 2003 speech to the National Economists Club in Washington, D.C., then–Federal Reserve Governor Edward M. Gramlich argued that loan guarantee programs are unable to save failing industries or to create millions of jobs, because—he explained—the original lack of access to credit markets is caused by serious industrial problems, not vice versa. If an applicant's business plan cannot show a profit under reasonable economic assumptions, private lenders are unlikely to issue a loan, and rightly so.

Then why is the federal government still guaranteeing loans? Because it serves three powerful constituencies: lawmakers, bankers, and the companies that receive the subsidized loans.

Politicians are able to use loan programs to reward interest groups while hiding the costs. Because such loan programs are almost entirely off budget, Congress can approve billions of dollars in loan guarantees with little or no impact on appropriations. Moreover, unlike Solyndra, most failing projects take years to collapse, allowing politicians to collect short-term rewards while skirting, or postponing, political blame. It's like buying a house on credit without having a trace of the transaction on your credit report.

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26. Wang, "Federal Clean Energy," 15.
27. Wang, "Federal Clean Energy," 15.
28. Peter Bradford, "Taxpayer Financing for Nuclear Power: Precedents and Consequences" (Nonproliferation Policy Education Center, 2008), http://www.npolicy.org/article_file/Taxpayer_Financing_for_Nuclear_Power-Precedents_and_Consequences.pdf.
29. Ben Casselman, "Alaska Pipeline Scrapped," *Wall Street Journal*, May 18, 2011, http://online.wsj.com/article/SB10001424052748703509104576329541913338186.html.
30. The Center for the Next Generation website, "Advanced Energy and Sustainability," accessed June 13, 2012, http://www.tcng.org/programs/advanced-energy-and-sustainability.

It is also easy to understand why companies and company executives seek these loans. The preferential treatment they enjoy comes at the expense of the taxpayer, however, and ultimately at the expense of our market and political system.

Another potential beneficiary of these loans is the financial institution that issues them. With other loan programs, such as the SBA's, evidence suggests that lenders may have an incentive to favor borrowers that qualify for a loan with a government guarantee over those that do not. When a small business defaults on its obligation to repay a loan, bankers do not bear most of the cost; taxpayers do. Meanwhile, lenders make large profits on SBA loans by pooling the guaranteed portions and selling investors trust certificates that represent a claim to the cash flow.

How profitable is this? Testifying before Congress in April 2006, David Bartram, the president of the SBA Division of U.S. Bancorp, the nation's sixth largest financial services company, explained that "return on equity of SBA loans can exceed 70 percent."[31] A 70 percent return on equity (RoE) is remarkably high. Right now, the five-year average RoEs for the two biggest banks in America—Citigroup and Bank of America—are 16.2 percent and 14.5 percent, respectively.

More study is required to determine whether a similarly outsized return to financial institutions occurs with the DOE program, but the parallels between the DOE and SBA programs suggest that this is a possibility.

CONCLUSION

The Department of Energy's loan guarantee programs have been the focus of much public attention since energy companies Solyndra, Beacon Power, and Abound went bankrupt, leaving taxpayers to shoulder hundreds of millions of dollars in loan guarantees. The evidence strongly suggests that these programs fall short of their stated goals of developing clean energy and creating jobs. Of equal concern is the indirect damage to the nation's economic fabric through distortion of market signals, cronyism, and mal-investment. Companies are pursuing financial benefit through the political system, and the economy—and our country—are paying the price.

31. Veronique de Rugy, "Banking on the SBA" (Mercatus on Policy, Mercatus Center at George Mason University, Arlington, VA, 2007), http://mercatus.org/publication/mercatus-policy-banking-sba.

ABOUT THE MERCATUS CENTER AT GEORGE MASON UNIVERSITY

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ABOUT THE AUTHOR

Veronique de Rugy is a senior research fellow at the Mercatus Center at George Mason University. Her primary research interests include the U.S. economy, federal budget, homeland security, taxation, tax competition, and financial privacy issues. Her popular weekly charts, published by Mercatus, address economic issues ranging from lessons on creating sustainable economic growth to the implications of government tax and fiscal policies.

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De Rugy writes regular columns for *Reason* magazine and the *Washington Examiner*, and she blogs about economics at *National Review Online*'s the *Corner*. Her charts, articles, and commentary have been featured in a wide range of media outlets, including the *Reality Check* segment on Bloomberg Television's *Street Smart*, the *New York Times*' *Room for Debate*, the *Washington Post*, the *Wall Street Journal*, CNN International, *Stossel*, *20/20*, C-SPAN's *Washington Journal*, and Fox News.

Previously, de Rugy has been a resident fellow at the American Enterprise Institute, a policy analyst at the Cato Institute, and a research fellow at the Atlas Economic Research Foundation. Before moving to the United States, she oversaw academic programs in France for the Institute for Humane Studies Europe. She received her MA in economics from the Paris Dauphine University and her PhD in economics from the Pantheon-Sorbonne University.

Chairman WEBER. Thank you, Dr. de Rugy.

We are going to start with the questions portion. I will recognize myself for five minutes.

Dr. Danielson, the Administration often explains EERE's large budget by describing the office in three major categories, and I think you went through them, transportation, renewable power, and energy efficiency. By the way, I own an air conditioning company, I have for 34 years, so I am—energy efficiency is something that we deal with frequently, power requirements and those types of things. But even after dividing the EERE budget into these three categories, each category exceeds the allocation for nuclear or fossil energy research and development. Now, Dr. de Rugy made the comment that no one knows going into the future with certainty what is going to be the best form of energy, and while, you know, our crystal—my crystal ball doesn't work, apparently the battery is ran down, didn't have enough energy, I have to say the nuclear is probably a good possibility. So each category exceeds the allocation for nuclear or fossil energy research and development in the fiscal year 2016 budget request, with transportation actually funded at $793 million, renewable power funded at $645 million, and energy efficiency at $1 billion in the proposal. By contrast, fossil energy R&D is $560 million, nuclear energy R&D is $482 million, and each individual account in EERE is more than either one. In fact, the proposed budget for EERE is almost two times, as I said in my opening statement, more than the budgets for nuclear, fossil and electricity R&D combined.

Do you think, and you—I mean you say that those three offices combined, as it were, you heard the figures, do you think this represents a balanced, all-of-the-above approach to energy research and development, and do you believe these EERE programs are more valuable to the American economy than research on our electric grid, fossil energy or nuclear energy R&D? And I will let you answer.

Dr. DANIELSON. Well, thank you, sir. Thanks for that question. It is an important one.

We and I do believe this is a reasonably balanced agenda as you look across the different sectors the DOE invests in. You have pointed out that fossil energy is at $842 million, nuclear energy at $907 million. Sustainable transportation is about $793 million, which is comparable to those numbers. That set of offices is where we do most of our work that relates to the transportation sector, which is where our foreign oil dependence is.

Chairman WEBER. Okay, but aren't you quoting the figures for the whole office, not just the R&D portion?

Dr. DANIELSON. Yes, I am quoting for the whole office.

Chairman WEBER. Okay, but we are wanting to compare the R&D portions of that spending.

Dr. DANIELSON. Okay, so in terms of R&D, I think maybe a better way to look at it is that the sustainable and transportation office is around $793 million. It is an important area to emphasize in that our transportation sector is where our dependence on foreign oil is. If you look at renewable energy, which is where we are addressing the power sector, and technology and the power sector, that is at $645 million. The nuclear energy office exclusively ad-

dresses the power sector, and so I think comparing the renewable energy number and the nuclear number is a reasonable thing to do. And then we are the only office that is addressing efficiency in the built environment, which is a sector that is not addressed by the other offices. And if you take out some specific unique deployment-oriented programs such as the Weatherization Assistance Program, or Federal Energy Management Program and our Appliance Standards Program, that is at about $600 million of research and development.

So I do believe this is a well-balanced portfolio. The Secretary is always very clear that we are funding all-of-the-above in the context of a low-carbon future, and in addition, that we are not looking to prescribe market share, we are looking to innovate across the board and let the market determine what the market share will be.

Chairman WEBER. Well, let me get to my second question. Considering that the budget has grown, as I said earlier, 58 percent in the last decade, what successes would you—what reasons would you point to to tell us why the office needs to grow another 42 percent?

Dr. DANIELSON. Well, we are at a unique time in the history of a number of the technologies in the EERE portfolio where, after decades of long-term investment, we have gotten to the point where direct cost competitiveness is in our sights in the next, you know, 5, 10, 15, 20 years for a number of these technologies. And we are also seeing significant investments overseas to try to gain advantage in these areas, and so——

Chairman WEBER. I don't mean to cut you off. I get that but, of course, obviously, with our deficit and the way the economy is now, then we ought to really, really be focused on as much cost-cutting as we are about to have some super expenses.

Mr. Loris, would you agree with his thoughts on the fact that the—this is an above—you know, all-of-the-above approach?

Mr. LORIS. I would agree in the sense that it is an all-of-the-above approach to reduce costs, and it is not a proper role of the government, and we should have the same scrutinies of the Office of Fossil Energy, the Office of Nuclear Energy to get rid of all of these things.

Chairman WEBER. Okay. Ms. McCormick?

Ms. MCCORMICK. I think this is——

Chairman WEBER. Turn your—there you go.

Ms. MCCORMICK. I agree with Dr. Danielson, this is a critical time for these industries. We have seen significant cost reductions, and now is not the time to let those go.

Chairman WEBER. Irrespective of an $18 trillion deficit?

Ms. MCCORMICK. Well, things will have to be balanced. I think that we are looking for stable and consistent funding so that these industries can continue this momentum of growth.

Chairman WEBER. Okay. Dr. de Rugy, how about you, do you agree with Dr. Danielson?

Dr. DE RUGY. I mean I actually think—I agree that—with Nick that it is not the role—the proper role of the federal government, and a lot of the time when we talk about the benefit of a given program, it is because we actually don't look at the net cost. We don't look at the jobs that are actually lost, the impact on competition.

We don't look at, you know, we don't look at a lot of things, so these benefits are—happen as if they have happened in a vacuum.

Chairman WEBER. All right. Thank you for that. I am past my time. I am going to yield to the Ranking Member, Mr. Grayson of Florida.

Mr. GRAYSON. Thank you. I have never worked in an air conditioning business. I had the burden of actually being in an economist for a few years, and before that studied economics, a further burden that I share with some of you apparently.

So let us start with Dr. de Rugy. You mentioned that one of the legitimate functions of government is the creation of public goods. What is a public good?

Dr. DE RUGY. Public good is something that the private sector wouldn't produce, and that would benefit everyone.

Mr. GRAYSON. And why is it the private sector doesn't produce public goods?

Dr. DE RUGY. Usually because the cost is too high, and no one is willing to invest in it.

Mr. GRAYSON. Well, also because not a single commercial entity can internalize all of the generated profit, isn't that correct? Isn't that the essence of a public good?

Dr. DE RUGY. Yes.

Mr. GRAYSON. All right, so isn't knowledge a public good?

Dr. DE RUGY. Knowledge is a public good, but—actually, no. No. We have a lot of investment—private investment in knowledge, and——

Mr. GRAYSON. Well——

Dr. DE RUGY. —private investment in energy too.

Mr. GRAYSON. That is true, but you cannot internalize inside one company the benefit that comes from knowledge, and that includes scientific knowledge, doesn't it?

Dr. DE RUGY. But the government is very bad at actually knowing anything, and one of the reasons is because there is no cost and benefit, there is no profit and losses, which is the way, as we know, since Friedrich Hayek, actually the market disperses the knowledge across millions of actors in the most efficient way.

Mr. GRAYSON. Well, that sounds more like ideology than economics to me——

Dr. DE RUGY. That is actually——

Mr. GRAYSON. —Dr. de Rugy.

Dr. DE RUGY. Well, actually, it is interesting because——

Mr. GRAYSON. And I am very familiar with the work of——

Dr. DE RUGY. —Larry Summers has said that this insight of Hayek is the most important economic insight of the 20th century, so I don't think——

Mr. GRAYSON. All right, well, you agree with me that one company cannot, for instance, internalize the benefit that comes from conservation? That is a benefit that is spread across dozens if not hundreds of different companies, even in our economy, and probably thousands in the world economy. Isn't it true that scientific knowledge in the form of better conservation cannot be internalized and, therefore, it is a public good?

Dr. DE RUGY. I don't agree.

Mr. GRAYSON. Mr. Loris——

Dr. DE RUGY. Actually, we see——
Mr. GRAYSON. —what about you?
Mr. LORIS. I wouldn't agree either. I think there——
Mr. GRAYSON. Really?
Mr. LORIS. —are plenty of opportunities for the private sector to invest in conservation and make a profit from it.
Mr. GRAYSON. So you wouldn't even concede that the government should generate public goods as Dr. de Rugy did in her opening statements?
Mr. LORIS. I think the proper role for—is to focus on more of the things that the Office of Science does, which is——
Mr. GRAYSON. Answer my question please.
Mr. LORIS. Could you repeat the question?
Mr. GRAYSON. The question is would you concede that the government does, in fact, have a role in creating public goods, or you wouldn't even believe then scientific research should be done to create those public goods?
Mr. LORIS. I think it would depend on the circumstance.
Mr. GRAYSON. Well, the circumstance——
Mr. LORIS. Which public good are you talking——
Mr. GRAYSON. —is the creation of a public good in the form of scientific knowledge.
Mr. LORIS. Scientific knowledge, sure.
Mr. GRAYSON. Yes. Okay, good.
All right, now, what about externalities. Tell me what an externality is.
Mr. LORIS. An externality is, you know, something that is not captured by the production of a good, such as pollution, or external benefits coming from the production of a good as well.
Mr. GRAYSON. All right, so would you agree with me that it is a legitimate basis for scientific research by the government to address the market inefficiencies that are caused by externalities like pollution——
Mr. LORIS. No.
Mr. GRAYSON. —which is caused by fossil fuels and not by most renewable energy?
Mr. LORIS. No, I don't think the most efficient way to internalize a negative externality is through government programs——
Mr. GRAYSON. I didn't ask you whether it was the most efficient way, I asked you whether that was legitimate.
Mr. LORIS. No, I don't—not spending money on scientific research to internalize negative externalities, no, I don't believe that is a——
Mr. GRAYSON. Well, again, I feel like I am hearing more ideology than I am economics at this point.
Back to you, Dr. de Rugy. Would you agree with me that a barrier to entry is a legitimate form of a market imperfection that could be addressed by the government?
Dr. DE RUGY. Well, very often the government is responsible for putting up——
Mr. GRAYSON. Oh, my goodness, can I just——
Dr. DE RUGY. —barriers to entry.
Mr. GRAYSON. —have the question answered?

Dr. DE RUGY. Well, usually, if a government—if a private sector has a monopoly and the government tries to break it——

Mr. GRAYSON. What is a barrier——

Dr. DE RUGY. —I think——

Mr. GRAYSON. —to entry, Dr. de Rugy?

Dr. DE RUGY. It is—the barrier—like you have a company that has a monopoly and a—and prevents other companies to getting in because the costs are too high for these companies to compete.

Mr. GRAYSON. Okay. So lack of capital is a barrier to entry, is it not? And that lack of capital is addressed by scientific research done by the government——

Dr. DE RUGY. Actually——

Mr. GRAYSON. —isn't that correct?

Dr. DE RUGY. Actually, this is an excuse used by the government, and there are many, many instances to justify their program, and when you actually look at the supposedly market failure that the government identifies, there is none. And the private sector is the best one use—is the best player to actually come up with solutions to whatever lack of capital. Look at the——

Mr. GRAYSON. All right, your excuse is other people's reason——

Dr. DE RUGY. —export/import bank——

Mr. GRAYSON. —and progress, but let us finish with this since my time is almost running out. We spend $6 trillion each year on energy, we being the human species, humanity. We spend $6 trillion a year. Now, let us suppose, hypothetically, that someone could spend $200 billion and create free energy forever. You will agree with me that that would be an enormous rate of return, would it not? Yes?

Dr. DE RUGY. If——

Mr. GRAYSON. Mr. Loris? Yes?

Dr. DE RUGY. It would be.

Mr. GRAYSON. Enormous rate of return.

Dr. DE RUGY. Yes.

Mr. GRAYSON. Right, Dr. de Rugy? Enormous rate of return, right? Can you identify for me anybody now operating in the renewable energy sector that could come up with $200 billion and do that?

Dr. DE RUGY. But you are assuming that, for instance, if there is a market failure, which I don't concede there necessarily is in the energy market, that actually it a necessary and sufficient condition for the government to invest. The way the government invests because the decisions are driven by politics——

Mr. GRAYSON. All right, Mr. Loris——

Dr. DE RUGY. —is actually——

Mr. GRAYSON. —would you like to answer my question?

Mr. LORIS. I think there are six trillion reasons for the renewable energy sector to capture opportunities, and they don't need any more.

Mr. GRAYSON. Can you identify for me a single company in the renewable energy sector that could raise $200 billion, even if it was to eliminate the cost of energy forever, one company?

Mr. LORIS. I don't know the answer to one company, but I know you have a lot of companies like BP and major fossil fuel producers that invest in renewable opportunities to capture——

Mr. GRAYSON. Which puts those——

Mr. LORIS. —those opportunities too——

Mr. GRAYSON. —out of business if they actually did that research.

Mr. LORIS. Largely——

Mr. GRAYSON. All right, thank you.

I yield back.

Chairman WEBER. The gentleman yields back.

And now recognize the gentleman from Washington, Mr. Newhouse.

Mr. NEWHOUSE. Thank you, Mr. Chairman. Appreciate it. And thank you all for being here and helping us look at the Department's request for the budget for EERE, and a very interesting conversation.

Could I ask a question of you, Dr. Danielson? I come from the Pacific Northwest where we are blessed with—I would say a diverse mix of energy, including hydro, wind, nuclear, gas, also utilize energy efficiency. We are also a leader in modernizing our electric grid with the forward-thinking utilities and world-class research that—institutions like the University of Washington, my alma mater, Washington State, and also the Pacific Northwest National Laboratory, which all worked together to develop test beds to take research from the lab to demonstrate new innovative technologies.

The Secretary appeared before us, I believe it was in February. He discussed the DOE's grid modernization which is very much in line with what we are trying to do in the State of Washington. So could you clarify for me the EERE programs which will advance the grid modernization, and how those investments will benefit states like mine?

Dr. DANIELSON. Well, thank you for that question, Congressman. And congratulations on PNNL's 50th anniversary recently.

Mr. NEWHOUSE. Thank you.

Dr. DANIELSON. There are some key areas where we are making innovation investments as it relates to grid modernization. One area is in the area of predicting solar and wind resources much more accurately, so using advanced modeling and simulation to develop tools that would actually allow utilities to know how much wind and solar are coming and when, which would allow them to much more effectively operate the grid.

We are also, you know, one of the most exciting and important emerging opportunities we have as it relates to the grid is the dramatic reduction in cost of distributed energy technologies. So Americans, more and more, have the opportunity to actually generate their own power on-site, whether it is photovoltaic power, combined heat and power from combustion to fuel cells. And also with the emergence of advanced information technologies over the last couple of decades, we now have the opportunity to set up a truly transactive market where, instead of having a modern—a grid system that only has a few hundred or a thousand generators controlled, we can actually empower the consumer to interact with the grid in a real-time way, and so that is something we are spending a lot of time and effort and innovation in is enabling that market—

that transactive market so that homes can transact with the grid in a cost-effective way.

Mr. NEWHOUSE. Could I also ask you to help us understand why this is all a role of government, and why the electric industry, which owns a lot of the grid, is not modernizing on its own? And maybe that relates to some of that what we have already been talking about.

Dr. DANIELSON. When I get together with folks from across the utility industry, from the solar industry, from Public Utility Commissions, they all realize and recognize that the most cost-effective way to get to a low-carbon future will likely involve distributed energy, but making that transition is difficult. And so we have a Grid Modernization Laboratory Consortium where Pacific Northwest National Lab is the lead, where we are working with utilities to help them understand what those least-cost approaches are going to be, and how can they make the best transmission and distribution investments to enable the most cost-effective, reliable, resilient grid going into the future.

Mr. NEWHOUSE. Thank you, Doctor.

My time is getting short, so quickly, I am going to ask you about the energy storage R&D that is scattered throughout several areas. Let us see, it is the Office of Science, the Joint Center of Energy Storage Research, the ARPA–E, Energy Storage Program at the Office of Electric Delivery and Energy Reliability, Vehicle Technical Program—Technologies Program, Solar Energy Program, Hydropower Program. There is—the list goes on. So how many battery and energy storage programs can there be found within the agency, and can you tell me that we are sure that the highest priority is—research is funded so that we avoid duplication?

Dr. DANIELSON. Thanks for that question. It is an important one.

Just in the last few years, the Department of Energy has set up internal Tech Teams that have representatives from each of the offices of relevance, and in areas like grid storage or energy storage. And so we are actually very tightly coordinated, and if you look at each and every one of those efforts, they are distinct, they are synergistic, and they do not overlap. And so both in terms of our energy storage work that is related to electrified transportation, which is the primary role of our Vehicle Technologies Office, and then when you look at grid storage, that is a little bit more spread around the Department, including primarily the Office of Electricity, but also our Water Power Program does research in hydropower, which is not done in the Office of Electricity. And so it is a—spread around in a way that I think is perhaps unfortunate and not transparent, but it is highly coordinated.

Mr. NEWHOUSE. Good. Good. I appreciate that.

Mr. Chairman, I yield back the negative amount of my time.

Chairman WEBER. Thank you, Mr. Newhouse. We will carry that over for next hearing.

The Chair now recognizes the gentleman from Illinois, Mr. Lipinski.

Mr. LIPINSKI. Thank you, Mr. Chairman. If we did that, it would really shorten things up, you know. So I had better get going.

I believe that the work that EERE does is critical to achieving a sustainable energy future and growing our nation's energy econ-

omy. We see that the technologies developed at EERE provide a more robust energy portfolio, reduces our impact on the environment, and enables a growing U.S. clean energy industry. So I am glad to see the 2016 budget request is doing more to support clean energy innovation and make the United States a leader in the clean energy marketplace.

So a couple of questions, I want to see how many of these I can get to about some of the things the EERE is doing. And I am going to start with a question for Dr. Danielson. We saw that Paris just temporarily had a ban on half the cars from driving, in response to smog problems. Transportation contributes to almost 1/3 of emissions in the United States. Electric vehicles can enable more environmentally friendly transportation, and at Argonne National Lab, which is in my district, they are working to develop new battery technologies that will enable cheaper, longer-range electric vehicles. Can you describe the biggest challenges to widespread use of electric vehicles, and how strong funding for EERE is helping to improve vehicle technologies?

Dr. DANIELSON. Well, thanks for that question. You know, the biggest—the longest pole in the tent as it relates to electric vehicles having a cost-competitive situation versus traditional vehicles is really in the battery cost. And as you mentioned, our Argonne National Laboratory has been an absolute powerhouse in terms of developing new advanced lithium-ion battery technologies. Indeed, they have developed basically a battery that is twice as good as any other battery out there, and early versions of the material they have developed are now getting into the market. But I am very optimistic. You know, right now, if you look at the technology we have, we are at about $300 per kilowatt hour. Something like a 100-mile electric vehicle would pay back at that price over five years. A plug-in hybrid of 40 miles electric range would pay back at about $200 per kilowatt hour, and a 300-mile electric vehicle would require a battery cost of about $125 per kilowatt hour. So we are at about $300 per kilowatt today, but with continued investments in innovation, using the cutting-edge scientific facilities at Argonne, in addition to an applied set of researchers that we are supporting there, and we have since the 90s, we are confident that we are going to get to that cost goal in the 2020 time frame.

Mr. LIPINSKI. Very good. I want to move on to the role of DOE commercialization. In your testimony, Ms. McCormick, you mentioned that you don't think DOE's mission stops at the laboratory bench. And I thank you for recognizing the importance of getting innovative technology transitioned to the marketplace.

I want to ask, can you describe why federally-funded technology transition programs are critical to bridging the valley of death between lab and market, and I just want to mention the—I know Lab Corps is starting up, which I think is going to be very helpful, but can you talk about the important role of the federal government here?

Ms. MCCORMICK. Yes, thank you. The Business Council for Sustainable Energy represents a broad range of energy technologies, so the answer to that question is unique to each industry. It is a little bit different for each one, depending on where they are and what they do. But I am hearing pretty universally from the technologies

within our coalition about the need for the government to be a neutral player to help industries as they break into these markets, and some of these issues related to things like grid integration or some of these soft costs that are mentioned, for example, for some industries like the solar industry, because they do not have a financial vested interest in the electricity grid. They can sometimes share best practices from the states, and learn and share that information to other states and to other players across the country. So I think that the Department of Energy is uniquely positioned to provide that kind of technical assistance, and provide the ability for these technologies to break into the market, because the electricity sector is a regulated industry, and it has layers of regulation; the federal level, the state level, is it not an open free market, and there are reasons for that. And so the Department of Energy can offer a lot of assistance to these technologies that are not legacy technologies, but are newer and more innovative.

Mr. LIPINSKI. Thank you.

With my few seconds left, I just—I have a question for the record about hydrogen and what EERE can do with that. As the author of the H–Prize Act, I am very happy to see that moving forward right now. So with that, I will yield back.

Chairman WEBER. Is the gentleman requesting that question be read into the record or made a part of the record?

Mr. LIPINSKI. I—are we going to have five days to submit?

Chairman WEBER. Yes, absolutely, without a doubt.

Mr. LIPINSKI. Yes.

Chairman WEBER. Okay, thank you.

Chair now recognizes the gentleman from Kentucky, Mr. Massie.

Mr. MASSIE. Thank you, Mr. Chairman.

First off, I want to let you know I drive an electric car, although I suspect the electrons providing the electromotive force this morning to get me here came by virtue of the combustion of fossil fuels. So I have a Friends of Coal license plate on my electric car. I also live in a house that has a 13 kilowatt solar array on it, and I am very interested in these things. I tell republicans that you can dislike the subsidies, I dislike the subsidies, but you shouldn't hate solar panels because they are rocks that make electricity, and that is a pretty virtuous rock.

But let me ask you about this, and I have some experience in this. Mr. Danielson, if you wanted to install another megawatt of production capacity in our country, would it be cheaper to do it in a solar form or on 100 households with 10 kilowatt arrays?

Dr. DANIELSON. You know, I don't know the direct answer to that question. So the big difference that—I would have to just do the calculation, would be is that your——

Mr. MASSIE. Is it cheaper to put a whole bunch of these up on roofs—on the roofs of houses? To climb up on the roofs——

Dr. DANIELSON. Okay.

Mr. MASSIE. —drill holes in your roof, risk falling off, like I have done, so I am very familiar with this, or to just build a solar farm—a centralized——

Dr. DANIELSON. Thank you for that clarifying question.

Mr. MASSIE. Okay.

Dr. DANIELSON. The—it is cheaper to build a centralized solar power plant per kilowatt hour, per megawatt than it is for a distributed——

Mr. MASSIE. It is——

Dr. DANIELSON. —but what I would like to point out is that it is a different—we are—it could be a different value, that if you are putting a rooftop system in, you are avoiding the retail rate, whereas if you have a centralized system, it is putting power into the grid——

Mr. MASSIE. Right.

Dr. DANIELSON. —at a wholesale rate.

Mr. MASSIE. And you get out of some taxes, I suppose. But the grid has to be designed for the worst case, not the best case or the average case, right? So——

Dr. DANIELSON. Okay.

Mr. MASSIE. —because solar power is so variable, it still really doesn't do anything for design—for redesigning the grid. I suspect it will always be the case that it is cheaper to put in a larger facility than to go up on your roof and drill holes and do all these distributed installations. So why is our government so fixated on subsidizing the installation of all these distributed systems, which can't even begin to approach the cost-effectiveness of a more centralized system?

Dr. DANIELSON. Well, this is something that we are looking to tackle with our Grid Modernization Laboratory Consortium is to look at long-term planning and system-level costs so that, you know, if you are able to put quite a bit of distributed solar out there, could that reduce your cost of building out more distribution or more transmission. And so, you know, we would want to make sure to do that analysis from a system-level cost basis.

Mr. MASSIE. Right. Okay. Well, I want to ask another question because, again, you have to design for the worst case, and without a better battery, you are basically not going to improve the situation. You talked about your five criteria; impact, additionality, openness, economic benefit, proper role of government. Can you motivate a $7,500 subsidy for a $100,000 car in those five terms? Specifically, I am talking about the federal tax credit for cars—electric cars that—luxury vehicles that cost $100,000. What is the price elasticity for a $100,000 luxury vehicle, and how many more—has the government gone back to study how many more of those have been sold, and what the economic benefit to all of society is because of that tax credit?

Dr. DANIELSON. So on your first question related to the application of the five core questions of EERE, we don't administer the subsidy programs, so those questions wouldn't—I didn't develop those——

Mr. MASSIE. Okay.

Dr. DANIELSON. —I developed those with innovation programs in mind. And then can you repeat your second question?

Mr. MASSIE. Well, I am concerned about, is that an efficient way to achieve goals, to subsidize a luxury good?

Dr. DANIELSON. Well, what we have seen in the development of many technologies, including clean energy technologies, is that, you know, this is something I saw when I was in the business world,

is that innovative new technologies often find application in first markets where customers are willing to pay. For example, 35 years ago photovoltaic started in satellites. Now we have reduced the cost by 99 percent, and so now they are getting into the grid market. So I think an expensive electric vehicle, let us say such as what Tesla makes, is a first market adopter chance to get the EV industry going and drive volume——

Mr. MASSIE. So I will point out——

Dr. DANIELSON. —and drive——

Mr. MASSIE. —for economic benefit or additionality that all of those subsidies add up to about $500 million, which is two percent of their market cap. So I find it hard to believe that it wouldn't have happened without that subsidy.

While I have a little bit of time left, I want to ask when was the car invented?

Dr. DANIELSON. Geez, I don't know the exact——

Mr. MASSIE. At least 100 years ago?

Dr. DANIELSON. Yeah. Yeah.

Mr. MASSIE. And it is fundamentally the same architecture. So why are we doing car research? When we do electric or vehicle battery research or fuel cell vehicles, you mentioned, shouldn't we be doing research on fuel cells and batteries and not the vehicle itself or the application to the vehicle? I mean after all, the batteries that are in the car that you mentioned came literally from a laptop, so why is it more virtuous if it is a vehicle when we know, in general, we need battery technology? Shouldn't we be focused on basic research instead of trying to iterate on something that—whose basic architecture was settled 100 years ago?

Dr. DANIELSON. Well, one thing I will point out is that the preponderance of the work we do at EERE is applied research, and early stage applied research. And so it is really cutting-edge innovation. It is not basic research in the sense that it is just exploratory and really intending to create knowledge—we are actually trying to develop technologies. And so I did want to emphasize that. But when we do analyses and look at what the impact can be, there is a lot of room for improving the efficiency of the combustion engine. There is a lot of room for improving the materials that a car is made of to make it much more lightweight. And we also see great opportunity in fuel cells and electric vehicles, and we are looking to innovate in these areas and help achieve cost reduction in these technologies, but it is ultimately going to be the market that will decide which of these get into the market.

Mr. MASSIE. All right, my time has expired.

Chairman WEBER. Gentleman yields back.

The gentleman from Texas, Mr. Veasey, is recognized.

Mr. VEASEY. Thank you, Mr. Chairman. I appreciate that.

And I wanted to ask about wind energy, particularly to Dr. Danielson. Dr. Danielson, you may know that in Texas, we are basically the king of wind. We have about 20 percent of the capacity nationwide coming out of our state. Most of that was done with tax credits and different things like that. Some of that was actually done when Mr. Weber and I were serving in the Texas legislature together, and so we are very proud of what it means to our economy, and would hate to see our economy, you know, wrecked by

any policy that would reverse the progress that we have made in delivering wind to our state, and the—and what that has meant for the entire country.

And I wanted to ask you in particular about wind, and what sort of research that you guys are doing to make wind even more efficient. Like one of the things that I would like to see with wind, for instance, is, if you have ever been out to west Texas, you will know that it takes up a lot of space. It takes up a lot of landmass. What are we doing to make it to where wind or wind turbines can be moved in various locations, and maybe made even more efficient to deliver the same amount of capacity as they currently do?

Dr. DANIELSON. Well, thanks for that question. You know, one of the areas that we—is our primary research and development focus in wind is in wind plant optimization. So you find that when—if you have a wind turbine all by itself, it performs in a certain way. When you bring it into a farm, you typically get 30 percent reduction in the power output because of the way that the turbines interact with each other. And you also find that some turbines are getting a lot of turbulence from the turbine in front of them, and they will break in a shorter period of time than others. And so we have a consortium around our national laboratories focused on taking advantage of high-performance computing capabilities and advanced modeling simulation in the area of fluid dynamics to try to figure out how do you put together a wind farm, and how do you control it in a way that you can get that 30 percent back. So if you could get 30 percent more energy out of a windfarm without putting any more hardware on the ground, that is a significant cost reduction to drive wind towards direct cost-competitiveness nationwide.

Mr. VEASEY. One of the things that often surprises people when I visit one of the windfarms down in Midland, where they obviously produce a lot of oil too, I was asking the guy that was working out there at the windfarm about the generator at the bottom of the windmill, and he was explaining that, he said they actually use oil—a renewable oil, almost like a refined oil, like a 40-weight that you would use to change the oil in your car, they use this in the bottom of the windmill in order to, I guess, keep the generator going and to keep everything lubed. How much petroleum products are they—does wind currently use in order to make the windmills run properly?

Dr. DANIELSON. Thank you for that question. I actually don't know the answer to that question, but I would be more than happy to take it for the record and find an answer to that question.

Mr. VEASEY. Okay. Well, thank you. I appreciate that. And I did—I had a question for Ms. McCormick too. I just wanted to know just about some federal research investments in wind technologies that are impacting the growth right now in the wind energy sector.

Ms. MCCORMICK. Well, I do know that the wind industry is requesting and is supporting some of the funding that the Department of Energy is proposing for studying the impact on wildlife, so that they have some specific clarifications that they are looking for in the DOE budget, but obviously that is an issue that the industry is interested in seeing further research on.

Mr. VEASEY. Okay.

Thank you, Mr. Chairman. I am going to give back some of the time that we lost a little bit earlier.

Chairman WEBER. Well, good. Will you credit that to the gentleman from Washington's account?

Mr. VEASEY. I will do that.

Chairman WEBER. Okay.

Mr. VEASEY. Yes.

Chairman WEBER. Thank you.

Mr. VEASEY. Happy to.

Chairman WEBER. And the gentleman from Colorado, Mr. Perlmutter, is recognized.

Mr. PERLMUTTER. Thank you, Mr. Chairman. And thank you to the panel for appearing today. Thank you for your testimony.

Obviously, Dr. Danielson, I just want to congratulate you at EERE and the Department of Energy for its part—its role in really reducing the cost of photovoltaics, wind turbines, biomass efforts, because I would say that I am about competition, and the more competition that we have among energy sources the better off we are going to be. And we are seeing a reduction in demand, so that may be the efficiency side of EERE. We see other sources in terms of photovoltaics, wind, biomass, fusion, nuclear, all as competitive pieces, and now we see a giant drop in the price of oil which, in the past, has been difficult for the energy sector as a whole because it wiped our domestic energy, you know, whether it was oil and gas, fossil fuels, coal, or renewables. Our renewable energy efforts, can it withstand this drop in oil prices, Dr. Danielson?

Dr. DANIELSON. Well, thanks for that——

Mr. PERLMUTTER. Will people continue to participate in this?

Dr. DANIELSON. Thanks for that question. You know, it is actually the shale gas boom that is creating a more competitive environment in terms of natural gas power generation. And so there is no doubt that if those prices remain where they are, that other forms of energy, renewables or any other, nuclear, are going to have an even lower price point to compete with to be competitive. But there are benefits to diversity in any energy system. There are many folks out there co-ops, for example, who operate their own grids who see value in the lack of a fuel cost associated with renewables, so as they are building out a portfolio of, let us say, natural gas-powered assets, they want to include renewables in that portfolio as a way to mitigate risk against price changes in natural gas, for example.

Mr. PERLMUTTER. And I guess I would ask the economists on the panel. Mr. Loris, you, Dr. de Rugy, I mean I guess I am taking it as an axiom that more competition is better than less. Would you agree with me on that?

Mr. LORIS. Well——

Dr. DE RUGY. More competition—yeah, go ahead.

Mr. LORIS. Go ahead.

Dr. DE RUGY. Go ahead.

Mr. LORIS. Please.

Dr. DE RUGY. Yeah, no, more competition is good, but the problem with——

Mr. PERLMUTTER. It was a yes or no.

Dr. DE RUGY. Yes.
Mr. PERLMUTTER. Okay.
Mr. LORIS. Yes.
Dr. DE RUGY. More competition is good.
Mr. PERLMUTTER. Okay. So, Dr. de Rugy, I want to—you know, we are talking about the politics, and we are in the Congress of the United States of America, this is politics here, okay, because different people have different desires for different things. And so I am speaking today as an elected official. I used to be a bankruptcy lawyer handling big Chapter 11 bankruptcies, so I got to see the dark side of business and take them apart. In connection with subsidies and incentives, do you know how much in way of incentives, either by oil depletion allowances or other kinds of deductions, we give to the oil and gas industry?
Dr. DE RUGY. I don't know the exact amount.
Mr. PERLMUTTER. It is about $13.4 billion, which is pretty much—if you take all the tax deductions available to the renewable energy sources, they are pretty equivalent. I think they are about the same, solar and wind. It may be in a perfect world we shouldn't provide any incentives to either one, but I am a guy who thinks I want more energy sources, not less, I want more competition, not less, and if I am going to subsidize one, I am going to support the other so that we can get the best of both worlds. Does that makes sense to you, or is that——
Dr. DE RUGY. Well, at least——
Mr. PERLMUTTER. —am I mistaken?
Dr. DE RUGY. At least you are consistent.
Mr. PERLMUTTER. Good.
Dr. DE RUGY. And see, I don't want subsidies on the fossil fuels that I don't want on green energy, so——
Mr. PERLMUTTER. Okay. The Chairman asked a question about, you know, our debt, and I serve on the Financial Services Committee as well, so it is the banking, stock market, housing, economy. And, you know, the one thing that I know from the last eight years having served on that, we had a surplus at the end of the Clinton Administration, Revenues exceeded expenses, and then we had two tax cuts, two wars, and a crash on Wall Street that is the bulk of the debt that this country has incurred. It wasn't the cost of EERE or any of the energy, or any of the other things. The bulk of it was these massive things and tax cuts, wars and crash. Would you agree with me on that?
Dr. DE RUGY. Yeah, you—yes. Too much spending——
Mr. PERLMUTTER. Okay.
Dr. DE RUGY. —for sure.
Mr. PERLMUTTER. Okay. Mr. Chairman, I appreciate the opportunity to serve on this committee, and I yield back.
Chairman WEBER. The gentleman yields back.
And we appreciate the witnesses and their testimony. In closing today's hearing, I do want to say that I hope we draw attention to the fact that there has been a huge 42 percent increase requested by the Administration in the budget which, in today's hard economic times, is going to be very, very tough, so I hope we have served to at least outline and discuss that back and forth. Thank you for your valuable testimony. Thank you for sitting through our

questions. Thank the Members for their questions. The record will remain open for two weeks for additional comments and written questions from Members.

The hearing is adjourned.

[Whereupon, at 4:02 p.m., the Subcommittee was adjourned.]

Appendix I

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. David Danielson

QUESTIONS FROM CHAIRMAN LAMAR SMITH

Q1. What percentage of EERE's funding supports research and development programs, versus the percentage that supports deployment and commercialization activities?

A1. Approximately two-thirds (66%) of the Office of Energy Efficiency and Renewable Energy (EERE)'s programmatic budget request (exclusive of corporate support activities such as program direction and funding for research and development facilities at the National Renewable Energy Laboratory) directly supports research, development, and demonstration activities. Approximately 24 percent supports commercialization and deployment activities. Most deployment funding is distributed to States and localities via formula-based weatherization assistance grants and the State Energy Program. The remaining 10 percent of EERE's programmatic budget request supports other essential activities such as return-on-investment analyses, technology integration, R&D management, and congressionally mandated standards development.

Q2. The multi-year trend in Congressional appropriations is far more modest than the budget proposed by the White House, providing little-to-no growth in the budget for science and energy research. If the budget for EERE remains flat in FY 2016 appropriations, how will you adjust this budget proposal to meet enacted levels?

A2. The President's FY 2016 Budget Request would enable the Department of Energy (DOE) to adequately support its mission of enabling the transition to a clean energy future with low-cost, all-of-the-above energy technologies. Under the FY 2016 Request, EERE would invest $2.7 billion toward continuing its focus on growing the domestic clean energy industry, increasing energy productivity for American businesses, and expanding access to renewable power and alternative vehicles. EERE would 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.

DOE looks forward to working with Congress to support the President's Budget Request in order to grow the United States' clean energy economy. However, the Department

cannot speculate on which EERE efforts would be impacted or adjusted as a result of any final FY 2016 appropriations bill passed by Congress.

Q3. The budget request includes a substantial increase in spending for EERE-from 1.9 billion in FY 2015 to over 2.7 billion for FY 2016-a 42% increase. Do you believe EERE is capable of effectively managing such a large increase in funds?

A3. Yes. EERE has a highly skilled workforce and the project management processes in place to steward the taxpayer's investment. There is a $5.3 million increase in program direction that allows EERE to hire an additional 22 technology managers and other critical staff to help manage the increase in requested program funding.

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.

Q3a. What about the ongoing personnel and management issues that exist within EERE? For example, an April 2014 Special Report from the Department's Inspector General found that EERE suffered from "problems with the work environment and poor morale" that "clearly had an impact on program operations." The report goes on to state that employees repo1ied feeling pressured to avoid cooperation with the Inspector General. In the rep01i, the Inspector General recommended that there be an independent review of personnel matters within EERE to dete1mine the extent of personnel management

weaknesses and take any necessary disciplinary actions against individuals responsible for weaknesses identified. Was this independent review undertaken?

A3a. Yes

Q3b. Who managed this review?

A3b. DOE's Office of Hearings and Appeals conducted an independent fact finding analysis to determine the extent of personnel management weaknesses that may have contributed to the conduct of the IRIS project and subsequent Office of Inspector General review.

Q3c. What corrective actions have been taken?

A3c. The Office of the Under Secretary for Science and Energy reviewed the fact finding report prepared by the Office of Hearings and Appeals and, in collaboration with the Office of the General Counsel and the Office of the Chief Human Capital Officer, determined a path forward regarding personnel matters within EERE. Generally, corrective actions have involved the development of a comprehensive employee engagement strategy focused on employee roles, responsibilities and morale. This has included the development and utilization of targeted communication and training tools. EERE leadership has also participated in a number of management training activities.

Q3d. Was anyone removed from a management position as a result of the review?

A3d. While the Department does not comment on specific personnel actions, senior leadership has taken steps to address personnel issues identified in the independent fact finding analysis.

Q3e. Given the management issues within EERE, what guarantee can you provide that any funding provided by Congress for programs in EERE will be spent responsibly?

A3e. EERE is committed to efficient, effective management of taxpayer funds, and is well equipped to maintain this standard at the FY 2016 request level. 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 ARPA-E's 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: 1) more clearly defined roles and responsibilities in project execution by establishing uniform position requirements across the organization; 2) enhanced project management standard operating procedures; 3) guidance to more effectively negotiate detailed statements of project objectives for each project, including quarterly progress reviews and annual "Go/No-Go" milestones; and 4) end-of-project deliverables clearly oriented around accomplishments that can impact the energy marketplace.

Q4. In the FY 2016 DOE budget proposal, one of three primary goals listed for EERE is "reducing market barriers" for clean energy technologies. Some of the market barriers listed include "lack of reliable information", "inconsistent regulatory environments," and "workforce training gaps."

Q4a. What percentage of EERE's budget is allocated to this primary goal?

A4. DOE plays an important role in reducing barriers to the adoption of clean energy technologies in the market that are technologically ready. These barriers—such as a lack of reliable information on performance, burdensome or inconsistent regulatory barriers including permitting, codes and standards, and workforce training gaps— are reduced through activities that include the development of technology solutions to barriers, providing best practice information, sustaining and enhancing the clean energy workforce, and providing reliable, objective data.

EERE's market barrier reduction work accounts for a small portion of the overall budget because these are low cost, high value activities. EERE believes the FY 2016 Budget provides the most appropriate level of funding for these activities, which are essential to EERE's mission and help increase the impact of EERE's research, development, and demonstration portfolio.

Q4b. Does the Department provide other forms of energy with assistance addressing these challenges, or is this goal only for renewable energy?

A4b. There is a strong Departmental focus on addressing the "lack of reliable information,

inconsistent regulatory environments, and workforce training gaps." Improving availability of public information about emerging technologies is a mantra for all the applied energy offices, which typically invest in either cost-shared research, development and demonstration projects to advance the state of technology commercialization or in grant-supported research that is made publicly available. It is also worth noting that the Energy Information Administration is widely-recognized as the world-leading source for objective, survey-based statistical information about the energy landscape, including fossil, nuclear and other energy sources. Though the Department has a limited role in direct regulation beyond a few specific areas, we place strong emphasis on outreach and engagement with other agency, state, municipal, local and tribal authorities with regulatory responsibilities. In most cases, the Department is called upon to provide its technical expertise to inform and sometimes directly support development of regulatory processes and structures.

Q4c. Wouldn't you agree that coal and natural gas face "inconsistent regulatory environments" under EPA's power plant regulations?

A4c. The Clean Air Act provides EPA authority to regulate emissions of air pollutants. The proposed regulation would provide a framework for regulating carbon dioxide emissions from electric generating units. Comments regarding the regulatory consistency of the proposed rule should be directed to EPA.

Q5. The FY 2016 budget proposal provides significant funding for renewable power; increasing spending to $645 million -a 41% increase from FY 2015 enacted levels. Is any percentage of this increase being spent to address environmental mitigation challenges for solar and wind power, specifically concerns with the significant impact these forms of energy can have on wildlife habitat, specifically endangered species?

A5. The FY 2016 Budget Request for Solar Energy Technologies Office would fund new and ongoing research and analysis at the National Laboratories on a variety of efforts to reduce the balance of systems costs, including the impact of concentrating solar power (CSP) and photovoltaics (PV) on the environment, such as impact on wildlife. The Department has also previously supported environmental base-lining and mitigation strategies at CSP and PV plants. For example, work performed in cooperation with

Argonne National Laboratory (ANL) helped to provide a comprehensive evaluation of impacts of solar on avian species at facilities across the United States. In turn, ANL has identified several strategies to assist industry and state and federal governments in minimizing potential impacts of solar on avian species.

In addition, the DOE's FY 2016 Budget Request also supports a new $4.5 million research initiative under the Wind Program focused on Eagle Impact Mitigation Technologies. This effort would support the development and evaluation of advanced mitigation technologies that will help to better characterize and reduce potential impacts to eagles, and support industry in obtaining new permits required by the Bald and Golden Eagle Protection Act. An additional $5 million is requested in FY 2016 to expand the Wind Program's ongoing work to develop additional measures to mitigate deployment impacts of wind on key avian species and bats. This includes investing in novel detection and deterrence technologies for key avian species and bats to supplement bat deterrent work that began under an FY 2015 Funding Opportunity Announcement, and supporting research and development at the national laboratories to test these systems at operational wind turbines and improve their integration into wind facilities.

Q6. The FY 2016 budget request includes a proliferation of battery and energy storage R&D scattered throughout DOE, including in the Office of Science through the Joint Center for Energy Storage Research (JCESR), in ARPA-E, in the Energy Storage program at the Office of Electricity Delivery and Energy Reliability, and in the Vehicle Technologies program, Solar Energy program, Hydropower program, Geothermal program, and Advanced Manufacturing program at EERE.

Q6a. How many battery and energy storage programs can be found in DOE?

A6a. DOE serves a vital role in resolving major technical challenges associated with the widespread deployment of energy storage for grid and vehicle applications. DOE teams with industry, state and local governments, academia, and other Federal agencies to support the discovery of new technologies to improve the cost and performance of energy storage systems. These activities are intended to help catalyze the timely, material, and efficient transformation of the nation's energy system and secure U.S. leadership in clean energy technologies.

Because energy storage technologies and applications are wide-ranging, DOE has established a comprehensive, cross-cutting program to address the full spectrum of challenges, from fundamental research to demonstration and deployment. This strategy and associated efforts are described in the DOE's December 2013 Grid Energy Storage report. Further discussion of the trends and opportunities in energy storage will occur in the DOE's 2015 Quadrennial Technology Review, which is expected to be released later this summer. Core battery and grid energy storage efforts include:

- The Office of Science's Materials Sciences and Engineering Program which includes the Joint Center for Energy Storage and Research;
- The Office Electricity Delivery and Energy Reliability's Grid Energy Storage Program;
- The Office of Energy Efficiency and Renewable Energy's (EERE) Electric Drive Vehicle Battery Research and Development Program and Solar Systems Integration Program;
- The Advanced Research Projects Agency-Energy Robust Affordable Next Generation Energy Storage Systems (RANGE) and Full-Spectrum Optimized Conversion and Utilization of Sunlight (FOCUS) programs.

Other small energy storage efforts exist in programs across DOE and are focused on the application of energy storage to specific energy types. For example, EERE's Wind and Water Power Technologies Office is conducting a study on the feasibility of adding low cost modular pumped storage to existing domestic hydropower infrastructure.

Q6b. How can you make sure the highest priority research is funded and duplicative research is avoided?

A6b. DOE's program offices pursue specific research and development activities relevant to their focus area and share results widely across DOE. These efforts are coordinated by the Office of the Under Secretary for Science and Energy. Coordination across offices extends beyond budget planning; it also serves as a conduit for better coordinated communication with external stakeholders and as a connection for proactive synchronization of program execution.

Q6c. Wouldn't it make sense to cut out the overhead cost and risk of duplication by combining all of these various programs into one battery and energy storage program at DOE?

A6c. No. Because energy storage technologies and applications are wide-ranging, DOE has established a comprehensive, cross-cutting program to address the full spectrum of challenges, from fundamental research to demonstration and deployment. DOE's program offices pursue specific research and development activities relevant to their focus area and share results widely across the Department. These efforts are coordinated by the Office of the Under Secretary for Science and Energy.

Q7. The budget request for the Vehicle Technologies program receives one of the largest requested increases in EERE - with an FY 2016 request at $444 million, an increase of $164 million. The program is focused on reducing transportation costs by "replacing conventional fuels" and increasing efficiency using conventional fuels.

a. What portion of the budget for the Vehicle Technologies program is dedicated to research and development?
b. What portion of R&D within this program do you believe is beyond the scope of what could be accomplished by industry?
c. Why do you believe industry will not pursue this research and development?

A7. Approximately 78 percent of the FY 2016 Budget Request for Vehicle Technologies supports research and development of multiple technology areas including batteries and electric drive, vehicle systems, advanced combustion engines, materials, and advanced fuels and lubricants. Funds support a balanced portfolio of competitively-awarded projects with industry, universities, and others in the research community, as well as direct-funded work that leverages the unique capabilities and facilities at the Department's national laboratories.

Vehicle Technologies seeks to avoid research and development that industry can and should support on its own. Among the key questions considered when evaluating technologies and specific projects for funding are whether the work provides "additionality" beyond what industry can do on its own, as well as whether the effort is an appropriate role for government. In addition, Vehicle Technologies maintains regular and frequent communication with industry through its two partnerships – U.S, DRIVE,

for automotive technology research, and 21st Century Truck, for commercial truck technology research. These partnerships bring together the top scientists and engineers from DOE, including national laboratories, and industry partner organizations (including auto manufacturers, fuel companies, electric utilities, and engine and truck manufacturers) to discuss key barriers to commercialization, set technical targets, develop technology roadmaps, and evaluate research progress. This regular interaction (technical teams meet monthly) helps to avoid duplication of effort and ensure that DOE-funded projects remain focused on the critical barriers to technology commercialization that industry cannot overcome on its own.

Q8. The FY 2016 request for the EERE Bioenergy program is $246 million, with a goal of producing one billion dry tons of non-food biomass resources by 2030, and produce "cost competitive biofuels at $3/gallon of gasoline equivalent." Not only does this price and production goal not guarantee competitiveness for biofuels under current energy prices, but it does not address the ongoing challenges with scalability, cost of production, and lack of private sector investment in advanced biofuels without additional federal funding.

Q8a. How is the Department addressing these challenges in the biofuels program?

A8a. EERE believes that the target price of $3/gallon of gasoline equivalent is a realistic goal to enable advanced biofuels to be competitive with the wholesale gasoline market. EERE is focused on reducing costs and improving efficiencies along every part of the bioenergy supply chain, from feedstock production and logistics, to conversion technologies, process integration, and the demonstration of new first-of-a-kind biorefineries.

For example, over the past 10 years, the Bioenergy Technologies Office (BETO) made significant investments in reducing conversion costs for cellulosic ethanol, including dramatic improvements in reducing enzyme costs. In 2012, these advances allowed national laboratory scientists to achieve the modeled production of cost-competitive cellulosic ethanol for an Nth plan facility. Industry partners, such as POET-DSM and Abengoa, are using some of these technologies to build pioneer, first-of-a-kind plants, to produce commercial volumes of cellulosic ethanol.

Once large scale biorefineries have been validated through commercial operation, BETO believes that private investors will be willing to help successful companies finance the

replication and expansion of these facilities to enable those companies to more rapidly increase production, and displace a larger share of the fuels and products market.

Q8b. What percentage of funding for biofuels program is spent on research and development, versus the percentage that supports large-scale demonstration, deployment, and commercialization projects?

A8b. In EERE's FY 2016 funding request for BETO, approximately 36 percent of funding would support demonstration scale projects, and most of the remaining 64 percent would support R&D as additional advanced pathways to multiple biofuels and products are explored.

Q8c. Why do you think industry has not taken more initiative in developing biofuels when the global transportation market provides ample opportunity for new transportation fuels if biofuels became cost-competitive?

A8c. Industry stakeholders have already invested hundreds of millions of dollars in the construction of new biorefineries, including those that are cost-shared with DOE. Other investors and businesses have been reluctant to make more significant investments in the sector because there are still a number of technical and financial risks associated with the construction of first-of-a-kind biorefineries. Technical risks occur because the conversion processes have typically not been tested at these larger commercial scales, often involve process steps never used before and frequently include new equipment being used at that scale for the first time. These technical challenges lead to uncertainty of capital and operating costs for first of kind plants which leads to reluctance of financiers to invest or lend for large scale plants.

EERE is working to reduce these technical risks, and support demonstration-scale facilities to validate industrial processes for commercial production. In this way, EERE fulfills a central role of government to fill gaps in private-sector funding, and help de-risk new technologies which carry substantial economic, U.S. competitiveness, and environmental benefits.

Q9. The FY 2016 budget request includes over $1 billion for energy efficiency programs at the Department of Energy, with programs designed to reduce energy use in buildings, manufacturing, and transportation within EERE. EERE's energy efficiency programs,

particularly in the Advanced Manufacturing program, have frequently involved working with large companies, including LyondellBasell--one of the largest chemical companies in the world-and Dow Chemical.

Q9a. When we face an $18 trillion national debt, do we really need to be paying major corporations to invest in energy efficiency? Don't these large companies already have a market Incentive and capability to reduce their own energy costs?

A9a. Manufacturing is critical to future United States innovation, global economic competitiveness, and job growth. With opportunities to improve energy efficiency in specific manufacturing processes by 25 percent or more, the development and deployment of manufacturing technologies has multiple benefits in reducing both the energy footprint and associated greenhouse gas emissions from manufacturing as well as supporting the competitiveness in the manufacturing of new clean energy products. U.S. manufacturing can particularly benefit from technologies for energy efficiency across the board, as industry must continually improve productivity and efficiency to remain globally competitive.

While the majority of energy used by the U.S. manufacturing sector is currently consumed by several energy-intensive industries -- including, for example, large companies in the energy-intensive chemical industry, which accounts for over 20 percent of U.S. manufacturing energy use -- U.S. manufacturers of all sizes face barriers to adopting industrial energy efficiency technologies and approaches. To significantly increase energy productivity in the U.S. manufacturing sector, large and small companies in energy-intensive industries will need to be actively engaged in the development and deployment of energy-efficient technologies.

DOE works with a variety of stakeholders from industry, academia and research institutions to support research and development and address market barriers that will help U.S. manufacturers competitively manufacture clean energy technologies in the U.S. while increasing U.S. manufacturing competitiveness across the board by increasing energy productivity. With regards to helping manufacturers improve their energy intensity, DOE does not directly fund industry to deploy energy-saving technologies. Rather, DOE supports innovation in foundational energy-related advanced manufacturing

technologies, materials, and processes relevant to energy-intensive and clean energy manufacturing industries; and provides technical assistance to domestic manufacturers regarding different energy-saving technologies. These DOE-supported investments demonstrate to the U.S. manufacturing industry more broadly the technical and economic viability of innovating manufacturing technologies as well as improved energy management technologies and approaches.

For example, DOE Industrial Assessment Centers (IACs) help small- and medium-sized U.S. manufacturers save energy and become more competitive, while also educating and training the next generation of manufacturing sector workers. The IACs, located across the country at 24 major universities, conduct energy efficiency, productivity improvement, and waste-reduction assessments for small- and medium-sized manufacturers at no cost to them. This effort provides the opportunity to take advantage of promising advanced energy-saving technologies and approaches to small- and medium-sized manufacturers with no professional in-house staff the ability to perform such energy-saving assessments and opens the opportunity for them to take advantage of promising advanced energy saving technologies and approaches. Case studies of IAC assessments are available on our website at http://energy.gov/eere/amo/industrial-assessment-centers-iacs.

Q10. During the last Congress, the Science Committee invested a great deal of effort to reach bipartisan agreement on the Revitalizing American Manufacturing Innovation Act (RAMI), which authorized the administration's National Network for Manufacturing Innovation (NNMI). Our efforts were rewarded when the House approved our bill on a voice vote, the then-Democrat-controlled Senate accepted our bill and it was included in last year's omnibus. EERE was provided the ability to transfer up to $250 million over the next 10 years to NIST to carry out NNMI.

Q10a. How does EERE plan to implement the newly authorized program? Is there a plan to transfer any funds in support of NNMI in FY 2016?

Q10a. The Administration's FY 2016 Budget Request asks Congress to support more than $350 million in additional discretionary funds across four agencies – through the Departments of Energy, Defense, Commerce and Agriculture – to launch seven new institutes as part

of the interagency National Network for Manufacturing Innovation (NNMI). Two of these new Institutes would be supported through the Department of Energy, pending the appropriation of funds. The Administration's Budget also requests appropriations to continue supporting the commitments made to nine Institutes already funded, including four Institutes at the Department of Energy.

The Revitalize American Manufacturing and Innovation Act (RAMI) language provided authorization to transfer funds but does not require it. To promote efficiency and effectiveness and ensure funding is used for the activities it is appropriated for, mission-related institutes should be funded by the agencies that will run them, which is how the NNMI institute funding structure is laid out in the FY 2016 Budget.

The President's NNMI has always been a multi-agency effort that brings together the best of industry, academia and the government to invest in manufacturing competitiveness. Institutes are supported across different agencies with different missions – all of which have relevance to a stronger U.S. manufacturing sector. The DOE-sponsored Institutes are members of the NNMI and share best practices, coordinate with other Federal agencies (where appropriate), and have an additional clearinghouse of information for manufacturers. DOE will continue to support existing and new DOE-specific Institutes through DOE annual appropriations.

Q10b. How does EERE plan to implement policy provisions of RAMI, especially those to assure fair, apolitical competition for funds? Please assure the Committee that, whether or not EERE plans to transfer funds to support NNMI this year, the organization will follow the policy provisions of the RAMI Act.

A10b. DOE continues to participate in the interagency National Network for Manufacturing Innovation (NNMI). The Revitalizing American Manufacturing Innovation Act (RAMI) authorizes the NNMI and in general supports increased coordination among federal agencies that direct and sustain manufacturing innovation institutes as part of the NNMI. DOE continues to participate in the interagency NNMI. The Revitalizing American Manufacturing Innovation Act (RAMI) authorizes the NNMI and in general supports increased coordination among federal agencies that direct and sustain manufacturing innovation institutes as part of the NNMI. DOE will continue to work with its agency

partners to leverage best practices from its Clean Energy Manufacturing Innovation Institutes, as well as other agencies' efforts, to benefit the interagency network and to abide by the provisions of the RAMI Act.

The RAMI legislation's direction to ensure fair competition of federal funds as part of competitive solicitations to fund manufacturing innovation institutes is consistent with current DOE research and development proposal selection policy. DOE Advanced Manufacturing Office will continue to follow an external merit review process when selecting competitive proposals for negotiations for funding under any future Clean Energy Manufacturing Innovation Institute competitive Funding Opportunity Announcement.

Q11. Your experience in this administration began at ARPA-E. ARPA-E sets concrete deadlines and benchmarks for projects to achieve in order to continue receiving federal funds.

Q11a. Have you taken any steps to recreate this environment at EERE?

A11a. The Active Project Management approaches described in the response to question 3 above were inspired by the Advanced Research Projects Agency–Energy's (ARPA-E) rigorous project management efforts. Using ARPA-E as a model, EERE has implemented greater Government engagement in its projects, including: substantial involvement in cooperative agreements; more frequent face-to-face meetings; and site visits to evaluate project progress and performance. By implementing new and augmenting existing project management practices such as go-no/go milestones, EERE has increased the rate at which we discontinue projects that are unable to meet their targets or fulfill their original intent.

Q11b. If so, what are some examples of projects at EERE that have been closed out due to missed targets or deadlines?

A11b. While the overwhelming majority of EERE's projects are successful, EERE has increased the rate at which we discontinue projects that are unable to meet their targets or fulfill their original intent. Below are examples of two projects that EERE recently discontinued due to missed targets or deadlines:

1. A Bioenergy Technologies Office project was discontinued in the third quarter of FY 2014 because the project had incurred additional costs due to the facility and equipment layout design requiring revision to meet hazardous building classification. The project experienced several delays and could no longer absorb any additional costs.

2. A Building Technologies Office project was discontinued during the fourth quarter of FY 2014 because a technical milestone was not met (specifically, the strategic assessment was not sufficiently comprehensive and robust to guide Office action).

Q12. EERE provides a portion of its funding to "Incubator" programs designed to develop innovative technologies that are not currently represented in its technology offices. How does the Department prevent duplication between these programs and ARPA-E's initiatives?

A12. The Incubator program is complementary to and distinct from activities funded by the Advanced Research Projects Agency – Energy (ARPA-E). ARPA-E supports early-stage development with the objective of establishing new learning curves – to create entirely new options for transformative energy technologies.

EERE is an organization focused on achieving aggressive and well-defined mid-to-long term clean energy goals for the United States of America. In that context, EERE has established multi-year plans and roadmaps. This roadmap-based approach is one of EERE's greatest strengths, but it can create challenges in recognizing and exploring unanticipated, game changing pathways that may ultimately be superior to the pathways/approaches on our existing roadmaps.

The EERE Incubator program explores bridges between emerging technologies and existing roadmaps – to further integrate new learning curves (created by ARPA-E or others) into revised technology roadmaps. EERE's incubators play an important role in enhancing the openness of our programs and the diversity of our technology solution pathways to make sure we are able to integrate new, potentially game-changing ideas into our portfolio. Incubator funding opportunity announcements (FOAs) are designed to

target these new approaches, which are not represented in our current roadmaps or within the planned scope of ARPA-E projects. Incubators are housed within individual EERE technology offices, and focus on supporting the mission of that office, as authorized by Congress. In FY 2016, EERE is requesting to continue to include a small fraction of its annual funding for Incubator programs within each of its technology offices.

The Incubator programs were built based on the successful model of the SunShot Incubator Program, which was established in 2007. Since the program was created, approximately $100M has been invested in 100 awards and been leveraged into $1.8B in follow on private investment.

QUESTIONS FROM REPRESNTATIVE DAN LIPINSKI

Q1 In the last several years, automotive fuel cell costs have been reduced by more than 50 percent, fuel cell durability has doubled, and the amount of expensive platinum needed in fuel cells has fallen by 80 percent since 2005. Fuel cells that run on hydrogen represent an opportunity for a zero emissions fuel. I worked to institute the Hydrogen H-Prize that was launched last year, because I think this should be part of an "all of the above" approach to our energy future. Can you discuss the challenges that EERE is addressing for hydrogen and fuel cells for automotive and other applications?

A1. As noted, EERE's Fuel Cell Technologies Office (FCTO) has enabled substantial progress and in addition to the metrics cited, FCTO's efforts have led to more than 500 issued patents since 1979, 40 commercial technologies since 1999 and another 65 technologies anticipated to enter the market in the next 3 to 5 years.

The program's goals focus on key challenges:

- Reduce the projected high-volume manufacturing cost of transportation fuel cell systems by more than 25 percent to meet the $40/kW target by 2020 and more than 45 percent to meet the ultimate target of $30/kW.
- Double transportation fuel cell system on-road durability from about 2,500 hours in 2009 to 5,000 hours in 2020.
- Reduce the cost of hydrogen produced from renewable resources from the current high volume status of approximately $7/gallon of gasoline equivalent (gge) to $4.00/gge (delivered, dispensed and untaxed) by 2020.
- Reduce the cost of vehicular hydrogen storage systems from $17/kWh (projected at high volumes) to $10/kWh by 2020.

In addition to funding research and development to address the above challenges DOE co-launched H2USA, a public-private partnership to address the key challenge of a widespread hydrogen infrastructure. As part of this partnership, FCTO established the H2FIRST (Hydrogen Fueling Infrastructure Research and Station Technology) project, which is a collaboration between the National Renewable Energy Laboratory and Sandia National Laboratories that addresses infrastructure challenges such as metering, fueling

protocol validation and development approaches to reduce station cost, permitting times and station siting.

Appendix II

Additional Material for the Record

PREPARED STATEMENT OF COMMITTEE RANKING MEMBER
EDDIE BERNICE JOHSNON

OPENING STATEMENT

Ranking Member Eddie Bernice Johnson
Committee on Science, Space, and Technology

"Department of Energy Oversight: Office of Energy Efficiency and Renewable Energy"
Energy Subcommittee Hearing

March 24, 2015

Thank you, Chairman Smith for holding this hearing. I would also like to thank Assistant Secretary Danielson and the other witnesses for being here today.

Back in 1962, before some of our witnesses today were born, President Kennedy challenged the country to win the global space race and put a man on the moon. America responded to this challenge by investing in education and research and development programs, and in improving our nation's educational system. Eight short years later, Neil Armstrong stepped onto the moon's surface. Moreover, the R&D that accompanied America's "moonshot" spurred entirely new industries and business initiatives.

Today, DOE's Office of Energy Efficiency and Renewable Energy is undertaking a SunShot — striving to meet a goal of making utility-scale solar systems cost competitive with other sources of electricity by the end of the decade. EERE has been working with ARPA-E and industry leaders on SunShot to try to achieve a 75% cost reduction, and it is actually ahead of schedule to meeting this goal. Based on what has been achieved to date, it is clear that over the next few years, solar panels and other solar power system components will become more efficient, cost effective, and accessible for businesses, homeowners, and the federal government, which is our nation's largest energy consumer.

Renewable energy plays a critical role in the future of our country. I would like to remind my colleagues that we have seen how government-supported research can pay off when it comes to energy development. And I am highlighting this solar energy initiative in particular today because it further demonstrates our need to remain committed to scientific discovery and advancing new technologies. It speaks not only to the mission of EERE, but to the future of our nation's ability to meet our energy and environmental needs, all while ensuring that we will be a net exporter rather than an importer of products in the growing clean energy economy.

If DOE's proposed budget is adopted, EERE would receive a much-needed boost. Beyond SunShot, the geothermal and marine energy research programs would establish important new test sites to help advance next generation technologies, and the Department's important advanced manufacturing program would expand considerably.

I am also pleased to see that EERE is clearly making progress in coordinating several critical research areas that cut across the Department's various programs, including the energy-water nexus – which I personally am very concerned about. These are just a few examples, and I look

DOCUMENT SUBMITTED BY DR. DAVID DANIELSON

COMMITTEE:	HOUSE SCIENCE, SPACE, AND TECHNOLOGY, ENERGY SUBCOMMITTEE
HEARING DATE:	MARCH 24, 2015
WITNESS:	DAVID DANIELSON PAGE: 62, LINE 1452

INSERT FOR THE RECORD

Wind turbines use oil during their operations in the gearbox, for lubrication of bearings and gears, and hydraulic fluid for yaw, blade pitch control, and braking. It can be assumed that the majority of the oil used is petroleum-based.

- Specifically, gearbox oil averages a volume of 200 liters/MW, and most original equipment manufacturers recommend replacing the oil every three years, making the annual gearbox oil average 66.7 liters/MW.

- The average amount of grease used for main shaft bearings, pitch and yaw bearings and gears, and generator bearings is estimated to be 7 kg/MW on a yearly basis. The initial fill for grease is estimated to be 50 kg/MW. Assuming a 20-year operational turbine life, the annual quantity for grease would be 9.5 kg/MW.

- The amount of hydraulic oil used depends on whether it is used only for the brakes, or also to actuate the pitch and yaw. (A diagram of turbine components is available on the Department's website at: http://energy.gov/eere/wind/how-does-wind-turbine-work.) For example, the volume of hydraulic oil utilized may be between 5 liters/MW for turbines that require hydraulic oil for brakes only, and 150 liters/MW turbines that require hydraulic oil for brakes as well as pitch and yaw. (GE's pitch and yaw are electric rather than hydraulic.) Original equipment manufacturers recommend replacing hydraulic oil every five years, so the annual hydraulic oil volume would be 30 liters/year or 1 liter/year, depending on the turbine.

For context, the average wind turbine deployed in the United States in 2013 was 1.87 MW and there are over 60 GW in cumulative wind capacity installed nationwide.